МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ

ДНУ «Український інститут науково-технічної експертизи та інформації»

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ДОСЛІДЖЕННЯ НАУКОМЕТРИЧНОЇ АКТИВНОСТІ У СВІТІ ЗА ТЕМАТИКОЮ «РАКЕТНІ ВІЙСЬКА І АРТИЛЕРІЯ»

Науково-аналітична записка

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Дослідження наукометричної активності у світі за тематикою «Ракетні війська і артилерія»: науково-аналітична записка / Т.В. Писаренко, Т.К. Кваша, О.Ф.Паладченко, І.В. Молчанова. – Київ: УкрІНТЕІ, 2025. – 95 с.

Викладено результати дослідження перспективних світових наукових напрямів досліджень у сфері «Ракетні війська і артилерія» на основі даних бази Web of Science Core Collection (WoS) за 2019-2024 рр. Дослідження здійснено з метою можливого врахування отриманих результатів при розробленні та прийнятті відповідних рішень щодо наукових і технологічних напрямів досліджень, технічного переоснащення, модернізації та реформування оборонно-промислового комплексу України.

Розраховано на представників органів державної влади, наукових працівників, інженерних кадрів, викладачів закладів вищої освіти, аспірантів і студентів відповідних спеціальностей.

ЗМІСТ

ВСТУП

Ракетні війська та артилерія є основними ударними і вогневими засобами Сухопутних військ. Ракетні війська вражають засоби ядерного і хімічного нападу, основні угруповання військ, авіації на аеродромах, засоби протиповітряної оборони, пункти управління, тилові та інші важливі об’єкти противника в усій глибині його оперативного шикування, а на приморських напрямках вони руйнують пункти базування Військово-морських сил противника та знищують його бойові кораблі й судна.

Ракетні війська складаються із частин оперативно-тактичних ракет, тактичних ракет і ракетно-технічних частин та підрозділів, які входять до складу загальновійськових об’єднань.

Артилерія призначена для знищення та подавлення тактичних засобів ядерного і хімічного нападу, артилерії, танків, бойових машин піхоти, вертольотів на майданчиках, наземних елементів систем високоточної зброї, протитанкових та інших вогневих засобів, живої сили, пунктів управління, засобів протиповітряної оборони, радіоелектронних засобів, руйнування фортифікаційних споруд противника, дистанційного мінування місцевості та виконання завдань світлового забезпечення.

Свої завдання в загальновійськовому бою вона виконує у взаємодії з авіацією, ракетними частинами та вогневими засобами інших родів військ.

До основних складових ракетних військ і артилерії відносяться[1]:

Ракетний комплекс – це сукупність функціонально взаємопов'язаних ракет, технічних засобів і споруд, призначених для підтримки ракет у готовності до застосування, пуску, управління польотом та виконання інших завдань. Такий комплекс включає ракету, пускову установку, засоби наведення, управління, транспортування та інші допоміжні системи.

Гаубична артилерія – це вид артилерії, який використовує гаубиці (артилерійські системи з відносно коротким стволом) для ведення переважно навісної стрільби з закритих вогневих позицій по цілях поза прямою видимістю. Вона є частиною ракетних військ і артилерії сухопутних військ та складається з гаубиць, боєприпасів до них, засобів управління вогнем, артилерійської розвідки та іншого забезпечення.

Гарматна артилерія – це вид артилерії, що використовує артилерійські гармати, які мають довший ствол та вищу початкову швидкість снаряда порівняно з гаубицями чи мортирами, що дозволяє вести точний вогонь по цілях на великих відстанях. Вона включає гарматні установки, боєприпаси, засоби управління вогнем, розвідки та забезпечує вогневу підтримку в бою, а також

[1] Тактична підготовка артилерійських підрозділів : електронний підручник / П. Є. Трофименко, Ю. І. Пушкарьов, С. П. Латін та ін. - Суми, 2012. URL : https://buklib.net/books/37527/ http://lib.sumdu.edu.ua/library/DocDownload?docid=393262

може класифікуватися за типом озброєння (наприклад, протитанкова гармата) або за призначенням (наприклад, зенітна гармата).

Реактивна артилерія – це вид ракетної зброї, яка використовує реактивні снаряди, що мають власний реактивний двигун для досягнення цілі. Це дозволяє забезпечити високу швидкість польоту та ураження значних площ одночасно завдяки залповій стрільбі з багатоствольних пускових установок. Її основні задачі – це знищення живої сили, вогневих засобів противника, а також руйнування його оборонних споруд.

Протитанкова артилерія – це вид артилерії, а також відповідні підрозділи та частини, призначені для знищення танків та іншої броньованої техніки противника шляхом стрільби прямим наведенням. Вона є частиною протитанкової оборони і включає спеціальні гармати з високою початковою швидкістю снаряду.

Дослідження наукометричної активності ракетних військ і артилерії у світі проведено станом на вересень 2025 р. на платформі бази даних Web of Science (WoS) із використанням БД WoS Core Collection за тематикою «Ракетні війська і артилерія» для публікацій, інформація яких не становить державну таємницю. Аналіз наявної інформації виконаний стосовно компонентів ракетних комплексів та артилерії на основі таких критеріїв пошуку: розширений пошук; усі мови; усі типи документів; з 2019 по 2024 рік.

1. Наукометрична активність за складовими озброєння ракетних військ і артилерії та галузями досліджень

Сукупна вибірка за визначений період за вказаною тематикою у світі становила 997 публікацій.

У 2024 р. *кількість публікацій* склала 192 одиниці, що у 1,4 разу більше цього ж показника за 2019 р. Публікаційна активність у світі за вказаною тематикою у період 2019-2024 рр. щорічно зростала в межах 140-192 одиниці.

Кількість цитувань публікацій за визначений період становила 3637, щорічно зростаючи з 30 у 2019 р. до 1329 у 2024 р., тобто збільшилася майже у 44,3 разу.

Частка публікацій від вибірки в розрізі *складових* озброєння ракетних військ і артилерії склала:

- «Ракетні комплекси» – 15,5% (від загальної кількості відібраних публікацій);
- «Гаубична артилерія» – 4,7%;
- «Гарматна артилерія» – 22,3%;
- «Реактивна артилерія» – 51,7%;
- «Протитанкова артилерія» – 5,8%.

За результатами дослідження публікацій 2019-2024 рр. за вказаною тематикою було виокремлено наступні *галузі досліджень*:

- інженерія – 51,5% (від загальної кількості відібраних публікацій);

- інформатика – 11,4%;
- матеріалознавство – 9,7%;
- механіка – 8,2%;
- системи автоматизованого управління – 7,9%;
- телекомунікації – 6,4%.
- термодинаміка – 4,9%.

Найвищі індекси цитування у 2019-2024 рр. відмічені за такими галузями дослідження: «Інформатика» – 8700,0%, «Системи автоматизованого управління» – 6800,0% та «Механіка» – 6400,0% (рис. 1).

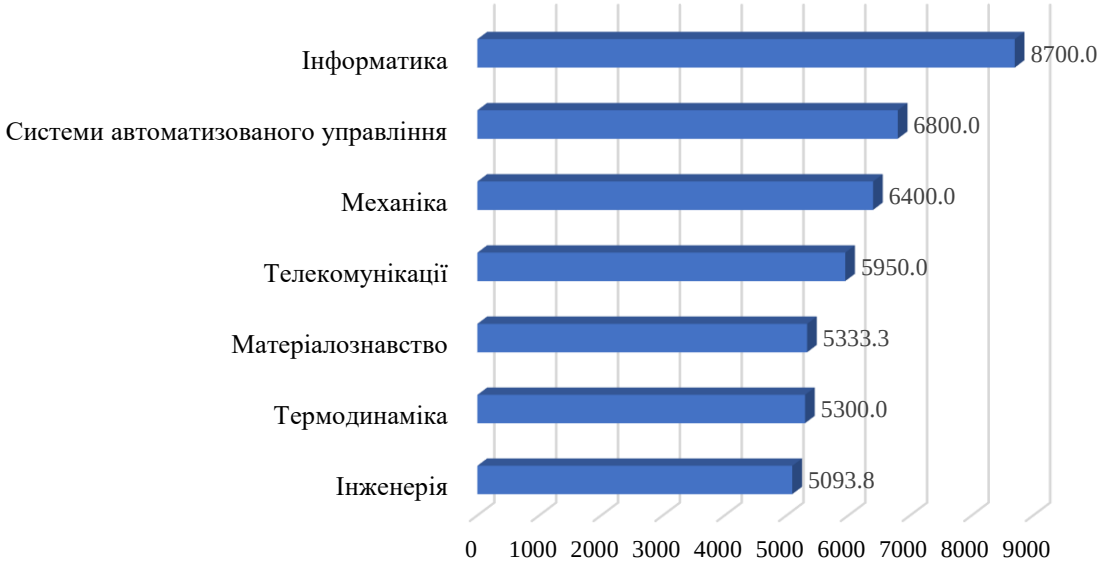

Рис. 1 Індекси цитування у світі за галузями дослідження тематики «Ракетні війська і артилерія», 2019-2024 рр., %

Джерело: розроблено авторами на основі даних Web of Science

1.1 Наукометрична активність за складовою озброєння ракетних військ і артилерії «Ракетні комплекси»

У таблиці 1 наведена наукометрична активність за складовою ракетних військ і артилерії «Ракетні комплекси» визначеної тематики в розрізі галузей дослідження.

Таблиця 1 - Тенденції наукометричної активності в світі за складовою ракетних військ і артилерії «Ракетні комплекси» в розрізі галузей дослідження, 2019-2024 рр.

Галузі дослідження	Країни з найбільшою кількістю публікацій	Організації з найбільшою кількістю публікацій	Індекс публікацій (2024/2019 рр.), %	Індекс цитування (2024/2019 рр.), %	Частка публікацій від загальної кількості публікації галузі дослідження, %
Інженерія	Китай, США, Республіка Корея	NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), AUBURN UNIVERSITY (США), JOHNS HOPKINS UNIVERSITY США), KOREA ADVANCED INSTITUTE OF SCIENCE	566,7	3100,0	**44,5**

Галузі дослідження	Країни з найбільшою кількістю публікацій	Організації з найбільшою кількістю публікацій	Індекс публікацій (2024/2019 рр.), %	Індекс цитування (2024/2019 рр.), %	Частка публікацій від загальної кількості публікації галузі дослідження, %
		TECHNOLOGY KAIST (Республіка Корея)			
Інформатика	Китай, Республіка Корея, Туреччина	CHINA ELECTRONICS TECHNOLOGY GROUP (Китай), NORTHWESTERN POLYTECHNICAL UNIVERSITY (Китай), KOREA ADVANCED INSTITUTE OF SCIENCE (Республіка Корея), ANKARA YILDIRIM BEYAZIT UNIVERSITY (Турція)	166,7	3500,0	**15,5**
Матеріало-знавство	Індія, Китай, Японія, Польща	ANNA UNIVERSITY (Індія), NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), CHIBA INSTITUTE OF TECHNOLOGY (Японія), MILITARY UNIVERSITY OF TECHNOLOGY IN WARSAW (Польща)	300,0	800,0	**6,4**
Механіка	Китай, США, Республіка Корея	NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), AUBURN UNIVERSITY (США), AJOU UNIVERSITY (Республіка Корея)	300,0	300,0	**7,1**
Системи автомати-зованого управління	Китай, США, Туреччина	BEIHANG UNIVERSITY (Китай), NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), TEXAS A M UNIVERSITY SYSTEM (США), TOBB EKONOMI VE TEKNOLOJI ÜNİVERSİTESİ (Туреччина)	250,0	2400,0	**16,1**
Телекомуні-кації	Китай, Єгипет, Індія	BEIHANG UNIVERSITY (Китай), EGYPTIAN ARMED FORCES (Єгипет), VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY (Індія)	200,0	900,0	**5,2**
Термодина-міка	США, Туреччина, Китай	AUBURN UNIVERSITY (США), BEIJING INSTITUTE OF TECHNOLOGY (Китай), GAZI UNIVERSITY (Туреччина)	300,0	500,0	**5,2**

Джерело: розроблено авторами на основі даних Web of Science

Найбільша частка кількості публікацій від загальної кількості публікацій за складовою «Ракетні комплекси» належить галузі дослідження «Інженерія» – 44,5%, найменша – галузям дослідження «Телекомунікації та «Термодинаміка» – по 5,2%. У трійку світових країн-лідерів за кількістю публікацій входять Китай, США, Республіка Корея.

Найбільший індекс публікацій 2024/2019 рр. має галузь «Інженерія» – 566,7%; найбільший індекс цитування 2024/2019 рр. – галузь «Інформатика» (3500,0%).

1.2 Наукометрична активність за складовою озброєння ракетних військ і артилерії «Гаубична артилерія»

За складовою ракетних військ і артилерії «*Гаубична артилерія*», наукометрична активність представлена у таблиці 2 у розрізі галузей дослідження.

Таблиця 2 - Тенденції наукометричної активності у світі за складовою ракетних військ та артилерії «Гаубична артилерія» в розрізі галузей дослідження за 2019-2024 рр.

Галузі дослідження	Країни з найбільшою кількістю публікацій	Організації з найбільшою кількістю публікацій	Індекс публікацій (2024/2019 рр.), %	Індекс цитування (2024/2019 рр.), %	Частка публікацій від загальної кількості публікації галузі дослідження, %
Інженерія	Китай, Канада, США	NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), NORTHWEST INST MECH ELECT ENGN (Китай),	500,0	1300,0	**46,8**
Інформатика	Китай, Російська Федерація, Туреччина, США	NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), PRIMAKOV NATIONAL RESEARCH INSTITUTE OF WORLD ECONOMY INTERNATIONAL RELATIONS OF THE RUSSIAN ACADEMY OF SCIENCES (Російська Федерація), AKDENIZ UNIVERSITY (Туреччина), CLEMSON UNIVERSITY (США)	200,0	300,0	**10,7**
Матеріало-знавство	Туреччина, Словенія	ISTANBUL TECHNICAL UNIVERSITY (Туреччина), ANADOLU UNIVERSITY (Туреччина), UNIVERSITY OF MARIBOR (Словенія)	300,0	500,0	**8,5**
Механіка	Китай, Аргентина, Франція	ARMY ENGINEERING UNIVERSITY OF PLA (Китай), NATIONAL UNIVERSITY OF MAR DEL PLATA (Аргентина), INST FRANCO ALLEMAND RECH ST LOUIS (Франція)	200,0	200,0	**10,6**
Системи автомати-зованого управління	Китай, Чеська Республіка	NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), CHINA NORTH INDUSTRIES NORINCO (Китай), UNIVERSITY OF DEFENCE CZECH REPUBLIC (Чеська Республіка)	200,0	200,0	**8,5**
Телекомуні-кації	Китай, Індія,	BEIJING INSTITUTE OF TECHNOLOGY (Китай),	100,0	300,0	**8,5**

Галузі дослідження	Країни з найбільшою кількістю публікацій	Організації з найбільшою кількістю публікацій	Індекс публікацій (2024/2019 рр.), %	Індекс цитування (2024/2019 рр.), %	Частка публікацій від загальної кількості публікації галузі дослідження, %
	Російська Федерація, Туреччина	DRDO DEF INST ADV TECHNOL DIAT (Індія), FIRAT UNIVERSITY (Туреччина), TYUMEN STATE UNIVERSITY (Російська Федерація)			
Термодина-міка	Китай, Франція	NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), CHINA NORTH VEHICLE RES INST (Китай), INST FRANCO ALLEMAND RECH ST LOUIS (Франція)	200,0	200,0	**6,4**

Джерело: розроблено авторами на основі даних Web of Science

Найбільша частка кількості публікацій від загальної кількості публікацій за складовою «Гаубична артилерія» належить галузі дослідження «Інженерія» – 46,8%, найменша – галузі дослідження «Термодинаміка» – 6,4 %. У трійку світових країн-лідерів за кількістю публікацій входять Китай, Туреччина, США.

Найбільший індекс публікацій 2024/2019 рр. має галузь «Інженерія» – 500,0%; найбільший індекс цитування 2024/2019 рр. має галузь «Інженерія» – 1300,0%.

1.3 Наукометрична активність за складовою озброєння ракетних військ і артилерії «Гарматна артилерія»

За складовою ракетних військ і артилерії «*Гарматна артилерія*» наукометрична активність у розрізі галузей дослідження представлена у таблиці 3.

Таблиця 3 - Тенденції наукометричної активності в світі за складовою ракетних військ та артилерії «Гарматна артилерія» в розрізі галузей дослідження за 2019-2024 рр.

Галузі дослідження	Країни з найбільшою кількістю публікацій	Організації з найбільшою кількістю публікацій	Індекс публікацій (2024/2019 рр.), %	Індекс цитування (2024/2019 рр.), %	Частка публікацій від загальної кількості публікації галузі дослідження, %
Інженерія	Китай, Індія, США	NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), DEFENCE RESEARCH DEVELOPMENT ORGANISATION DRDO (Індія), ASME (США)	257,1	8400,0	**37,8**
Інформатика	Китай, США, Польща	NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), GEORGIA INSTITUTE OF TECHNOLOGY (США), WARSAW UNIVERSITY OF TECHNOLOGY (Польща)	350,0	6800,0	**10,8**

Галузі дослідження	Країни з найбільшою кількістю публікацій	Організації з найбільшою кількістю публікацій	Індекс публікацій (2024/2019 рр.), %	Індекс цитування (2024/2019 рр.), %	Частка публікацій від загальної кількості публікації галузі дослідження, %
Матеріало-знавство	Китай, Індія, Російська Федерація	UNIVERSITY OF SCIENCE TECHNOLOGY BEIJING (Китай), DEFENCE RESEARCH DEVELOPMENT ORGANISATION DRDO (Індія), INSTITUTE OF SOLID-STATE CHEMISTRY MECHANOCHEMISTRY SIBERIAN BRANCH OF THE RUSSIAN ACADEMY OF SCIENCES (Російська Федерація)	240,0	10200,0	**23,9**
Механіка	Китай, Російська Федерація, Індія	NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), KALASHNIKOV IZHEVSK STATE TECHNICAL UNIVERSITY (Російська Федерація), INDIAN INSTITUTE OF SCIENCE IISC BANGALORE (Індія)	600,0	4300,0	**9,5**
Системи автомати-зованого управління	Китай, Індія, США	NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), RAMAIAH INSTITUTE OF TECHNOLOGY (Індія), GEORGIA INSTITUTE OF TECHNOLOGY (США)	150,0	2500,0	**5,4**
Телекомуні-кації	Китай, США	NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), NORTH UNIVERSITY OF CHINA (Китай), SHENGLI XINDA NEW MAT CO LTD (Китай), CCDC SOLDIER CTR STTC (США)	500,0	4900,0	**5,4**
Термодина-міка	Китай, Сербія, Російська Федерація	NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), UNIVERSITY OF BELGRADE (Сербія), NOVOSIBIRSK STATE TECHNICAL UNIVERSITY (Російська Федерація)	700,0	3700,0	**7,2**

Джерело: розроблено авторами на основі даних Web of Science

Найбільша частка публікацій від їх загальної кількості за складовою «Гарматна артилерія» належить галузі дослідження «Інженерія» – 37,8%, найменша – галузям дослідження «Системи автоматизованого управління» та «Телекомунікації» – 5,4%. У трійку світових країн-лідерів за кількістю публікацій входять Китай, Індія, США.

Найвищий індекс публікацій 2024/2019 рр. має галузь дослідження «Термодинаміка» – 700,0%; найвищий індекс цитування 2024/2019 рр. – галузь дослідження «Матеріалознавство» – 10200,0%.

1.4 Наукометрична активність за складовою озброєння ракетних військ і артилерії «Реактивна артилерія»

За складовою ракетних військ і артилерії «*Реактивна артилерія*» наукометрична активність у розрізі галузей дослідження представлена у таблиці 4.

Таблиця 4 - Тенденції наукометричної активності у світі за складовою ракетних військ та артилерії «Реактивна артилерія» в розрізі галузей дослідження, 2019-2024 рр.

Галузі дослідження	Країни з найбільшою кількістю публікацій	Організації з найбільшою кількістю публікацій	Індекс публікацій (2024/2019 рр.), %	Індекс цитування (2024/2019 рр.), %	Частка публікацій від загальної кількості публікації галузі дослідження, %
Інженерія	Китай, Італія, США	NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), POLYTECHNIC UNIVERSITY OF TURIN (Італія), SAPIENZA UNIVERSITY ROME (Італія), GEORGIA INSTITUTE OF TECHNOLOGY (США)	140,0	4230,0	**65,8**
Інформатика	Китай, США, Республіка Корея	NATIONAL UNIVERSITY OF DEFENSE TECHNOLOGY CHINA (Китай), ARIZONA STATE UNIVERSITY (США), KOREA ADVANCED INSTITUTE OF SCIENCE TECHNOLOGY KAIST (Республіка Корея)	275,0	4300,0	**7,8**
Матеріало-знавство	Китай, Італія, Індія	HARBIN INSTITUTE OF TECHNOLOGY (Китай), POLYTECHNIC UNIVERSITY OF MILAN (Італія), KONGU ENGINEERING COLLEGE (Індія)	166,7	3000,0	**3,9**
Механіка	Китай, США, Франція	NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), AUBURN UNIVERSITY (США), UNIVERSITE PARIS SACLAY (Франція)	275,0	1700,0	**7,4**
Системи автомати-зованого управління	Китай, Франція, Республіка Корея	NANJING UNIVERSITY OF SCIENCE TECHNOLOGY (Китай), UNIVERSITE PARIS SACLAY (Франція), KOREA ADVANCED INSTITUTE OF SCIENCE TECHNOLOGY KAIST (Республіка Корея)	225,0	1900,0	**6,0**
Телекомуні-кації	Китай, Республіка Корея, Італія	NATIONAL UNIVERSITY OF DEFENSE TECHNOLOGY CHINA (Китай), KOREA ADVANCED INSTITUTE OF SCIENCE TECHNOLOGY KAIST (Республіка Корея), CONSORZIO NAZL INTERUNIV TELECOMUNICAZ (Італія)	400,0	5700,0	**6,2**

Галузі дослідження	Країни з найбільшою кількістю публікацій	Організації з найбільшою кількістю публікацій	Індекс публікацій (2024/2019 рр.), %	Індекс цитування (2024/2019 рр.), %	Частка публікацій від загальної кількості публікації галузі дослідження, %
Термодина-міка	Італія, США, Франція	POLYTECHNIC UNIVERSITY OF TURIN (Італія), CLEVELAND STATE UNIVERSITY (США), ARTS ET METIERS INSTITUTE OF TECHNOLOGY (Франція)	700,0	1000,0	**2,9**

Джерело: розроблено авторами на основі даних Web of Science

Найбільша частка публікацій від їх загальної кількості за складовою «Реактивна артилерія» належить галузі дослідження «Інженерія» – 65,8%, найменша – галузі дослідження «Термодинаміка» – 2,9%. У трійку світових країн-лідерів за кількістю публікацій входять Китай, США, Республіка Корея.

Найвищий індекс публікацій 2024/2019 рр. має галузь дослідження «Термодинаміка» – 700,0%; найвищий індекс цитування 2024/2019 рр. – галузь дослідження «Телекомунікації» – 5700,0%.

1.5 Наукометрична активність за складовою озброєння ракетних військ і артилерії «Протитанкова артилерія»

За складовою ракетних військ і артилерії *«Протитанкова артилерія»* наукометрична активність у розрізі галузей дослідження представлена у таблиці 5.

Найбільша частка публікацій за складовою «Протитанкова артилерія» належить галузі дослідження «Інженерія» – 53,5%, найменша – галузі дослідження «Телекомунікації» – 3,4%. У трійку світових країн-лідерів за кількістю публікацій входять Польща, Російська Федерація, Китай.

Найвищий індекс публікацій 2024/2019 рр. має галузь дослідження «Інженерія» та «Інформатика» – 300,0%; найвищий індекс цитування 2024/2019 рр. – галузь дослідження «Інформатика» – 3600,0%.

Таблиця 5 - Тенденції наукометричної активності у світі за складовою ракетних військ та артилерії «Протитанкова артилерія» в розрізі галузей дослідження, 2019-2024 рр.

Галузі дослідження	Країни з найбільшою кількістю публікацій	Організації з найбільшою кількістю публікацій	Індекс публікацій (2024/2019 рр.), %	Індекс цитування (2024/2019 рр.), %	Частка публікацій від загальної кількості публікації галузі дослідження, %
Інженерія	Польща, Туреччина, В'єтнам	MILITARY INSTITUTE OF ARMAMENT TECHNOLOGY (Польща), FIRAT UNIVERSITY (Туреччина), LE QUY DON TECHNICAL UNIVERSITY (В'єтнам)	300,0	2500,0	**53,5**

Галузі дослідження	Країни з найбільшою кількістю публікацій	Організації з найбільшою кількістю публікацій	Індекс публікацій (2024/2019 рр.), %	Індекс цитування (2024/2019 рр.), %	Частка публікацій від загальної кількості публікації галузі дослідження, %
Інформатика	Іспанія, Туреччина, Індія	UNIVERSIDAD REY JUAN CARLOS (Іспанія), ANKARA YILDIRIM BEYAZIT UNIVERSITY (Туреччина), KONGU ENGINEERING COLLEGE (Індія)	300,0	3600,0	**17,2**
Матеріало-знавство	Китай, Туреччина, Польща	BEIJING INSTITUTE OF TECHNOLOGY (Китай), FIRAT UNIVERSITY (Туреччина), WARSAW UNIVERSITY OF TECHNOLOGY (Польща)	100,0	1600,0	**8,6**
Механіка	Туреччина, Польща	OTOKAR AUTOMOTIVE DEFENSE INDUSTRY (Туреччина), KIELCE UNIVERSITY OF TECHNOLOGY (Польща)	200,0	300,0	**5,2**
Системи автоматизованого управління	Китай, Єгипет	XIAN MODERN CONTROL TECHNOL RES INST (Китай), MIL TECH COLLAGE MTC (Єгипет)	200,0	100,0	**5,2**
Телекомуні-кації	Північна Македонія, Іспанія	SAINTS CYRIL METHODIUS UNIVERSITY OF SKOPJE (Північна Македонія), UNIVERSIDAD REY JUAN CARLOS (Іспанія), UNIVERSITY OF OVIEDO (Іспанія)	100,0	800,0	**3,4**
Термодина-міка	Республіка Корея, Російська Федерація, Болгарія	KOREA MIL ACAD (Республіка Корея), LOMONOSOV MOSCOW STATE UNIVERSITY (Російська Федерація), BULGARIAN ACADEMY OF SCIENCES (Болгарія)	100,0	400,0	**6,9**

Джерело: розроблено авторами на основі даних Web of Science

Публікації з найбільшою кількістю цитування за кожною складовою ракетних військ та артилерії наведені у Додатку А.

ВИСНОВКИ

1. Дослідження публікаційної активності за період 2019-2024 рр. дало можливість визначити найбільш актуальні та перспективні напрями наукових досліджень за тематикою «Ракетні війська і артилерія» та її складовими:

- *Ракетні комплекси* – у галузях досліджень «Інженерія», «Матеріалознавство», «Термодинаміка»;

- *Гаубична артилерія* – у галузі досліджень «Інженерія», «Матеріало-знавство»;

- *Гарматна артилерія* – у галузях досліджень «Інформатика», «Механіка», «Телекомунікації», «Термодинаміка»;

- *Реактивна артилерія* – у галузях досліджень «Телекомунікації», «Термодинаміка»;

- *Протитанкова артилерія* – у галузях досліджень «Інженерія», «Інформатика».

2. У сфері «Ракетні війська і артилерія» найбільше публікацій спостерігається за галуззю науки «Інженерія», на другому місці галузь «Інформатика», на третьому – «Матеріалознавство».

Найбільший вплив/найбільший інтерес викликають публікації за галузями «Інформатика», «Системи автоматизованого управління» та «Механіка».

3. За складовими сфери «Ракетні війська і артилерія»:

- найбільше публікацій / найбільша частка досліджень спостерігається за складовими *«Реактивна артилерія»* – 515 од. або 51,7% від загальної кількості відібраних публікацій (галузь науки «Інженерія» – 65,8% загального обсягу цих публікацій), *«Гарматна артилерія»* – 222 од. або 22,3% («Інженерія» – 37,8% від загального обсягу цих публікацій, «Матеріалознавство» – 23,9%), «*Ракетні комплекси»* – 155 од. або 15,5%. («Інженерія» – 44,5% загального обсягу цих публікацій, «Інформатика» – 15,5%);

- найбільший інтерес для наукового середовища має тематика за складовою *«Гарматна артилерія»* з найвищим індексом цитування – 10200,0% («Інженерія» – 8400%, «Матеріалознавство» – 10200.0%).

4. Отже, за складовими сфери «Ракетні війська і артилерія» з найвищими частками публікацій найбільш популярними є дослідження за галуззю «Інженерія» (складова *«Реактивна артилерія»*), а найбільш впливовими/цитованими – публікації за галузями «Інженерія» та «Матеріалознавство» (складова *«Гарматна артилерія»*).

5. Тематичне спрямування найбільш цитованих публікацій у сфері «Ракетні війська і артилерія» за галузями «Інженерія» та «Матеріалознавство» (складова «Гарматна артилерія»):

«Інженерія»: *моделювання* процесу взаємодії кулі зі стволом, поширення термомеханічної втомної тріщини у автофретажованому стволі гармати, пошкодження зсувом міжфазної поверхні хромового покриття / сталевої підкладки під навантаженням термічної ерозії; *порохове паливо підвищеної енергії; вплив кількох структурних параметрів на внутрішню балістику.*

«Матеріалознавство»: *аналіз ерозії та аналіз деградації міцності* матеріалу ствола гармати; *керамічні термобар'єрні покриття*; лазерне *зміцнення трибологічної стійкості хромових* покриттів, *прецизійне тверде точіння сталі* AISI4340: багатоцільова оптимізація для одночасно низької шорсткості поверхні та високої продуктивності.

Додаток А

Перелік публікацій з найбільшою кількістю цитування за тематикою «Ракетні війська та артилерія» (2019-2024 рр.)

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
РАКЕТНІ КОМПЛЕКСИ				
Інженерія				
1	Тривимірний фіксований у часі робастний спільний закон наведення для одночасної атаки з обмеженням кута удару.	Three-dimensional fixed-time robust cooperative guidance law for simultaneous attack with impact angle constraint. Chen, ZY; Chen, WC; Liu, XM; Cheng, J. AEROSPACE SCIENCE AND TECHNOLOGY. 2021. Volume 110, 106523.	This paper proposes a three-dimensional (3-D) robust nonlinear cooperative guidance law for multiple missiles to simultaneously attack a maneuvering target at desired impact angles. Since the flight time of terminal guidance is very short, the fast convergence of guidance errors is a vital demand, especially when the initial errors are huge and the target is maneuvering. By utilizing the theory of fixed time convergence, a distributed sliding surface that only utilizes the information from adjacent missiles is first designed, whose convergence time is independent of initial conditions. In order to avoid the performance degradation due to the estimation error of time-to-go, the consensus variables of the fixed-time sliding surface are chosen as range-to-go and radial relative velocity. Then, a robust cooperative guidance law along the line-of-sight (LOS) direction is proposed to bring the multi-missile system to reach the sliding surface in finite time. Thus, the simultaneous attack to a maneuvering target can be guaranteed. Next, the guidance laws in the elevation and azimuth direction of LOS are developed to ensure the fixed time convergence of LOS angles. The fixed-time stability is proved through the Lyapunov theory and bi-homogenous property. Simulation results indicate that the impact time of each missile under the proposed guidance law is the same, without any deviation. Compared with the state-of-the-art methods, the convergence time of LOS angles is shortened by about 30%. In addition, the miss distance and errors of LOS angles can be reduced by more than 80%.	https://www.webofscience.com/wos/woscc/full-record/WOS:000623620700001
2	Проектування та динамічний аналіз гумово-металевих ізоляторів між супутником та ракетним комплексом-носієм.	Design and dynamic analysis of metal rubber isolators between satellite and carrier rocket system.	To achieve mobility and rapid-response, vehicles are used to launch satellites, and such systems will inevitably undergo random vibrations caused by uneven ground excitations. However, cameras or other high-precision satellite payloads cannot withstand such harsh mechanical	https://www.webofscience.com/wos/woscc/full-record/WOS:000458889500001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		Cao, XB; Wei, C.; Liang, JQ; Wang, LX. MECHANICAL SCIENCES. 2019. Volume 10. Issue 1. Page 71-78.	environment in the absence of isolators. Hence, in the present paper, due to the advantages of the superior damping properties of metal rubber (MR), we designed MR structures to absorb vibrations. Correspondingly, the dynamical behaviours of the integrated system were comprehensively analysed to ensure that vibrations would not cause the payloads to collide with the fairing. In addition, the effects of geometric parameters of the isolated structures on the vibration properties of the system were investigated. This work provides a feasible design method of using simple MR structures, instead of very complicated isolators, for a mobile satellite launching system moving on rough roads.	
3	Експериментальне дослідження характеристик горіння порошкового магнію та вуглецевого газу в ракетному двигуні	Experimental study on combustion characteristics of powder magnesium and carbon dioxide in rocket engine. Li, Y.; Hu, CB; Zhu, XF; Hu, JM; Hu, X.; Li, C.; Cai, YP. ACTA ASTRONAUTICA. 2019. Volume 155. Page 334-349.	Mechanisms of powder magnesium and carbon dioxide combustion are required for the concept of Mars propulsion based on the perspective of in-situ resource utilization. Most current characterizations are based on laboratory experiments conducted in stationary or simple flow configuration. However, the chamber condition in most applications of engine is very complicated with high pressure and multi-phase flow environment, and the combustion process in engine-scale has not been established. The burning efficiency, combustion stability and excessive deposition are the mainly primary issues that limit the combustion performance in rocket environment, the experimental study aims at combustion characteristics and the affection mechanism of powder magnesium and carbon dioxide in rocket engine. A new configuration of powder rocket system is established. Meanwhile, a multiple-inlet configuration of CO2 injection is designated to control the CO2 injection positions and parameters, such as global and local oxidant-fuel ratio. Ignition process is studied and an empirical model for ignition judgment is established according to the result of ignition tests. Mechanism for combustion deposition is studied by the analysis of morphology, composition and distribution, characteristics of combustion efficiency are estimated based on test pressure and thermodynamic calculation, and oscillation mechanism of combustion pressure is obtained by frequency domain analysis. The higher concentration of magnesium particle, the cool CO2 injection and the increasing of CO concentration is supposed to be the main reasons for the deposition in different areas along the axis of the combustion chamber. The allocation of gas injection is an important factor that affects the combustion sufficiency associated to the heterogeneous reaction. Raising the O/F ratio in chamber head is an effective way to improve combustion efficiency for rocket engine, and the efficiency is improved firstly and then is decreased with increasing flow rate of	https://www.webofscience.com/wos/woscc/full-record/WOS:000463687900032

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			fluidization gas. The low frequency oscillation is supposed to be related to flame instability induced by the gas injection in chamber head. The influence caused by primary and secondary gas injection are further analyzed in the frequency domain, the related characteristic bands are classified and the fluctuation tendency is obtained.	
4	Траєкторія багатоступеневої системи запуску ракети	Trajectory Design of a -Rocket Multistage Launch System. Forbes-Spyratos, SO; Kearney, MP; Smart, MK; Jahn, IH. JOURNAL OF SPACECRAFT AND ROCKETS. 2019. Volume 56. Issue 1. Page 53-67.	The integration of a reusable scramjet vehicle as the second stage of a multistage space launch system has the potential to reduce the cost of small-payload orbital launches. This paper determines the maximum payload to orbit trajectory of a multistage rocket-scramjet-rocket system. This trajectory is calculated by formulating the problem as an optimal control problem, and then solving it using the pseudospectral method. Using this method, it is determined that the optimal trajectory for the scramjet stage involves an initial decrease in dynamic pressure, followed by constant-dynamic-pressure flight, and finally a pullup maneuver. This optimal trajectory results in an 8.35% improvement in payload mass to orbit when compared to a constant-dynamic-pressure trajectory with minimum pullup. Furthermore, the optimal pullup maneuver decreases the maximum dynamic pressure experienced by the final rocket stage by 20.3%. The sensitivity of the trajectory is tested by varying the maximum allowable dynamic pressure and the drag produced by the vehicle. A maximum dynamic pressure variation of +/- 5 kPa is shown to produce only +3.8% and -3.5% variations in the payload mass. A drag increase of 10% is shown to produce a similar optimal trajectory shape, indicating robustness with variation of the vehicle aerodynamics.	https://www.webofscience.com/wos/woscc/full-record/WOS:000457390100006
5	Моделювання динамічних характеристик та симуляції аеродинамічного шипоподібного сопла для змінної тяги твердопаливного ракетного двигуна	Dynamic characteristic modeling and simulation of an aerospike-shaped pintle nozzle for variable thrust of a solid rocket motor. Ha, DS; Kim, HJ. ACTA ASTRONAUTICA. 2022. Volume 201. Page 364-375.	To utilize propulsion energy effectively, it is necessary to develop technology that can enable variable thrust by altering the area of the nozzle throat in a solid rocket motor in real time. In this study, an aerospike-shaped pintle nozzle, an altitude compensation nozzle technology, was designed to improve the performance compared to that of the existing pintle nozzles. Pressure fluctuations caused by the movement of the pintle led to the hysteresis of the combustion chamber pressure, which sharply increased the pintle load. Depending on the design conditions of the actuator, a load that was approximately 2.5 times larger than that in the normal state could be applied to the actuator. Additionally, cold flow tests were conducted under static conditions to verify the reliability of the design code for the actuator load prediction results. Moreover, firing tests were performed to verify the reliability of the internal ballistic simulation code. Finally, factors related to the thermal expansion of the pintle and the deformation of the nozzle throat, which caused changes in the nozzle throat area during	https://www.webofscience.com/wos/woscc/full-record/WOS:000870557300005

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			combustion, were identified and mathematically modeled. Additional firing tests were conducted to validate the updated numerical model. Before the model was updated, a pressure difference occurred at most three times or more between the performance prediction model and the firing test results, but the performance prediction error was reduced when the modified numerical analysis was used. If the present results are applied to a guided missile system, the highaltitude operation performance will improve and precision thrust control will become possible, enabling flexible guided missile system operation.	
Інформатика				
1	Автономне проектування та супровід пароплану / ракетного комплексу з великою дальністю польоту.	Autonomous Homing Design and Following for Parafoil / Rocket System with High-altitude. Guo, YM; Yan, JG; Wu, CH; Wu, XW; Chen, MP; Xing, XJ. JOURNAL OF INTELLIGENT & ROBOTIC SYSTEMS. 2021. Volume 101. Issue 4, 73.	This paper addresses a challenging problem to achieve energy-saving autonomous homing to the desired target for a parafoil/rocket system with high-altitude. The system is subject to external unknown crosswind disturbance during the process. A novel optimal multiphase homing algorithm with high-altitude considering constant wind is first presented. To reduce the time-varying wind disturbance, an improved adaptive path-following guidance law is developed. In this method, the arctangent function is extended to a general form, and the convergence rate is improved by replacing the function. Stability and convergence of the guidance law are shown in the sense of Lyapunov. Compared with the existing methods, the proposed homing strategy reduces the energy consumption when the initial altitude is too high, and the tracking errors convergence faster. Numerical simulation is further conducted to demonstrate the effectiveness of the proposed strategy.	https://www.webofscience.com/wos/woscc/full-record/WOS:000634927000003
2	Ефективне та модульне моделювання динаміки запуску трубчастих ракет на рухомій пусковій установці	An efficient and modular modeling for launch dynamics of tubed rockets on a moving launcher. Zhou, QB; Rui, XT; Wang, GP; Zhang, JS. DEFENCE TECHNOLOGY. 2021. Volume 17. Issue 6. Page 2011-2026.	This paper develops a modular modeling and efficient formulation of launch dynamics with marching fire (LDMF) using a mixed formulation of the transfer matrix method for multibody systems (MSTMM) and Newton-Euler formulation. Taking a ground-borne multiple launch rocket systems (MLRS), the focus is on the launching subsystem comprising the rocket, flexible tube, and tube tail. The launching subsystem is treated as a coupled rigid-flexible multibody system, where the rocket and tube tail are treated as rigid bodies while the flexible tube as a beam with large motion. Firstly, the tube and tube tail can be elegantly handled by the MSTMM, a computationally efficient order-N formulation. Then, the equation of motion of the in-bore rocket with relative kinematics w.r.t. the tube using the Newton-Euler method is derived. Finally, the rocket, tube, and tube tail dynamics are coupled, yielding the equation of motion of the launching subsystem that can be regarded as a building block and further integrated with other subsystems. The deduced dynamics equation of the launching subsystem is not limited to ground-borne MLRS but also	https://www.webofscience.com/wos/woscc/full-record/WOS:000731355700002

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			fits for tanks, self-propelled artilleries, and other air-borne and naval-borne weapons undergoing large motion. Numerical simulation results of LDMF are given and partially verified by the experiment.	
3	Оцінка операційної ефективності системи озброєння на основі системи правил довіри з інтервальними даними	Weapon system operational effectiveness evaluation based on the belief rule-based system with interval data. Gao, F.; Zhang, A.; Bi, WH. JOURNAL OF INTELLIGENT & FUZZY SYSTEMS. 2020. Volume 39. Issue 5. Page 6687-6701.	Weapon system operational effectiveness evaluation is of significant importance to weapon system development, and it can be viewed as a multiple criteria decision-making problem with qualitative information, precise data, interval data, and even missing information. Furthermore, due to the complexity of weapon systems and military operations, using prior knowledge such as experiment data, simulation data, and experts' knowledge could enhance the accuracy and reliability of the evaluation result. To this end, by introducing interval-valued evidential reasoning (ER) approach into belief rule-based system (BRBS), this paper proposed an interval-valued BRB inference method for weapon system operational effectiveness evaluation Firstly, the operational effectiveness evaluation hierarchy is established based on the analysis of the weapon system. Then, the belief rule base (BRB) is constructed to capture prior knowledge of the weapon system. Next, different kinds of information are transformed into belief distribution, and the proposed interval-valued BRB inference method is applied to relay the input to the BRB and obtain the evaluation result. Finally, three numerical examples of missile system operational effectiveness evaluation with interval data, precise data, and missing information are conducted to illustrate the process of the proposed method and demonstrate its feasibility.	https://www.webofscience.com/wos/woscc/full-record/WOS:000595520600058
4	Космічна інфрачервона система: місії, виклики та можливості	SBIRS: Missions, Challenages and Oppotunities. Li, WJ; Yan, SQ; Wang, CL; Ouyang, Y. IEEE 4TH INTERNATIONAL CONFERENCE ON CLOUD COMPUTING AND BIG DATA ANALYSIS (ICCCBDA). 2019. Page 363-367.	The Space-Based Infrared System (SBIRS) is an important part of the anti-missile system. As the scale of SBIRS deployment expands, it will bring unprecedented pressure to the system. In this paper, we discussed the mission of SBIRS and the timeliness, accuracy, scalability and knowledge discovery challenges, explore advanced technologies that can improve the performance of SBIRS. Six technologies were studied in this paper: compressive sensing, on-board processing, cluster-based HPC system, parallel file system, NoSQL database, and data mining technology. And we introduced the related applications of technologies mentioned above. The result can provide ideas for the improvement of SBIRS.	https://www.webofscience.com/wos/woscc/full-record/WOS:000475685900070
5	Закон спільного наведення зі скінченним часом для кількох ракет з обмеженнями кута удару та комутаційними топологіями зв'язку	Finite-time Cooperative Guidance Law for Multiple Missiles with Impact Angle Constraints and Switching Communication Topologies. Hou, ZW; Lan, XJ; Chen, HB;	In this paper, based on terminal sliding mode control (TSMC), a cooperative impact time and angle constrained guidance (CITACG) law for multi-missile system with switching network topologies is proposed. The obtained CITACG is composed of two parts. One part is designed to make the missiles intercept the target from their predetermined impact angles. And the other part's goal is to make the	https://www.webofscience.com/wos/woscc/full-record/WOS:001050288800002

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		Zhuang, XB. JOURNAL OF INTELLIGENT & ROBOTIC SYSTEMS. 2023. Volume 108. Issue 4, 85.	multiple missiles intercept the target simultaneously without predefining a common impact time. Sliding mode surface of the first part is designed based on TSMC, meanwhile integral terminal sliding mode control (ITSMC) and graph theory are applied to derive the second part of the CITACG. When the communication network switches between the connected topology and the disconnected one, a Lyapunov candidate function is introduced and the corresponding stability conditions are derived. The proposed guidance law is the summation of the two guidance parts, therefore it is a direct method and do not have to switch the guidance command between the impact angle constrained guidance law and the impact time constrained guidance law. The predetermined common impact time is not required in the proposed CITACG, and the missiles can automatically adjust themselves to intercept the target simultaneously by communicating between their neighbors. Numerical simulations demonstrate the great performance of the proposed guidance law.	
Матеріалознавство				
1	Ударна реакція прецизійного лінійного кумулятивного заряду в багатоступеневому ракетному комплексі	Shock Response of Precision Linear Shaped Charge in a Multistage Rocket System. Choi, S.; Kwon, S.; Lee, SE; Moon, MA. INTERNATIONAL JOURNAL OF AERONAUTICAL AND SPACE SCIENCES. 2023. Volume 24. Issue 1. Page 92-104.	Recently, a linear pyrotechnic device known as a precision linear shaped charge (PLSC) was proposed for the stage separation of a multistage rocket system. PLSCs exhibit improved system reliability by simplifying the system design involved in the stage separation process. However, they may cause the malfunction of electronic components in such systems due to pyroshock that is generated during their operation. In this study, a numerical method based on a two-dimensional (2D) hydrocode and three-dimensional (3D) explicit code was applied to evaluate the generation and transmission of pyroshock induced by the operation of a PLSC in an aerospace system structure. The analysis results were verified using PLSC operation tests. The analysis and experimental results were quantified using maximax shock-response spectrum curves. From this, the pyroshock attenuation characteristics related to the distance from the PLSC and the presence of a discontinuity along the shockwave transmission pathway were discussed.	https://www.webofscience.com/wos/woscc/full-record/WOS:000847264000004
2	Закон наведення на основі глибокої нейронної мережі з використанням контрольованого навчання	Deep Neural Network-Based Guidance Law Using Supervised Learning. Kim, M.; Hong, D.; Park, S. APPLIED SCIENCES-BASEL. 2020. Volume 10. Issue 21, 7865.	This paper proposes that the deep neural network-based guidance (DNNG) law replace the proportional navigation guidance (PNG) law. This approach is performed by adopting a supervised learning (SL) method using a large amount of simulation data from the missile system with PNG. Then, the proposed DNNG is compared with the PNG, and its performance is evaluated via the hitting rate and the energy function. In addition, the DNN-based only line-of-sight (LOS)	https://www.webofscience.com/wos/woscc/full-record/WOS:000588984600001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			rate input guidance (DNNLG) law, in which only the LOS rate is an input variable, is introduced and compared with the PN and DNNG laws. Then, the DNNG and DNNLG laws examine behavior in an initial position other than the training data.	
3	Дослідження поведінки смоляної маси поліуретанової зшиваючої матриці шляхом додавання сумішей триолів / діолів для застосування в композиціях твердих ракетних палив	Investigation of the Gum Stock Behavior of Polyurethane Crosslinking Matrix by Adding Triol / Diol Mixtures for the Application of Composite Solid Rocket Propellants. Elbeih, A.; Boshra, IK; Elhedery, TM. DEFENCE SCIENCE JOURNAL. 2022. Volume 72. Issue 2. Page 195-204.	The addition of some advanced additives to improve the mechanical properties of polyurethane (PU) polymeric matrix, which acts as a binder system in composite solid rocket propellants (CSRPs), is a target for the energetic materials researchers. In this investigation, 45 compositions of different crosslinked PU matrices were produced to demonstrate the effect of adding crosslinking mixture (CM) on the mechanical capabilities of polyurethane gum stock. The crosslinking mixture (CM) is composed of a triol crosslinker, trimethylolpropane (TMP), and a chain extender, 1,4-butanediol (BD). For comparison, traditional PU samples without crosslinking additives were formulated. As a prepolymer, HTPB was used with a curing agent (HMDI). The research was carried out with different ratios of TMP to BD, different curing ratios (NCO/OH=0.7, 0.9, and 1.1), and crosslinking mixture contents in the range of 0-5 wt.%. The mechanical characteristics of all the cured formulations were measured. It was demonstrated that changing the ratio of TMP to BD has a significant impact on the mechanical performance causing a wide range of elongation and strength qualities. Increasing the wt.% of triol crosslinker in the sample enhanced the tensile strength, whereas the strain has been decreased. The addition of diol chain extender increased the strain rate of the samples. The mechanical parameters were adjusted simply by employing the crosslinking ingredients to get exceptional mechanical characteristics at each NCO/OH curing ratios. Also it was concluded that PU samples of curing ratio (NCO/OH= 0.7-0.9) with TMP:BD (1:1) showed a promising results and could be used according to the requirements of the rocket system designers.	https://www.webofscience.com/wos/woscc/full-record/WOS:000798741500008
4	Самобалансуючий підсилювач потужності з мінімальним зміщенням постійного струму для схем керування автоматизованою пусковою установкою ракетного комплексу класу «земля-повітря»	Self-Balancing Power Amplifier with a Minimal DC Offset for Launcher Automation Control Circuits of a Surface-to-Air Missile System. Zoltowski, P.; Buzantowicz, W. APPLIED SCIENCES-BASEL. 2022. Volume 12. Issue 7, 3532.	This paper discusses the design of a new self-balancing amplifier of an AC component power characterized by a minimal output DC offset. The design of the amplifier is based on semiconductor technology and intended for application in low-frequency analog signal processing paths, particularly in surface-to-air missile system launcher automation circuits. The proposed solution has several design and technical-implementation advantages, whereas the primary novelty compared to the commonly used ones is the ability for self-generating a near-zero DC component value of output signal. The design features and technical parameters of the developed amplifier make it suitable for use in a wide range of devices that must ensure the stable, prolonged	https://www.webofscience.com/wos/woscc/full-record/WOS:000780838100001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			operation of a low-frequency power amplifier under variable weather conditions and a minimal DC offset of output signal.	
5	Розробка газогібридного ракетного комплексу з прямим вприскуванням палива з використанням гліцидилазидного полімеру	Development of a direct injection gas-hybrid rocket system using glycidyl azide polymer. Wada, Y.; Hatano, S.; Banno, A.; Kawabata, Y.; Hasegawa, H.; Oda, T; Hori, K. INTERNATIONAL JOURNAL OF ENERGETIC MATERIALS AND CHEMICAL PROPULSION. 2019. Volume 18. Issue 2. Page 157-170.	The development of a direct injection gas-hybrid rocket system using glycidyl azide polymer (GAP) as a solid fuel for the thrusters of very small satellites is described. Furthermore, a performance evaluation and the combustion characteristics of the propulsion system are presented. GAP is capable of self-decomposition and generates fuel-rich gas, which makes it viable as a fuel gas-hybrid power source for rockets. GAP also has a higher density compared to other polymers such as hydroxyl-terminated polybutadiene (HTPB), and the high-density specific impulse enables the development of a small thruster system. Gaseous oxygen was used as the oxidizer for the first test of the gas-hybrid rocket. The gas generator was tested using a 60 mm diameter motor with an end-burning GAP grain. The experimental combustion pressure was initially set at 1 MPa, and adjustments to the oxygen flow were made based on the test results of the gas-generator combustion. The resulting ignition smoothness and combustion stability were observed. Excellent characteristic velocity efficiency (90%)-larger than that of a classical hybrid rocket motor -was obtained. Moreover, quenching of the GAP gas generator was achieved after the oxidizer injection was stopped, which implies that this system has the capability of re-ignition.	https://www.webofscience.com/wos/woscc/full-record/WOS:000473297600004
Механіка				
1	Моделювання та адаптивне керування пропорційно-інтегрально-диференційною нейронною мережею зворотного поширення для спеціальної пускової установки з використанням нової версії методу матриці переносу для багаточасткових комплексів	Simulation and adaptive control of back propagation neural network proportional-integral-derivative for special launcher using new version of transfer matrix method for multibody systems. Miao, YF; Wang, GP; Rui, XT. JOURNAL OF VIBRATION AND CONTROL. 2020. Volume 26. Issue 9-10. Page 757-768.	Rocket launcher system, as a special launcher placed on tactical vehicles, is a very complex mechanical system with characteristics of strong shock and vibration. In order to improve position accuracy, as well as reduce vibration, this paper creates a nonlinear dynamics model of the launcher system by using a new version of the transfer matrix method for multibody systems. The overall transfer equation of the nonlinear model is deduced. Combining with general kinematics equations of the rocket, the system launch dynamics are simulated and compared with experiments to verify the correctness of the model. On this basis, a backpropagation neural network proportional-integral-derivative adaptive control system is designed to improve servo control of the launcher. Then, the effectiveness of this method is verified by comparing with the traditional proportional-integral-derivative control method. Simulated results show that the backpropagation neural network proportional-integral-derivative control system makes the azimuth and elevation angles reach the target values smoothly and quickly, with higher accuracy. The results prove that the proposed	https://www.webofscience.com/wos/woscc/full-record/WOS:000499537600001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			method prominently reduces vibrations of the launcher, by adjusting the control parameters online according to the operation state of the system, presenting a better stability and robustness.	
2	Багатопрофільний інструмент оптимізації та аналізу продуктивності балістичних ракет	Multidisciplinary Optimization and Performance Analysis Tool for Ballistic Missiles. Adsiz, MA; Kutay, AT. AIAA SCITECH 2019 FORUM, 2019.	During rocket/missile system design process, system design must be made in accordance with military standards, which have very strict rules. Product delivery dates usually are very rigid. Despite this, during conceptual design, requirements are often updated within the design process that requires the design to be updated frequently. It is essential to perform these steps as efficiently and quickly as possible. The products which are inexpensive and have best performance parameters are preferred, and so the companies with these products can survive. For this purpose, the conceptual design, which is the first step of the system design process, needs to be optimized. In this study, it is aimed to develop a system design tool that simplifies the conceptual design process, creates design alternatives quickly, tests them, performs performance analysis, and selects the optimum among these alternatives. By using this tool, it is possible for the designer to obtain the information needed for the preliminary process quickly and efficiently.	https://www.webofscience.com/wos/woscc/full-record/WOS:000136176960 1039
3	Оптичні вимірювання на місці викиду гібридної ракети GOX/ABS	In-Situ Optical Measurements of a GOX/ABS Hybrid Rocket Plume. Whitmore, SA; Frischkorn, C.; Petersen, S. AIAA. SCITECH 2022 FORUM, 2022, 0771.	Results from proof of concept tests using fiber-optic cables inserted into the combustion port of a lab- scale hybrid rocket system are reported. The fiber-optics allow in-situ optical characterization of the combustion plume properties including flame temperature and combustion plume species. The fiber optic cables act as radiation conduits, transmitting the optical signals to miniature spectrometers. Multiple hot firings with burn durations varying from 5 to 25 seconds were performed. The fiber optic sensors survived for all of the hot fire tests and resulting rocket performance data were correlated with in- situ optical spectra data. When the optical measurements were adjusted to account for the spectrometer transfer-function and the resulting spectra were curve-fit to Planck's radiation law, the sensed ensemble mean flame temperature agrees to within 20 degrees C with the analytically predicted flame temperature. Additionally, local maxima in the optical spectra correspond to the emission frequencies of atomic and molecular hydrogen, water vapor, and molecular nitrogen; all species that are known to exist in the hybrid combustion plume. Based on these preliminary test results, it is concluded that this simple in-situ measurement system operates as designed, and it shows considerable promise for future applications to a wide swath of gas-generator systems.	https://www.webofscience.com/wos/woscc/full-record/WOS:001409636200171

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
4	Цільовий ракетний комплекс «Апогей»: розробка замкнутої системи зворотного зв'язку з модуляцією опору для керування підйомом ракети	TARS: Development of a Drag-Modulating Closed-loop Feedback System to Control a Rocket's Ascent. Bregin, E.; Jaffar, MKM. AIAA SCITECH 2024 FORUM, 2024.	This paper presents a study on the development and experimental validation of an advanced Air Brake system specifically designed for our Targeted Apogee Rocket System (TARS). The primary objective of the Air Brake is to effectively modulate drag during the coast phase through a closed-loop feedback loop, thereby enabling precise control over the rocket's ascent trajectory. By imposing its influence throughout the flight, the Air Brake aims to steer the rocket toward a desired apogee. To achieve this, a state-estimation scheme and a model predictive controller are developed, tested, and experimentally validated. The results obtained from the verification and validation process demonstrate the system's effectiveness, solidifying its potential as a solution for achieving ascent control in rocketry applications.	https://www.webofscience.com/wos/woscc/full-record/WOS:001375987907008
5	Корекція швидкості з використанням даних стабілізованої головки самонаведення	INS Velocity Correction Using Stabilized Seeker Data. Büyükkoçak, S.; Akgül, M.; Ata, EH. AIAA SCITECH 2024 FORUM, 2024.	One of the most important features that affect the performance, range and accuracy of a tactical missile system is the navigation capability of the missile system. Today, navigation systems use inertial measurement units as basic sensors. In this paper, seeker stabilized LOS calculations are used to correct the velocity components of the navigation solution through a Kalman filter to improve navigation accuracy using a control grade IMU in the presence of an electronic warfare environment. This work presents a new method that aims to improve the accuracy of INS speed results without relying on GPS signals. The filter works great even when the exact location of the reference point is unknown. The effect of IMU biases, false target data, and flight path on the performance and observability of the filter is extensively investigated through extensive simulation studies using a 6-degree-of-freedom model assuming a flat earth scenario. The findings of this study highlight the potential of the proposed method to effectively integrate seeker measurements into missile applications, thereby increasing the accuracy of INS velocity results. The ability to bypass the need for GPS signals offers a significant advantage in scenarios where GPS signals are unavailable or unreliable.	https://www.webofscience.com/wos/woscc/full-record/WOS:001375901807039
Системи автоматизованого управління				
1	Розподілений закон спільного наведення для кількох ракет із затримкою входу та перемиканням топології	Distributed cooperative guidance law for multiple missiles with input delay and topology switching. Yu, H.; Dai, K.; Li, HJ; Zou, Y.; Ma, X.; Ma, SJ; Zhang, H. JOURNAL OF THE FRANKLIN INSTITUTE. 2021.	This paper considers the simultaneous attack of a stationary target by multiple missiles. A novel fixed-time distributed guidance law based on the proportional navigation (PN) guidance law is designed by integrating a consistent control technique into the guidance strategy. This guarantees that the time-to-go of the missile becomes consistent. The guidance law adopts a discrete design, and a compensation item driven by normal acceleration is added to tangential acceleration. This eliminates the potential singularity problem when the heading angle is	https://www.webofscience.com/wos/woscc/full-record/WOS:000739703900012

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		Volume 358. Issue 17. Page 9061-9085.	zero before the consistency is obtained, and thus the multiple missile system still converges in fixed time. In addition, the proposed guidance law can be applied to both undirected and directed graphs. Furthermore, two improved guidance laws are proposed to improve the robustness of the system against adverse effects caused by input delays and topology switching failures and to provide a theoretical proof. Finally, a simulation is used to verify the performance of the distributed guidance law and its robustness against the above failures.	
2	Спільне керування та наведення на основі відмовостійкого відстеження формування для кількох комплексів крилатих ракет в умовах відмов виконавчих механізмів та спрямованих топологій, що змінюються в часі	Time-varying fault-tolerant formation tracking based cooperative control and guidance for multiple cruise missile systems under actuator failures and directed topologies. Xu, XG; Wei, ZY; Ren, Z.; Li, SS. JOURNAL OF SYSTEMS ENGINEERING AND ELECTRONICS. 2019. Volume 30. Issue 3. Page 587-600.	This paper studies time-varying fault-tolerant formation tracking problems for the multiple cruise missile system under directed topologies subjected to actuator failures. Firstly, the time-varying fault-tolerant formation tracking process for the multiple cruise missile system is divided into the guidance loop and the control loop. Then protocols are constructed to accomplish distributed fault-tolerant formation tracking in the guidance loop with the adaptive updating mechanism, in the condition where neither the knowledge about actuator malfunctions nor any global information of the communication topology remains available. Moreover, sufficient conditions to accomplish formation tracking are presented, and it is shown that the multiple cruise missile system can carry on the predefined time-varying fault-tolerant control (FTC) formation tracking through the active disturbances rejection controller (ADRC) and the proportion integration (PI) controller by the way of the fault-tolerant protocol utilizing the designed strategies, in the event of actuator failures. At last, numerical analysis and simulation are designed to verify the theoretical results.	https://www.webofscience.com/wos/woscc/full-record/WOS:000473526800016
3	Метод випередження для оптимізації зенітно-ракетного комплексу з двокортежними лінгвістичними m-полярними нечіткими даними	An outranking method for optimizing anti-aircraft missile system with 2-tuple linguistic m-polar fuzzy data. Akram, M.; Noreen, U.; Deveci, M. ENGINEERING APPLICATIONS OF ARTIFICIAL INTELLIGENCE. 2024. Volume 132, 107923.	This research study is dedicated to enhancing the ELECTRE (ELimination and Choice Translating REality methodology), a robust and efficient approach for multi -criteria group decision -making (MCGDM). The basic premise is to inaugurate an upgraded version of the ELECTRE-III technique by integrating 2-tuple linguistic m -polar fuzzy data. This integration allows for the seamless handling of MCGDM challenges wherein decisionmakers utilize linguistic variables to articulate their perspectives' multi -sided or multi -pole nature. The group decision support system of 2-tuple linguistic m -polar fuzzy ELECTRE-III first evaluates the performances of the alternatives characterized by 2-tuple linguistic m -polar fuzzy numbers. In the second stage, the assessment of criteria weights is carried out by utilizing Shannon's entropy formula. This process leads to the aggregation of individual expert data, resulting in a comprehensive data set. Next, we formulate the approach by defining 2-tuple linguistic	https://www.webofscience.com/wos/woscc/full-record/WOS:001173764500001

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			m -polar fuzzy indifference threshold, preference threshold, and veto threshold functions, providing a more reliable basis for constructing outranking relations. The ranking module of the 2-tuple linguistic m -polar fuzzy ELECTRE-III method is simplified by computing the concordance credibility, discordance credibility, and net credibility degrees of each alternative. Further, a diagrammatic representation of the presented framework is portrayed to justify the corresponding step-by-step procedure for solving problems. To support the applicability of the 2-tuple linguistic m -polar fuzzy ELECTRE-III method, a case study involving selecting an anti-aircraft missile defence system is presented. Eventually, a comparative analysis is performed to emphasize the proposed methodology's unique characteristics and advantages compared to existing outranking approaches, namely 2-tuple linguistic m -polar fuzzy ELECTRE-II and 2-tuple linguistic mpolar fuzzy ELECTRE-I. This analysis showcases the remarkable results generated by the proposed method and serves as a testament to the validity and reliability of the presented research work.	
4	Активне керування придушенням збурень для керування орієнтацією ракетних комплексів на основі методу зворотнього кроку	Active Disturbance Rejection Control for Attitude Control of Missile Systems Based on Back-stepping Method. Zhuang, HX; Sun, QL; Chen, ZQ; Zeng, XY. INTERNATIONAL JOURNAL OF CONTROL AUTOMATION AND SYSTEMS. 2021. Volume 19. Issue 11. Page 3642-3656.	In this paper, a novel attitude control method for nonlinear missile system is proposed, which combines backstepping technique with linear active disturbance rejection control (LADRC). Firstly, the nonlinear missile model is introduced and transformed into the standard state equation. The linear extended state observer (LESO) is used to estimate the unknown variables. Compared with PID control method, the homologous LADRC design ensures that the state variables of the closed-loop system converge to the reference state. The stability of LESO and LADRC is theoretically analyzed and proved. A large number of comparative simulations show the effectiveness of the method. The simulation results show that LADRC has better control performance than SMC and PID method.	https://www.webofscience.com/wos/woscc/full-record/WOS:000692458400004
5	Реконфігуроване відмовостійке керування для гіперзвукових ракет з відмовами виконавчих механізмів за умови резервування виконавчих механізмів	Reconfigurable fault-tolerant control for supersonic missiles with actuator failures under actuation redundancy. Li, T.; Jiang, ZY; Yang, HB; Hu, C.; Zhang, SF. CHINESE JOURNAL OF AERONAUTICS. 2020. Volume 33. Issue 1. Page 324-338.	Aircraft undergoing actuator failures into under-actuation have been seldom studied in literature. Aiming at addressing actuator failures of Total Loss of Effectiveness (TLOE) as well as Partial Loss of Effectiveness (PLOE) resulting in different system actuations, reconfigurable Fault-Tolerant Control (FTC) is proposed for supersonic wingless missiles under actuation redundancy. The under-actuated system of TLOE failure patterns is solved by transformation to cascade systems through a 'shape variable'. Meanwhile, actuator TLOE faults of different unknown failure patterns from proper actuation to under-actuation are accommodated by a reconfigurable adaptive law on a multiple-model basis. The backstepping technique with the Extended State Observer (ESO) method adopted as a basic	https://www.webofscience.com/wos/woscc/full-record/WOS:000517551100025

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			strategy is applied to an established symmetric coupled missile system with actuator PLOE faults, modeling errors, and external disturbances. Additionally, the nonlinear saturation characteristics of actuators are settled by an auxiliary system with the Nussbaum function technique. The stability of the control system is analyzed and proven through Lyapunov theory. Numerical simulations are implemented in the presences of aerodynamic uncertainties, gust disturbance, and actuator failures. Results demonstrate the effectiveness of the proposed method with satisfactory tracking performance and actuator fault tolerance capacity.	
Телекомунікації				
1	Повністю розподілене змінне в часі керування формуванням для кількох невизначених ракет	Fully Distributed Time-Varying Formation Control for Multiple Uncertain Missiles. Liu, DY; Liu, H.; Valavanis, KP. IEEE TRANSACTIONS ON AEROSPACE AND ELECTRONIC SYSTEMS. 2021. Volume 57. Issue 3. Page 1646-1656.	The article addresses the fully distributed time-varying formation control problem for multiple missiles involving uncertainties. An adaptive control protocol is developed for the missiles, which includes uncertainties in the flight dynamics, while the adaptive control protocol does not require global information of the network missile system. Global formation flight stability is proven via the Lyapunov theory. Simulation tests are performed to validate the effectiveness of the developed protocol as applied to the network system.	https://www.webofscience.com/wos/woscc/full-record/WOS:000659550200018
2	Закон керування часом удару для гіперзвукових ракет на кінцевій фазі	Impact-Time-Control Guidance Law for Hypersonic Missiles in Terminal Phase. Zhu, CH; Xu, GD; Wei, CZ; Cai, DY; Yu, Y. IEEE ACCESS. 2020. Volume 8. Page 44611-44621.	Recent researches on hypersonic vehicles adopted in military have gained a lot of interest because of its high flight speed and efficiency. However the guidance laws for hypersonic missiles against the anti-missile system to increase survivability and defense penetration ability are still need to study. One main countermeasure to deal with this issue is to implement simultaneous attack. Therefore in this paper an impact-time-control guidance law for hypersonic missiles to impact a stationary target at the same desired final time is presented. Time-to-go estimation for time-varying velocity is derived by using a method of approximate acceleration form to extend the estimation method for constant velocity. The impact-time-control guidance law is firstly given and applied in vertical plane based on proportional navigation guidance law to control the impact time in terminal phase. Then the conditions that limit the method to apply are discussed. To overcome this issue, the guidance law applied in lateral plane is derived. The simulations are implemented using each method in vertical and lateral planes respectively and show good results for hypersonic missiles to achieve simultaneous attack.	https://www.webofscience.com/wos/woscc/full-record/WOS:000524712900013

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
3	Інерціальна навігаційна система: вплив стохастичного шуму на ймовірність кругового відхилення балістичних ракет	INS Stochastic Noise Impact on Circular Error Probability of Ballistic Missiles. Hegazy, SAH; Kamel, AM; Arafa, II; Elhalwagy, YZ. NAVIGATION-JOURNAL OF THE INSTITUTE OF NAVIGATION. 2022. Volume 69. Issue 2, 523.	A circular error probability (CEP) metric in ballistic missile science is an experimental indicator of the accuracy of a missile system. There are a lot of error sources that cause a ballistic missile to deviate from its ideal trajectory, and that causes a deviation from required CEP. This work discusses the problems of dispersion of ballistic missiles due to inertial navigation system (INS) errors. INS deterministic errors are usually calibrated and compensated using some proper techniques. However, INS stochastic errors can be modeled and analyzed. In this study, a chosen missile is thoroughly analyzed using the six degrees-of-freedom missile flight trajectory simulator. A Monte Carlo simulation is used to generate a large number of flight trajectories to inspect the effect of INS stochastic noise on missile CEP. Moreover, a strategy for selecting an adequate sensor according to mission requirements and its corresponding sensor errors is introduced.	https://www.webofscience.com/wos/woscc/full-record/WOS:000828554800008
4	Робастне H∞ проектування фільтрів нелінійних стохастичних сигнальних систем на основі глибоких нейронних мереж	Robust H∞ Deep Neural Network-Based Filter Design of Nonlinear Stochastic Signal Systems. Chen, BS; Wu, PH; Lee, MY. IEEE ACCESS. 2021. Volume 9. Page 165103-165119.	Recently, deep neural network (DNN) schemes based on big data-driven methods have been successfully applied to image classification, communication, translation of language, speech recognition, etc. However, more efforts are still needed to apply them to complex robust nonlinear filter design in signal processing, especially for the robust nonlinear H-infinity filter design for robust state estimation of nonlinear stochastic signal system under uncertain external disturbance and output measurement noise. In general, the design problem of robust nonlinear H-infinity filter needs to solve a complex Hamilton-Jacobi-Isaacs equation (HJIE), which is not easily solved analytically or numerically. Further, the robust nonlinear H-infinity filter is not easily designed by training DNN directly via conventional big data schemes. In this paper, a novel robust H-infinity HJIE-embedded DNN-based filter design is proposed as a co-design of H-infinity filtering algorithm and DNN learning algorithm for the robust state estimation of nonlinear stochastic signal systems with external disturbance and output measurement noise. In the proposed robust H-infinity DNN-based filter design, we have proven that when the approximation error of HJIE by the trained DNN through Adam learning algorithm approaches to 0, the HJIE-embedded DNN-based filter will approach the robust nonlinear H-infinity filter of nonlinear stochastic signal system with uncertain external disturbance and output measurement noise. Finally, a trajectory estimation problem of 3-D geometry incoming nonlinear stochastic missile system by the proposed robust H-infinity HJIE-embedded DNN-based filter scheme through the measurement by the sensor of radar system with external disturbance and measurement noise is given to illustrate the design procedure and	https://www.webofscience.com/wos/woscc/full-record/WOS:000734422800001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			validate its robust H-infinity filtering performance when compared with the extended Kalman filter and particle filter.	
5	Спільний удар кількома ракетами по стаціонарній цілі на основі розподіленої моделі прогнозного керування	Multi-missile Cooperative Strike on Stationary Target Based on Distributed Model Predictive Control. Chen, YD; Ning, ZK; Zhang, K.; Li, B. ADVANCES IN GUIDANCE, NAVIGATION AND CONTROL. 2023. Volume 845. Page 2678-2687.	This paper mainly studies multi-missile system cooperative strike on stationary target and designs a controller based on distributed model predictive control (DMPC) to ensure the performance of multi-missile strike system. The contributions of this paper are summarized as: Firstly, the nonlinear continuous model predictive control (MPC) system is linearized into discrete MPC system. Secondly, the distributed model predictive control method is used to get nice control effect and the computational complexity is reasonable. Finally, one consider the time of multiple missiles and the consistency of the distance between the target, the effect of simultaneously strikeing the target can be achieved through information exchange betoneen each missile. The simulation is used to verity the effectiveness of the proposed method.	https://www.webofscience.com/wos/woscc/full-record/WOS:001463221800261
Термодинаміка				
1	Термохімічні та енергетичні характеристики N-(2,2-біс(метокси-NNO-азокси)етил)нітрамінів	Thermochemical and Energy Characteristics of N-(2,2-bis(methoxy-NNO-azoxy)ethyl)nitramines. Zyuzin, IN; Lempert, DB; Nabatova, AV; Kazakov, AI. COMBUSTION EXPLOSION AND SHOCK WAVES. 2020. Volume 56. Issue 4. Page 464-470.	The standard enthalpies of formation of 1,1-bis(methoxy-NNO-azoxy)-3-nitro-3-azabutane and 1,1,8,8-tetrakis (methoxy-NNO-azoxy)-3,6-dinitro-3,6-diazaoctane were experimentally determined to be 87.7 +/- 3.9 and 283.8 +/- 6.2 kJ/mol, respectively. Calculations have shown that solid composite propellants containing these two compounds as gasifying components in metal-free compositions based on an active binder and ammonium perchlorate are inferior in the maximum achievable effective impulse at the third stage of the rocket system I-ef (3) to compositions based on HMX, but in designing special compositions with a limited content of organic explosive (not higher than 30-35%), these two compounds provide 5-10 s higher values of I-ef (3) than when using HMX.	https://www.webofscience.com/wos/woscc/full-record/WOS:000564989300010
2	Динамічні характеристики лазерного запалювання твердого палива та кисню для гібридного ракетного комплексу	Dynamic laser ignition characteristics of solid fuel and oxygen for hybrid rocket system. Xia, HQ; Wang, NF; Pang, JT; Wu, Y. COMBUSTION AND FLAME. 2024. Volume 263, 113423.	The transient laser ignition process in a slab burner that is similar to hybrid rocket motors is investigated in this study. The coupling characteristics between solid fuel properties, pyrolysis rate, and laser power were analysed. The results show that the laser ignition process can be divided into four stages: preheating, pyrolysis, ignition, and combustion, with the preheating and pyrolysis stages primarily controlled by the solid heating rate and the mixing characteristics in the fuel -rich combustion zone. Meanwhile, the ignition and combustion stages were characterized by ignition kernel growth and flame front propagation. The ignition delay time and the establishment of steady-state combustion were significantly affected by the ignition energy and fuel properties, i.e., The ignition delay time increases exponentially	https://www.webofscience.com/wos/woscc/full-record/WOS:001219300400001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			with decreasing laser energy. An increase in oxidizer flow flux reduces the demand for mixing during ignition, but the corresponding increase in combustion pressure poses challenges to the ignition process. A two-dimensional transient numerical model was established based on optical -thermal coupling theory to further understand the dynamic pyrolysis process of solid fuel particles. The model was validated through fire experiments under different laser ignition energy conditions. The results indicate that the deviation of the maximum penetration depth and ignition delay time between the experiment and the simulation is within 7 %.	
3	Оптимальна стратегія перехоплення зенітно-ракетного комплексу з урахуванням багатьох цілей та фаз	Optimal interception strategy of air defence missile system considering multiple targets and phases. Gao, KY; Xiao, H.; Qu, L.; Wang, SY. PROCEEDINGS OF THE INSTITUTION OF MECHANICAL ENGINEERS PART O-JOURNAL OF RISK AND RELIABILITY. 2022. Volume 236. Issue 1. Page 138-147.	Due to the rapid development and wide application of air attack weapons, air defence missiles against them are increasingly important and have become the main air defence weapons in modern war. However, interception strategy of air defence missile system is ignored in previous studies. Thus, using the combinatorial optimization, this paper proposes a methodology to optimize the strategy of ADMS in a missile-target interception process in order to minimize the expected costs for defender. According to the practice, the considered process has multiple targets and multiple phases, and the expected costs are composed of the loss caused by targets and the cost for intercept missiles. Two numerical examples are presented to illustrate the proposed methodology. The results of the examples show that interception strategies have a great impact on the expected costs of ADMS during a missile-target interception process.	https://www.webofscience.com/wos/woscc/full-record/WOS:000657989900001
4	Процес концептуального проектування моделі ракети та її виробництва з використанням методу адитивного виробництва	Conceptual Design Process of a Missile Model and Production Using Additive Manufacturing Method. Ay, N.; Bozdemir, M. DEFENCE SCIENCE JOURNAL. 2024. Volume 74. Issue 5. Page 734-742.	This study focuses on air-to-ground missile systems, which are widely used in Turkey and around the world and are becoming increasingly important. The development of missile systems takes into account various requirements defined by the end user. It is important to identify a system and its subcomponents that fully meet the requirements. This study analyzes an air-to-ground missile system and its main subcomponents identified through the conceptual design method based on the systematic design approach proposed by Pahl and Beitz. The aim is to determine the feasibility of obtaining an optimal solution that meets the requirements set by the conceptual design method. The missile design's optimal solution was modeled using SolidWorks software. A three-dimensional (3D) printer with FDM production technology was used to produce a prototype of the computer-modeled design. ABS and ABS-plastic blend filaments were preferred due to their material properties in the FDM production process. During the printing stage, the filament and output settings of the model were determined using the 3D printer's interface program. The filaments	https://www.webofscience.com/wos/woscc/full-record/WOS:001318209100013

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			were then extruded through a nozzle, following the cross-sectional geometry of the part. The resulting model was printed in pieces and assembled with a tolerance of 0.1mm. This process resulted in a 3D model of the missile, which was created to represent the system structure in different colours. The study demonstrates that the conceptual design method can be used to develop innovative and meaningful missile models.	
5	Порівняння ефективності блокування хвилею тиску в структурному перегородковому інжекторі та флюїдному перегородковому інжекторі	Comparison of blockage performance of pressure wave in structural baffle injector and fluidic baffle injector. Song, W.; Cha, J.; Yoon, Y.; Koo, J. ACTA ASTRONAUTICA. 2020. Volume 176. Page 666-671.	The role of the structural baffle injectors and blades in the liquid rocket engine is to block the transverse pressure waves that are caused by combustion instability. Although the protection of the liquid rocket system from high-frequency combustion instability is essential, there are side effects such as increased weight of the rocket and thermal effect. In this study, a fluidic baffle injector was applied to the simulant spray system, expecting that it would operate with the same performance as a structural baffle injector.	https://www.webofscience.com/wos/woscc/full-record/WOS:000583679400062
ГАУБИЧНА АРТИЛЕРІЯ				
Інженерія				
1	Загальний принцип конструкції гаубичної артилерійської зброї для забезпечення точності стрільби	General design principle of artillery for firing accuracy. Qian, LF; Chen, GS; Tong, MH; Tang, JS. DEFENCE TECHNOLOGY. 2022. Volume 18. Issue 12. Page 2125-2140.	In this paper, based on the topological description method, the kinematic and dynamic equations of the projectile flight and projectile-artillery coupling system during the whole process of firing are constructed. The factors that can affect the projectile burst points, namely the state parameters of the projectile on the muzzle and state parameters of the barrel muzzle, as well as the factors that affect the barrel muzzle state parameters, are analyzed. On this basis, the design principle of artillery firing ac-curacy is proposed. The error analysis and the corresponding inverse problem, the extraction method of key parameters affecting artillery implicated motion, the conformal and control method of rotating band are analyzed and presented. Finally, the presented method is verified through a vehicle mounted howitzer case, and the muzzle state parameter interval is obtained meeting the given firing accuracy. In addition, the sensitivity analysis of artillery parameters shows that the less the correlation between the parameters and the barrel, the less the influence on the projectile implicated motion. The analysis of the coupling effect between rifling and the rotating band shows that the uniform rifling is the optimal form for the conformal of the rotating band during firing.	https://www.webofscience.com/wos/woscc/full-record/WOS:000899686500001
2	Проблеми та нові методи розробки експериментів з надійності	Challenges and new methods for designing reliability experiments.	Engineers use reliability experiments to determine the factors that drive product reliability, build robust products, and predict reliability under use conditions. This article uses recent testing of a howitzer to illustrate the challenges in designing reliability experiments for complex,	https://www.webofscience.com/wos/woscc/full-record/WOS:000467061400019

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		Freeman, LJ; Medlin, RM; Johnson, TH. QUALITY ENGINEERING. 2019. Volume 31. Issue 1. Page 108-121.	repairable systems. We review research in complex system reliability models, failure-time experiments, and experimental design principles. We highlight the need for reliability experiments that account for various intended uses and environments. We leverage lessons learned from current research and propose methods for designing an experiment for a complex, repairable system.	
3	Високовимірна кількісна оцінка руху снаряда в стволі гаубиці, встановленої на вантажівці, на основі методу еволюції щільності ймовірності.	High-dimensional uncertainty quantification of projectile motion in the barrel of a truck-mounted howitzer based on probability density evolution method. Wang, MM; Qian, LF; Chen, GS; Lin, T.; Shi, JF; Zhou, SJ. DEFENCE TECHNOLOGY. 2024. Volume 32. Page 209-221.	This paper proposed an efficient research method for high-dimensional uncertainty quantification of projectile motion in the barrel of a truck-mounted howitzer. Firstly, the dynamic model of projectile motion is established considering the flexible deformation of the barrel and the interaction between the projectile and the barrel. Subsequently, the accuracy of the dynamic model is verified based on the external ballistic projectile attitude test platform. Furthermore, the probability density evolution method (PDEM) is developed to high-dimensional uncertainty quantification of projectile motion. The engineering example highlights the results of the proposed method are consistent with the results obtained by the Monte Carlo Simulation (MCS). Finally, the influence of parameter uncertainty on the projectile disturbance at muzzle under different working conditions is analyzed. The results show that the disturbance of the pitch angular, pitch angular velocity and pitch angular of velocity decreases with the increase of launching angle, and the random parameter ranges of both the projectile and coupling model have similar influence on the disturbance of projectile angular motion at muzzle.	https://www.webofscience.com/wos/woscc/full-record/WOS:001189022000001
4	Модель гідравлічного вузла та ідентифікація параметрів тупого гальма відскоку	Hydraulic node model and parameter identification of a dull recoil brake. Miao, W.; Qian, LF; Chen, LM. JOURNAL OF MECHANICAL SCIENCE AND TECHNOLOGY. 2022. Volume 36. Issue 11. Page 5511-5521.	This paper proposes a hydraulic node model for recoil brake. This model considers the compressibility and phase transition of recoil liquid by introducing a density-based piecewise equation of liquid state. For applying the hydraulic node model to a device named dull recoil brake, a least-squares parameter identification method based on the ant lion optimizer is used to determine the resistance coefficients. We measure the pressure responses of the dull recoil brake in firing tests on a 155 mm howitzer at two different working conditions and identify the resistance coefficients according to the pressure responses. Comparison between the simulations and the measurements verifies the hydraulic node model and the parameter identification result. This model shows remarkable performance in predicting the occurrence and magnitude of the hydraulic impacts. According to simulation results, we investigate the mechanism of the delayed retarding force and the secondary liquid impact. We find that the axial ending point of the crescent slots determines the moments when the recoil brake force rises and when the secondary liquid impact occurs.	https://www.webofscience.com/wos/woscc/full-record/WOS:000874449100003

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
5	Характеристика матеріалу вузла товкача блоку затворного механізму 155 мм гармати-гаубиці G5	Material Characterization of Follower Assembly of G5 155 mm Gun Howitzer Breach Mechanism Block. Nayan, AM; Idris, MR; Bakar, SRS; Ahmad, MY. JURNAL KEJURUTERAAN. 2021. Volume 4. Issue 1. Page 49-53.	Medium alloy steel is widely used as a material for guns and rocket launchers due to its high strength and excellent machinability characteristics. The purpose of this study is to determine the material properties of the follower assembly used in a breech block gun launcher which is significantly important for t he future product improvement. The microstructure and the effect of alloying elements in the follower assembly is evaluated in this study. The SPECTRO Optical Emission Spectroscopy (ES) method is used to analyse the chemical composition of the material and the Field Emission Scanning Electron Microscope coupled with Energy Dispersive X-Ray (FESEM-EDX) were used to analyse the inclusions of the sample. Results of the ES chemical composition analysis found that Nickel (Ni) is the major alloying elements beside Molybdenum (Mo), Chromium (Cr), Manganese (Mn), Silicon (Si), Sulphur (S), and Carbon (C) while chemical mapping and line scanning analysis of FESEM-EDX on inclusions distributed in the material microstructure identified as a compound of Manganese Sulphur(MnS). Fine dendritic microstructure arrangement and distribution in the microstructure analysis showed that the sample had been quenching in the heat treatment process, which also played a significant role in the material characterization. From the analysis, it is found that the material can be defined as medium alloy steel that is also typical for high strength material for ballistic application.	https://www.webofscience.com/wos/woscc/full-record/WOS:000712993100006
Інформатика				
1	Новий метод прицілювання снарядів зі стабілізацією обертання та детонатором корекції курсу, що приводиться в дію нерухомими передніми направляючими пристроями	Novel Aiming Method for Spin-Stabilized Projectiles with a Course Correction Fuze Actuated by Fixed Canards. Cheng, JS; Shen, Q.; Deng, ZW; Deng, ZL. ELECTRONICS. 2019. Volume 8. Issue 10, 1135.	Spin-stabilized projectiles with course correction fuzes actuated by fixed canards have the problem of great coupling in both the normal and lateral directions due to intensive gyroscopic effects, which leads to inconsistent maneuverability in different directions. Due to the limited correction ability, which results from the miniaturization of the fuze and fixed canards, a target-aiming method is proposed here to make full use of the correction ability of the canards. From analysis on how the canards work and building an angular motion model, the correction characteristics of a spinning projectile with fixed canards have been studied, and the inconsistent maneuverability in different directions of the projectile has been explained and used to help establish the proposed target aiming method. Hardware-in-the-loop simulation based on a 155 mm howitzer shows that when the correction ability of fixed canards is unchanged, the proposed method can improve the striking accuracy by more than 20% when compared to the traditional method.	https://www.webofscience.com/wos/woscc/full-record/WOS:000498262700075

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
2	Метод шифрування даних моніторингу для важеля передачі снарядів гаубиці з використанням зондування хаосу та стиснення	Monitoring data encryption method for howitzer shell transfer arm using chaos and compressive sensing. Liu, X; Hou, BL; Zhao, QQ. JOURNAL OF ALGORITHMS & COMPUTATIONAL TECHNOLOGY. 2019. Volume 13, 1748302619873598.	A novel data encryption method is presented for howitzer shell transfer arm using chaos and compressive sensing. Data are stored in the embedded fault diagnosis machine using chaos and compressive sensing, so the encrypted data are more secure in the embedded system and in the process of transmission with host computer. When the host computer extracts the operation data of the howitzer shell transfer arm monitored by the fault diagnosis machine, firstly, the encrypted data in the embedded diagnostic machine are read, then decrypted, and then the original signal is reconstructed by the orthogonal matching pursuit algorithm for further analysis and processing. The similarity degree between the reconstructed data and the original data is 0.947, the key space of the algorithm is (264)2048*200*(264)N, and the algorithm is sensitive to the key. The result shows that the method can effectively save a large number of confidential data.	https://www.webofscience.com/wos/woscc/full-record/WOS:000485244300001
3	Моделювання задачі синхронного цільового призначення зброї для оборонної лінії на основі гаубиць	Modeling of synchronous weapon target assignment problem for howitzer based defense line. Altinoz, OT. IEEE. 2020. CONGRESS ON EVOLUTIONARY COMPUTATION (CEC)	Weapon-target assignment (WTA) is a combinatorial optimization problem in the NP-hard category. The problem is to assign targets to weapons in order to ensure that the targets are eliminated with weapons in the most effective way. This problem, which can be discussed on different scenarios, is called static or dynamic according to the definition of the problem. In this study, the target value and hit probability values will be assigned according to the position of the target and the weapon. The WTA problem will be analyzed in different cases and solved using optimization algorithms. Howitzer will be chosen as weapon and four different types of targets will be offered to get solutions through different scenarios. Three different WTA problems will be examined. The first two scenarios will be solved with single-objective optimization algorithms, and the last case will be modeled as a multi-objective optimization problem.	https://www.webofscience.com/wos/woscc/full-record/WOS:000703998200089
4	Конститутивна модель в'язкопружного динамічного пошкодження матеріалу газового обтюратора модульно-зарядної гаубиці	Constitutive model of viscoelastic dynamic damage for the material of gas obturator in modular-charge howitzer. Li, ZG; Chen, LM; Li, YF; Jia, YF; Zhang, Q. DEFENCE TECHNOLOGY. 2024. Volume 39. Page 203-216.	In order to investigate the mechanical response behavior of the gas obturator of the breech mechanism, made of polychloroprene rubber (PCR), uniaxial compression experiments were carried out by using a universal testing machine and a split Hopkinson pressure bar (SHPB), obtaining stress-strain responses at different temperatures and strain rates. The results revealed that, in comparison to other polymers, the gas obturator material exhibited inconspicuous strain softening and hardening effects; meanwhile, the mechanical response was more affected by the strain rate than by temperature. Subsequently, a succinct viscoelastic damage constitutive model was developed based on the ZWT model, including ten undetermined parameters, formulated with incorporating three parallel components to capture the viscoelastic response at high strain rate and further enhanced by	https://www.webofscience.com/wos/woscc/full-record/WOS:001318217000001

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			integrating a three-parameter Weibull function to describe the damage. Compared to the ZWT model, the modified model could effectively describe the mechanical response behavior of the gas obturator material at high strain rates. This research laid a theoretical foundation for further investigation into the influence of chamber sealing issues on artillery firing.	
Матеріалознавство				
1	Проектування, аналіз, виготовлення та випробування композитного ствола гармати	Design, analysis, manufacturing, and testing of a composite gun barrel. Uyanik, MS; Soydan, AM; Yilmaz, A.; Ata, A. POLYMER COMPOSITES, 2024. Volume 45. Issue 13. Page 11804-11815.	User expects his weapon to be light and reliable and to perform multiple times firing per unit time at the same time. In today's technology, the maximum number of firings can be made per unit time with steel barreled weapons, but in composite barrels; many problems occur due to overheating, strength and reliability. Meeting these opposite demands is an engineering problem. In this study, the design of a composite-steel combination light gun barrel is studied. Firstly, pressure distribution through the barrel has been calculated using Vallier-Heydenreich method. According to the calculations, analysis has been conducted using both steel barrel and composite barrel. After the analysis, a composite barrel has been manufactured and testing has been conducted on an all-steel barrel and the manufactured composite barrel. Composite is carbon fiber and resin is epoxy resin. In composite material, carbon fiber is preferred at the rates of 50% and 60%, the material of the steel barrel is AISI 416R stainless steel. The manufactured steel barrels have the same outer diameter but different wall thickness ratios, firing tests were conducted in such a way that the number of shots per unit time was the same.Highlights Stress distribution within a gun barrel was calculated using Vallier-Heydenreich method. Design and finite element analysis analysis for an all-steel gun barrel and a composite gun barrel was conducted. A composite gun barrel was manufactured; by using composite materials, the barrel was lightened by 24.8%. The manufactured composite gun barrel and an all-steel gun barrel were tested by firing over 2500 shots.	https://www.webofscience.com/wos/woscc/full-record/WOS:001231725000001
2	Підхід до аналізу конструктивної цілісності ствола гармати-гаубиці на основі механіки руйнування	A fracture-mechanics-based approach to the analysis of the structural integrity of a howitzer cannon barrel. Fasun, G.; Predan, J.; Gubeljak, N. TRANSACTIONS OF FAMENA. 2024. Volume 48. Issue 3. Page 37-52.	This study explores the determination of the critical crack depth in howitzer cannon barrels, which is essential for ensuring operational safety, particularly under high-press ure conditions during firing. The fracture-mechanics-based approach, emphasizing the stress intensity factor Ki, is employed to evaluate crack propagation. Specifically, the R6 procedure is applied to assess the failure assessment diagram (FAD), crucial for identifying critical pressures concerning varying crack shapes and depths. The study examines the utilization of high-strength steel 35NiCrMoV12-5 in two distinct heat treatments (materials A and B). Experimental tensile tests and measurements of	https://www.webofscience.com/wos/woscc/full-record/WOS:001252336000001

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			the critical stress intensity factor Kic were conducted on both materials. The Finite Element Method (FEM) using Abaqus/CAE software was used in combination with experimental res ults. The FEM model was used to analyses semielliptical cracks of different depths and two different shapes. Stress intensity factor distributions along the crack tip were derived, indicating the material resistance to crack propagation.	
Механіка				
1	Швидкий метод, заснований на глибокому навчанні, для прогнозування ударного навантаження кабіни гаубицею, встановленої на транспортному засобі	A fast method based on deep learning for predicting the impact load of vehicle-mounted howitzer cab. Zhou, MD; Qian, LF; Cao, CY; Chen, GS; Xu, YD; Wei, SC. ACTA MECHANICA SINICA. 2024. Volume 40. Issue 4, 123319.	In the topology optimization design and strength check of a vehicle-mounted howitzer cab, it is necessary to obtain plenty of impact load laws under different firing conditions. How to obtain the impact load on the cab quickly is one of the challenges in the design of a vehicle-mounted howitzer. In this paper, the deep learning (DL) method is introduced to solve the impact load on the cab. A fast prediction method for cab impact load based on a ConvLSTM multidimensional feature neural network is proposed. The calculation of the impact load on the cab under different operating conditions is achieved, and the solving speed is close to the real-time level. The numerical examples show that the accuracy of the DL model is comparable to that of traditional computational fluid dynamics (CFD) simulation, but the solving time is on the millisecond level. The computational efficiency has been greatly improved, with the potential for offline training and online computing. When there is a slight change in the morphology of the cab, the proposed model remains applicable. The results can quickly provide load conditions for cab strength checking and topology optimization, help to shorten the development period of a vehicle-mounted howitzer, and lay the foundation for the construction of a digital twin model of a vehicle-mounted howitzer system.	https://www.webofscience.com/wos/woscc/full-record/WOS:001198694600002
2	Аналіз втомної цілісності гаубиці-гармати з використанням методу механіки руйнування	Fatigue integrity analysis of a howitzer cannon by using a fracture mechanics approach. Fasun, G.; Chapetti, MD; Gubeljak, N. ENGINEERING FRACTURE MECHANICS. 2023. Volume 292, 109672.	This study focuses on analysing the integrity and fatigue life of a cannon barrel manufactured from the KATO1 alloy (35NiCrMoV12-5) using two different heat treatments. The analysis utilizes a fracture mechanics approach, primarily based on the concept of a fatigue resistance curve. To conduct the analysis, various essential variables were either experimentally measured or theoretically estimated. These variables include microstructural size, static strength, fracture toughness, fatigue threshold for long crack growth, short crack range, fatigue crack propagation properties and fatigue limit. The fatigue limits of both materials were determined experimentally through the thermographic method. The approach employed in this study has proven effective in quantifying the influence of these different variables on the fatigue resistance and overall life of the barrel, as well as its safe operating conditions. By considering these factors, it	https://www.webofscience.com/wos/woscc/full-record/WOS:001098140800001

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			becomes possible to define a safe domain for the utilization of the cannon barrel and estimate the fatigue life under unsafe conditions. Furthermore, the analysis has provided valuable insights into areas where improvements can be made to enhance the fatigue resistance of the barrel material. Notably, addressing the fatigue threshold for long cracks could yield significant benefits by increasing the critical crack length for a given maximum pressure. This improvement would enhance the durability of the barrel, ensuring better performance over an extended period of use.	
3	Методичний аналіз збільшення механічного опору пружини ударника в замку стрільника гаубиці калібру 152 мм	Method analysis on increasing the mechanical resistance of the firing pin spring in the firing lock of the 152 mm caliber howitzer. Agavriloaei, LP; Petrisor, SM. ACTA TECHNICA NAPOCENSIS SERIES-APPLIED MATHEMATICS MECHANICS AND ENGINEERING. 2024. Volume 67. Issue 4. Page 639-642.	The authors of this scientific paper wish for highlight, experimentally and analytically, the possibility of constructive optimization of the compression-loaded firing pin spring within the organological assembly of the closure mechanism for the 152 mm caliber howitzer MD. 1981. Modifications were made to the winding angles of the spring during a constructive optimization that implicitly increased its resistance, leading to analytical and graphically characteristic curves rendering the progress of specific constructive parameters.	https://www.webofscience.com/wos/woscc/full-record/WOS:001442810000005
4	Електричні та оптичні випробування генератора напівгорючої плазми за допомогою симулятора плазмового запалювання	Electrical and Optical Test of a Semi-Combustible Plasma Generator via a Plasma Ignition Simulator. Jin, Y. IEEE TRANSACTIONS ON PLASMA SCIENCE. 2022. Volume 50. Issue 9. Page 3016-3021.	Electrothermal-chemical (ETC) launch technology can considerably increase the ballistic performance and optimize the fire range and range overlap of a 155-mm unimodular charge howitzer. To discuss the plasma ignition process of a semi-combustible plasma generator (SCPG) with a special tubular semi-combustible medium, a plasma ignition simulator (PIS) for the 155-mm unimodular charge howitzer is designed and manufactured to provide a realistic chamber environment. The optical and electrical measurements of a hybrid arc controlled ablation (ACA) plasma are operated via several sensors, a high-speed digital camera, and a compact spectrometer. Test results show that the PIS can satisfy the design requirements of the research of the plasma ignition process. When the discharge voltage is 6.5 kV, hybrid plasma propagation in the simulator chamber is observed and detected. The electronic excitation temperature of the hybrid plasma is approximate to 15 860 K, and the hybrid plasma propagation velocity is approximate to 1000 m/s. These transient propagating hybrid plasmas are enough to ignite all unimodular charges in the chamber within 1.0 ms. The results provide an important reference for future ETC launch tests.	https://www.webofscience.com/wos/woscc/full-record/WOS:000846370300001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
5	Експериментальне та числове моделювання протипробивних властивостей мішеней з композитного бетону на основі волокнистої кераміки та реактивного порошка	Experimental and Numerical Simulation Study on the Antipenetration Properties of Fiber Ceramic-Reactive Powder Concrete Composite Targets. Zou, HH; Song, CM; Wang, MY; Wang, DR; Wen, DS. SHOCK AND VIBRATION. 2019, 7673437.	Composite materials have been demonstrated to possess excellent antipenetration capacities, but the existing studies have not involved the penetration characteristics of ceramic-concrete composite targets. To investigate the antipenetration mechanisms of fiber ceramic-reactive powder concrete (FC-RPC) composite targets, three pieces of FC-RPC composite targets were designed to perform penetration tests. Antipenetration tests were performed with a special howitzer with a diameter of 125mm. The test parameters, such as the impact velocity, failure pattern of projectiles, penetration depth, crater diameter, and failure model of targets, were obtained. It was found that the FC-RPC targets exhibited an excellent antipenetration capacity and failed in a ductile manner, the target caused an obvious erosion effect on projectiles at low speed (i.e., 375m/s), and the antipenetration performance of the composite target was improved by increasing the thickness of the FC target. Simultaneously, numerical simulations of FC-RPC targets subjected to projectile impact were carried out by using LS-DYNA codes. Separately, combined and integrated finite element models were used to analyze the effect of the fiber layer in the composite target. The numerical results of the combined model were in good agreement with the experimental data, and the reliabilities of simulation were validated. The differential protection factor of the FC-RPC targets was obtained based on the penetration tests and numerical simulation, and an empirical formula for multilayer targets was presented.	https://www.webofscience.com/wos/woscc/full-record/WOS:000461713700001
Системи автоматизованого управління				
1	Залежна від швидкості розтягування матеріалу обтураторної подушки модульної гаубиці: експериментальний та конститутивний аналіз	Rate-Dependent Tensile Behavior of Modular-Charge Howitzer Obturator Pad Material: Experimental and Constitutive Analysis. Li, ZG; Chen, LM; Chen, HB; Li, YZ. IEEE. INTERNATIONAL CONFERENCE ON MECHANICAL ENGINEERING AND POWER ENGINEERING, MEPE, 2022. Page 85-91.	The rate-dependent tensile behavior of the obturator pad used as breechblock in the modular-charge howitzer is investigated experimentally and theoretically. To accurately determine the mechanical characteristics of the obturator pad material, uniaxial tension tests are carried out. The results indicate that the mechanical properties of specimen are obviously dependent on the strain rate. A modified Zhu-Wang-Tang (ZWT) visco-hyperelastic constitutive model has been presented, in which the standard elastic component has been substituted with several hyperelastic models, based on the physical behavior features. The model parameters were determined by fitting the model to experimental data by the least squares method. The results show that the visco-hyperelastic constitutive model proposed is capable of accurately describing the uniaxial mechanical property of the material used to make obturator pads. This study will serve as a theoretical guide for solving the chamber sealing problem of a modular charge howitzer.	https://www.webofscience.com/wos/woscc/full-record/WOS:001016382000017

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
2	Перспективи використання безпілотних наземних транспортних засобів у артилерійській розвідці	Prospects for the Use of Unmanned Ground Vehicles in Artillery Survey. Ivan, J.; Sustr, M.; Pekar, O.; Potuzak, L. PROCEEDINGS OF THE 19TH INTERNATIONAL CONFERENCE ON INFORMATICS IN CONTROL, AUTOMATION AND ROBOTICS (ICINCO). 2022. Page 467-475.	The article deals with the currently realized research of a new survey vehicle of the Czech field artillery, which task will be support of the activity of autonomous and non-autonomous artillery weapon systems. The article describes the basic aspects of artillery survey together with the current progress of the project. Baseline for the article is description of current status of Czech artillery survey and the way it supports the artillery operations. The individual chapters then present the identified variants of the functionality of the gun navigation system and the resulting requirements for the capability of the unmanned artillery survey vehicle. Main focus of the article is to present specific approach which Czech armed forces have in terms of artillery use under degraded and GPS denied operations. All these proposals are presented according to current status of Czech artillery which transitions from non-autonomous 152mm howitzers to the new, NATO standard 155mm autonomous weapon systems.	https://www.webofscience.com/wos/woscc/full-record/WOS:000852751300053
3	Виявлення несправностей за допомогою ковзного режиму спостерігача та його застосування на підйомних сервосистемах	Faults Detection Using Sliding Mode Observer and Its Application on Elevating Servo Systems. Tian, LF; Qian, LF; Li, M.; Fu, JW. JOURNAL OF CONTROL SCIENCE AND ENGINEERING. 2019, 4173871.	The elevating servo system (ESS) of vehicle-mounted howitzer (VMH) is a typical closed-loop electrohydraulic position servo system, and the faults of its actuator and sensor seriously affect the safety and reliability of the system. In practice, model uncertainty, nonlinearities, unknown disturbance, and output noise present enormous challenges to conduct fault detection of the system. In the current paper, an online fault detection scheme using the sliding mode technology is proposed. Not only the derivation method of state equation and some common fault expressions but also a new design of sliding mode observer with the ability to eliminate the influences of the above factors on detection results is given. The observer's parameter matrices are obtained by the linear matrix inequality. To promote the fault detection capability, a statistical-based dynamic threshold is developed to detect actuator faults and sensor faults simultaneously. Finally, experimental studies are implemented on a test rig for validating the system model, and the results of four experiments show the effectiveness of proposed methods.	https://www.webofscience.com/wos/woscc/full-record/WOS:000493785800001
4	Аналіз надійності та діагностика несправностей мережі управління та контролю на основі методу Байєса-GO	Reliability Analysis and Fault Diagnosis of Command and Control Network Based on Bayes-GO Method. Yang, YY; Mu, HN; Yi, XJ; Yan, HM; Chen, GL. PROGNOSTICS AND SYSTEM HEALTH MANAGEMENT	The command and control network is the center of information collection and command release in modern information warfare, and its reliability will directly affect the outcome of the war. In this paper, the equipment and environmental factors in the command and control network are comprehensively considered, and Bayes-GO method is used to analyze the two-terminal reliability of the artillery command vehicle to command the howitzer to strike the target. According to its command and control path, the GO model is established, and the GO graph is transformed into the corresponding Bayesian network on the	https://www.webofscience.com/wos/woscc/full-record/WOS:000485048900020

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		CONFERENCE (PHM-PARIS), 2019. Page 114-120.	basis of the mapping rules between models. In accordance with the forward and backward inference calculation rules of the Bayesian network, the quantitative analysis results of the two-terminal reliability of the command and control network can be obtained, and the weak links of the system are diagnosed.	
5	Надійне узагальнене прогнозне керування положенням для ланцюгового обертового магазина з датчиком збурень	Robust generalised predictive position control for chain-type rotary shell magazine with disturbance observer. Zhou, GZ; Qian, LF; Zou, Q.; Sun, L.; Wei, K. IET ELECTRIC POWER APPLICATIONS. 2024. Volume 18. Issue 9. Page 1072-1082.	The realisation of fast position tracking control and strong robust control of the chain-type rotary shell magazine in the complex systems such as the large calibre howitzer has been the focus and challenge of research. The predictive control strategies can achieve a fast dynamic response, but it relies on the system model. By integrating the generalised predictive control method with sliding mode theory, a novel robust generalised predictive position control method is proposed. Firstly, a non-cascade position tracking controller is designed based on the continuous-time model of the systems; then, a sliding mode compensation structure is introduced to address the degradation of control performance due to load variations and external disturbances. The scheme utilises the sliding mode switching term to overcome the effects caused by the disturbances while preserving the fast dynamic response characteristics of the original predictive control. Moreover, the disturbance observer is designed to further enhance the robustness by producing corresponding compensation according to the perturbation quantity. The proposed controller has been validated in a shell magazine test bench, indicating its superior position control performance of the shell magazine under different load conditions. This manuscript is aimed to address the problem in the automatic loading system of artillery, where the position tracking accuracy of the chain-type rotary shell magazine is compromised due to the load variation and external disturbance under actual working conditions. The authors propose a non-cascade robust generalised predictive control method that extends the conventional generalised predictive control to the second order. Meanwhile, a sliding mode compensation structure is introduced to ensure extremely high tracking accuracy even in the face of wide-ranging load variations. Image.	https://www.webofscience.com/wos/woscc/full-record/WOS:001240484200001
Телекомунікації				
1	Пластична деформація осколково-фугасного снаряда калібру 155 мм під час пострілу з гаубиці з використанням методу скінченних елементів	Plastic Deformation of High Explosive Projectile 155 mm during Gun Launch Conditions using Finite Element Method. Ohol, RB; Parate, BA; Thakur, DSG. DEFENCE SCIENCE	The structural integrity of artillery projectile 155 mm high explosive Extended Range Full Bore (ERFB) boat tail designed for 155mm howitzer guns of 39, 45 and 52 calibre plays a key role inside the gun barrel. This projectile comprises a shell body, a driving band, a boat tail, nubs, an explosive, and a fuze. Plastic deformation of the projectile and stripping of driving band are not permitted, when	https://www.webofscience.com/wos/woscc/full-record/WOS:000916889500003

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		JOURNAL. 2022. Volume 72. Issue 6. Page 793-800.	projectile is fired. An investigational study is necessitated to check the plastic deformation of the projectile subjected to maximum propellant charge pressure. The aim of this study is to check the effective plastic deformation and affirm the structural integrity. A 3-D explicit dynamic structural analysis of 155 mm HE ERFB BT during gun launch conditions is carried out by finite element method using FE code ABAQUS/Explicit. To understand the non-linear mechanical behavior of the projectile, the true stress-strain curves of the materials are considered. The plastic behavior of the projectile subjected to the time-dependent loading is studied by using the von Mises plasticity model. The results reveal that the shell body and boat tail have no plastic deformation and the most stressed component is the driving band. The investigation has affirmed the structural integrity of the projectile during gun launch conditions.	
2	Визначення резервного зазору між обтюраторним кільцем та затвором у металевому обтюраторному механізмі гаубиці великого калібру	Determination of the Reserved Gap Between the Obturator Ring and the Breechblock in the Metallic Obturation Mechanism of a Large Caliber Gun Howitzer. Ding, SK; Wang, H.; Qin, WJ. DEFENCE SCIENCE JOURNAL. 2024. Volume 74. Issue 3. Page 381-388.	A reserved gap between the obturator ring and the breechblock in the obturation mechanism of a large -caliber gun is required in the locked state of the gun, which is the main cause of gas leakage. In this study, the finite element analysis of the dynamic contact between the obturator ring and the breechblock and the computational fluid dynamics (CFD) analysis of the high-pressure gas flow through the gap between the obturator ring and the breechblock are conducted. The results show that the smaller the reserved gap is, the shorter the time period during which the contact pressure is zero after the obturator ring contacts with the breechblock will be under a low -bore pressure condition. The results also demonstrate that the leakage flow at the outlet of the gap and the gas flow in the external domain increase with the reserved gap size, and the gas flow in the external domain decays rapidly if the reserved gap is less than or equal to 0.02 mm under a high bore pressure condition. Based on the simulation results, the appropriate reserved gap value is determined and adopted in the studied gun, and good results are achieved in the firing tests.	https://www.webofscience.com/wos/woscc/full-record/WOS:000124572740 0012
3	Дослідження впливу різних типів та особливостей нарізних стволів на дальність стрільби вогнепальної зброї	Investigation of the Effect of Various Types and Features of Grooved Barrels on the Range of Firearms. Pihtili, H.; Yildirim, R. DEFENCE SCIENCE JOURNAL. 2023. Volume 73. Issue 1. Page 11-19.	The research has focused on the innovations which can be performed in order to increase the range of cannons and howitzers. The most important parameter affecting the range of a weapon system is the velocity distribution in the barrel and finally the initial muzzle velocity. On the other hand, the most important parameters affecting the initial muzzle velocity of the bullet are the internal barrel pressure, internal barrel friction, mass of the bullet and weight of the bullet. Taking these parameters into consideration, it has been revealed that improvements could be made by designing and manufacturing new types of barrels, ammunition and certain parts. The advantages and disadvantages	https://www.webofscience.com/wos/woscc/full-record/WOS:000953384300 0002

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			experienced after such changes have been determined and studied theoretically and experimentally.	
Термодинаміка				
1	Метод розрахунку внутрішнього балістичного двофазного потоку з урахуванням віддачі ствола гаубиці	A calculation method of interior ballistic two-phase flow considering the recoil of gun barrel. Dong, XL; Rui, XT; Li, C.; Wang, Y.; Fan, LL. APPLIED THERMAL ENGINEERING. 2021. Volume 185, 116239.	The theory of interior ballistic two-phase flow (IBTPF) is the primary means to study the distributions of physical quantities in gun chamber. In previous calculations, the gun breech is usually simplified as a fixed wall boundary, totally ignoring the effect of gun barrel recoil on interior ballistic processes. Thus to truly describe the interior ballistic process of the self-propelled gun (SPG), the transfer matrix method of multibody system (MSTMM) is combined with the theory of IBTPF in this paper. By simultaneously solving the generalized coordinate equations of multibody system and the conservation equations of IBTPF, the gun barrel recoil is converted to the moving boundary of the gun breech, and a more accurate calculation method of IBTPF is established. The results show that the simulated vibration characteristics, dynamic response during launch as well as interior ballistic performance of the SPG are all in good agreement with test values. Compared with no recoil, the gun barrel motion affects the growth regularity of the chamber volume behind the projectile, and eventually results in the changes of interior ballistic performance indexes such as maximum breech pressure and muzzle velocity. Overall, this study provides a more accurate prediction and simulation tool to enable better insight into such complicated interior ballistic processes, which is of great significance to the launch safety analysis and subsequent ballistic calculations.	https://www.webofscience.com/wos/woscc/full-record/WOS:000607843900007
2	Вплив модифікованого методу, заснованого на русі віддачі, на внутрішні балістичні характеристики надлегкої артилерії високого та низького тиску	Effect of modified method based on recoil motion on interior ballistic performance of ultralight high-low pressure artillery. Kong, LQ; Wang, JX; Song, HP; Tang, K.; Chen, RM; Li, YB; Gong, HX; Cai, SY. CASE STUDIES IN THERMAL ENGINEERING. 2024. Volume 53, 103957.	Light gun is of unique application prospect for its low body mass and projectile initial velocity. In order to solve the problem of calculation error caused by the large free recoil velocity of light ar-tillery in traditional interior ballistic model, a more suitable internal ballistic model for ultralight artillery was proposed through the design and test of a light gun, the accuracy of the algorithm was verified. The model described the effect of the recoil motion of the gun on chamber pressure and projectile acceleration travel, which made the calculation result more accurate when the gun mass was lighter. Compared with the experimental data, the errors of the calculation results using the improved algorithm were 2.90 % and 0.33 % respectively, while that using the traditional al-gorithm were 20.38 % and 10.02 % respectively. At the same time, the extended calculation was carried out to analyze the impact of the buffer device on the interior ballistic performance. The result showed that the lighter the gun, the greater the improvement brought by the buffer device under the same mass and	https://www.webofscience.com/wos/woscc/full-record/WOS:001165363100001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			recoil resistance. When the mass of the projectile and the gun was both 3 kg, the resistance of 70 kN could increase the velocity of projectile by 16.2 %. Furthermore, the internal ballistic elements of the traditional algorithm and the improved algorithm were calcu-lated respectively under the same working conditions. It was found that when the mass of the gun is 8.567 times the mass of the bullet, the error of the two algorithms was less than 1 %, and the er -ror increased gradually with the mass ratio of gun and projectile decreasing.	
3	Модель гарячої точки для займання вибухового заряду полімерно-зв'язуючої вибухової речовини в умовах запуску	A Hotspot Model for PBX Explosive Charge Ignition in a Launch Environment. Liu, W.; Wang, GP; Rui, XT; Gu, J.; Zhao, X. COMBUSTION SCIENCE AND TECHNOLOGY. 2022. Volume 194. Issue 10. Page 1954-1972.	The research of explosive ignition mechanisms in the launch environment is significant to determine the launch safety of explosive charge. Based on the two-phase flow theory, the internal ballistic process and the projectile base pressures are calculated accurately. The stress history of PBX explosive during the 155 mm howitzer launching process is obtained based on the finite element method, and then the 1D hollow sphere pore-collapse model considering explosive chemical reaction, heat conduction, phase transition, and viscoplastic deformation processes can be developed, to describe the hot spot formation in explosive charge. Finally, a quantitative determination method with initial porosity as the index for explosive ignition is proposed, contributing to the launch safety determination and performance evaluation of explosive change.	https://www.webofscience.com/wos/woscc/full-record/WOS:000596350800001
4	Аеробалістична оптимізація далекобійних керованих боєприпасів	Aeroballistic optimization of long-range guided ammunition. Bagy, S.; Libsig, M.; Martinez, B.; Masse, B. INTERNATIONAL JOURNAL OF NUMERICAL METHODS FOR HEAT & FLUID FLOW. 2024. Volume 34. Issue 7. Page 2688-2708.	PurposeThis paper aims to describe the use of optimization approaches to increase the range of near-future howitzer ammunition. Design/methodology/approachThe performance of a gliding projectile concept is assessed using an aeroballistic workflow, comprising aerodynamic characterization and flight trajectory computation. First, a single-objective optimization is run with genetic algorithms to find the maximal attainable range for this type of projectile. Then, a multi-objective formulation of the problem is proposed to consider the compromise between range and time of flight. Finally, the aerodynamic model used for the gliding ammunition is evaluated, in comparison with direct computational fluid dynamics (CFD) computations. FindingsApplying single-objective range maximization results in a great improvement of the reachable distance of the projectile, at the expense of the flight duration. Therefore, a multi-objective optimization is implemented in a second time, to search sets of parameters resulting in an optimal compromise between fire range and flight time. The resulting Pareto front can be directly interpreted and has the advantage of being useful for tactical decisions. Research limitations/implicationsThe main limitation of the work concerns the aerodynamic model of the gliding ammunition, which was initially	https://www.webofscience.com/wos/woscc/full-record/WOS:001013893200001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			proposed as an alternative to reduce significantly the computational cost of aerodynamic characterization and enable optimizations. When compared with direct CFD computations, this method appears to induce an overestimation of the range. This suggests future evolution to improve the accuracy of this approach. Originality/valueTo the best of the authors' knowledge, this paper presents an original ammunition concept for howitzers, aiming at extending the range of fire by using lifting surfaces and guidance. In addition, optimization techniques are used to improve the range of such projectile configuration.	
5	Еволюція акустичної нелінійності при поширенні вибуху вогнепальної зброї на відкритому повітрі: про збереження нелінійної поведінки	Evolution of acoustic nonlinearity in outdoor blast propagation from firearms: On the persistence of nonlinear behavior. Billot, G.; Marinus, BG; Harri, K.; Moiny, F. JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA. 2024. Volume 155. Issue 2. Page 1021-1035.	Acoustic events exceeding a certain threshold of intensity cannot benefit from a linearization of the governing wave equation, posing an additional burden on the numerical modelling. Weak shock theory associates nonlinearity with the generation of high frequency harmonics that compensate for atmospheric attenuation. Overlooking the persistence of this phenomenon at large distances can lead to mispredictions in gun detection procedures, noise abatement protocols, and auditory risk assessment. The state-of-the-art mostly addresses aircraft jet noise, a stationary and largely random type of signal. The extension of such conclusions to muzzle blasts requires caution in considering their peculiar impulsive and broadband nature. A methodology based on the time and frequency analysis of an experimental dataset of eight calibres intends to find quantitative metrics linked to acoustic nonlinearity in outdoor muzzle blast propagation. Propagating three waveforms (SCAR-L 7.62 mm, Browning 9 mm, and Howitzer 105 mm) up to 300 [m] with the in-house numerical solver based on the nonlinear progressive wave equation, demonstrates that the propagation does not downgrade to truly linear.	https://www.webofscience.com/wos/woscc/full-record/WOS:001158292300004
ГАРМАТНА АРТИЛЕРІЯ				
Інженерія				
1	Моделювання та імітація процесу взаємодії кулі зі стволом для пошкодженого ствола гармати	Modeling and simulation of bullet-barrel interaction process for the damaged gun barrel. Shen, C.; Zhou, KD; Lu, Y.; Li, JS. DEFENCE TECHNOLOGY. 2019. Volume 15. Issue 6. Page 972-986.	In this paper, the influences of bore damage on the bullet-barrel interaction process and the mechanism of how bore damage results in the end of a machine gun barrel's service life were studied, which had seldom been paid attention to in the past several decades. A novel finite element mesh generation method for the damaged barrel and a new transient coupled thermo-mechanical finite element (FE) model, which were based on the damage data obtained through barrel life tests, were developed to simulate the interior ballistics process of a coupled bullet-barrel system. Additionally, user subroutine VUAMP was developed in the FE model in order to take the bullet base pressure brought by propellant gas into account. Good consistency between the simulation	https://www.webofscience.com/wos/woscc/full-record/WOS:000503235100017

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			results and the experimental results verified the preciseness of the proposed mesh generation method and the FE model. The simulation results show that the increase of bullet's initial disturbance at the muzzle and the variation of its surface morphology caused by bore damage are primarily responsible for the life end of this 12.7 mm machine gun barrel.	
2	Розробка багатофізичної чисельної імітаційної моделі для дослідження поширення термомеханічної втомної тріщини у автофретажованому стволі гармати	Development of multi-physics numerical simulation model to investigate thermo-mechanical fatigue crack propagation in an autofrettaged gun barrel. Hussain, N.; Qayyum, F.; Pasha, RA; Shah, MS. DEFENCE TECHNOLOGY. 2021. Volume 17. Issue 5. Page 1579-1591.	In this research, a detailed multi-physics study has been carried out by numerically simulating a solid fractured gun barrel for 20 thermo-mechanical cycles. The numerical model is based on thermal effects, mechanical stress fields and fatigue crack mechanics. Elastic-plastic material data of modified AISI 4340 at temperatures ranging from 25 to 1200 degrees C and at strain rates of 4, 16, 32 and 48 s-1 was acquired from high-temperature compression tests. This was used as material property data in the simulation model. The boundary conditions applied are kept similar to the working gun barrel during continuous firing. A methodology has been provided to define thermo-mechanically active surface-to-surface type interface between the crack faces for a better approximation of stresses at the crack tip. Comparison of results from non-autofrettaged and autofrettaged simulation models provide useful information about the evolution of strains and stresses in the barrel at different points under combined thermo-mechanical loading cycles in both cases. The effect of thermal fatigue under already induced compressive yield due to autofrettage and the progressive degradation of the accumulated stresses due to thermo-mechanical cyclic loads on the internal surface of the gun barrel (mimicking the continuous firing scenario) has been analyzed. Comparison between energy release rate at tips of varying crack lengths due to cyclic thermo-mechanical loading in the non-autofrettaged and autofrettaged gun has been carried out.	https://www.webofscience.com/wos/woscc/full-record/WOS:000706711300001
3	Вплив кількох структурних параметрів на внутрішню балістику на основі ортогональних методів випробувань	Influence of multiple structural parameters on interior ballistics based on orthogonal test methods. Hu, CB; Zhang, XB. DEFENCE TECHNOLOGY. 2019. Volume 15. Issue 5. Page 690-697.	Influence of multiple structural parameters on the performance of a gun launch system driven by high-pressure reactive gases is important for structural design and performance adjustment. A coupled lumped parameter model was utilized to predict the propellant combustion, and a dynamic finite element method was applied to approximate the mechanical interactions between the projectile and the barrel. The combustion and the mechanical interactions were coupled through a user subroutine interface in ABAQUS. The correctness and the capability of the finite element approximations in capturing small structural changes were validated by comparing predicted resistance with experiments. Based on the coupled model, the influence of structural parameters of a medium-caliber gun on the system	https://www.webofscience.com/wos/woscc/full-record/WOS:000496432300005

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			performance was investigated. In order to reduce the research costs, orthogonal tests were designed to investigate the comprehensive effects of the parameters. According to statistical analysis, the important order of the structural parameters on the launching process was obtained. The results indicate that the influence of the width of the rotating band stands out among the studied parameters in the gun. The work provides a method to investigate the influence of multiple parameters on system performance and gives guidance for controlling the system performance.	
4	Порохове паливо підвищеної енергії на основі гексогену для боєприпасів танкової гармати	RDX Based Enhanced Energy Propellant for Tank Gun Ammunition. Jaiswal, G.; Shaikh, MAR; Shelar, SD; Ramavath, V.; Roy, S. PROPELLANTS EXPLOSIVES PYROTECHNICS. 2020. Volume 45. Issue 3. Page 472-479.	Ammunition designers are faced now a day with the tasks of improving muzzle velocity (MV) to achieve required penetration as well as developing gun propellant with minimum variation of ballistics at extremes of temperatures so as to maintain safe chamber pressure of gun. In order to meet the requirement an optimized propellant composition containing RDX, energetic plasticizer, nitrocellulose (NC), cellulose acetate (CA) and additives referred as Enhanced Energy Propellant (EEP) was processed and evaluated theoretically and experimentally. Performance in respect of ballistic parameters (static and dynamic), sensitivity, thermal characteristics, thermal stability and mechanical properties were evaluated and compared with that of the conventional triple base propellant (TBP). Experimental data on comparative study indicated that the newly developed EEP is superior to existing TBP in terms of energy, stability and thermal properties while sustaining the safe chamber pressure of gun. Dynamic firing results show that, EEP requires lower charge mass (7.43 kg) and lesser chamber pressure (459 MPa) to realize MV at par with standard. This illustrates high energy of EEP.	https://www.webofscience.com/wos/woscc/full-record/WOS:000497101000001
5	Модель пошкодження зсувом міжфазної поверхні хромового покриття / сталевої підкладки під навантаженням термічної ерозії	An interface shear damage model of chromium coating/steel substrate under thermal erosion load. Li, XL; Zang, Y.; Lian, Y.; Ma, MY; Mu, L.; Qin, Q. DEFENCE TECHNOLOGY. 2021. Volume 17. Issue 2. Page 405-415.	The Cr-plated coating inside a gun barrel can effectively improve the barrel's erosion resistance and thus increase the service life. However, due to the cyclic thermal load caused by high-temperature gunpowder, micro-element damage tends to occur within the Cr coating/steel substrate interface, leading to a gradual deterioration in macro-mechanical properties for the material in the related region. In order to mimic this cyclic thermal load and, thereby, study the thermal erosion behavior of the Cr coating on the barrel's inner wall, a laser emitter is utilized in the current study. With the help of in-situ tensile test and finite element simulation results, a shear stress distribution law of the Cr coating/steel substrate and a change law of the interface ultimate shear strength are identified. Studies have shown that the Cr coating/steel substrate interface's ultimate shear strength has a significant weakening effect due to increasing temperature. In this	https://www.webofscience.com/wos/woscc/full-record/WOS:000632640700008

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			study, the interfacial ultimate shear strength decreases from 2.57 GPa (no erosion) to 1.02 GPa (laser power is 160 W). The data from this experiment is employed to establish a Cr coating/steel substrate interface shear damage model. And this model is used to predict the flaking process of Cr coating by finite element method. The simulation results show that the increase of coating crack spacing and coating thickness will increase the service life of gun barrel.	
Інформатика				
1	Адаптивне керування, що спрацьовує за подіями, для систем керування танковою гарматою	Event-Triggered Adaptive Control for Tank Gun Control Systems. Cai, JP; Yu, R.; Yan, QZ; Mei, CL; Wang, BR; Shen, LJ. IEEE ACCESS. 2019. Volume 7. Page 17517-17523.	In this paper, an event-triggered adaptive control scheme is proposed for the gun control system of a tank subject to not only external disturbances but also uncertain modeling errors and unknown parameters. Compared with the existing results, the upper bound function of modeling errors is unknown. Therefore, the traditional event-triggered control method cannot be applied directly to handle the effect caused by the modeling errors. To solve this problem, a smooth function sg(.) is introduced to estimate the bound of modeling errors, such that their effects on system stability are successfully compensated. The simulation results are provided to illustrate the effectiveness of the proposed control scheme.	https://www.webofscience.com/wos/woscc/full-record/WOS:000459163200001
2	Ітеративне навчання на основі нейронної мережі з відстеженням помилок для систем керування танковою гарматою з довільними початковими станами.	Neural Network-Based Error-Tracking Iterative Learning Control for Tank Gun Control Systems With Arbitrary Initial States. Yang, QY; Yan, QZ; Cai, JP; Tian, JH; Guan, XH. IEEE ACCESS. 2020. Volume 8. Page 72179-72187.	In this paper, a novel neural network-based error-track iterative learning control scheme is proposed to tackle trajectory tracking problem for tank gun control systems. Firstly, the system modeling for tank gun control systems is introduced as a preparation of controller design. Then, the reference error trajectory is constructed to deal with the nonzero initial error of iterative learning control. The adaptive iterative learning controller for tank gun control systems is designed by using Lyapunov approach. Adaptive learning neural network is adopted to approximate nonlinear uncertainties, with robust control technique being used compensate the approximation error and external disturbances. As the iteration number increases, the system error can follow the desired error trajectory over the whole time interval, which makes the system state accurately track the reference error trajectory during the predetermined part time interval. Numerical simulations demonstrate the effectiveness of the proposed iterative learning control scheme.	https://www.webofscience.com/wos/woscc/full-record/WOS:000530816700003
3	Адаптивне ітеративне навчання керуванням танковою гарматою для сервосистем з зоною нечутливості вхідних сигналів	Adaptive Iterative Learning Control for Tank Gun Servo Systems With Input Deadzone. Zhang, YT; Yan, QZ; Cai, JP;	In this paper, an adaptive iterative learning control scheme is proposed to solve the trajectory-tracking problem for tank gun servo systems with input deadzone and arbitrary initial states. A time-varying boundary layer is constructed to deal with the nonzero initial error during the iterative learning controller design. Neural network control	https://www.webofscience.com/wos/woscc/full-record/WOS:000530832200069

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		Wu, XS. IEEE ACCESS. 2020. Volume 8. Page 63443-63451.	and robust control are jointly used to compensate uncertainties and deadzone nonlinearity. The ideal weight of neural network and the upper bound of noncontinuous uncertainties are estimated by using difference learning method. As the iteration number increases, the filtering error can converge to the time-varying boundary layer. All signal are guaranteed to be bounded. A simulation example is presented to verify the effectiveness of the proposed scheme.	
4	Надійне керування навчанням для сервосистем керування танковою гарматою за умови вирівнювання	Robust Learning Control for Tank Gun Control Servo Systems Under Alignment Condition. Zhu, GM; Wu, XS; Yan, QZ; Cai, JP. IEEE ACCESS. 2019. Volume 7. Page 145524-145531.	This paper proposes an adaptive learning control scheme to solve high-precision velocity tracking problem for tank gun control servo systems. Lyapunov approach is used to design the learning controller, with alignment condition used to cope with initial problem of iterative learning control. Robust control technique and adaptive learning control technique are synthesized to handle nonlinear uncertainties and external disturbances. The unknown parameters are estimated according to the full saturation difference learning strategy. As the iteration number increases, the system state can accurately track the reference signal over the whole time interval, and all signal are guaranteed to be bounded.	https://www.webofscience.com/wos/woscc/full-record/WOS:000498815100002
5	Бар'єрне адаптивне ітеративне навчання систем керування танковою гарматою за умови ненульової початкової помилки	Barrier Adaptive Iterative Learning Control for Tank Gun Control Systems Under Nonzero Initial Error Condition. Zhou, ZM; Wang, W.; Zhang, YT; Yan, QZ; Cai, JP. IEEE ACCESS. 2022. Volume 10. Page 8664-8672.	In this paper, a barrier adaptive iterative learning control scheme is proposed to solve the trajectory-tracking problem for tank gun control systems under nonzero initial error condition. A novel construction method of rectified reference trajectory is presented for dealing with the initial position problem of iterative learning control for tank gun control systems. With a quadratic form barrier Lyapunov function adopted to controller design, the quadratic form of system error is constrained within the preset range during each iteration. Adaptive iterative learning control technique and robust control technique are jointly used to compensate for the parametric/nonparametric uncertainties and nonsymmetric deadzone nonlinearity. As the iteration number increases, the system state of tank gun control systems may accurately track the rectified reference trajectory, which leads to a excellent tracking performance during the part operation interval of tank gun control systems. Simulation results are presented to verify the effectiveness of the proposed barrier adaptive iterative control scheme.	https://www.webofscience.com/wos/woscc/full-record/WOS:000796718800001
Матеріалознавство				
1	Аналіз ерозії ствола гармати та прогнозування терміну служби за типових умов стрільби	Erosion analysis of machine gun barrel and lifespan prediction under typical shooting conditions.	The operational lifespan of a conventional weapon, such as artillery or machine gun, highly depends on the performance of its barrel. The bore of a machine gun is exposed to erosion as the number of rounds fired increases, which results in continuous increases in barrel diameter and	https://www.webofscience.com/wos/woscc/full-record/WOS:000513001800021

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		Li, XL; Zang, Y.; Mu, L.; Lian, Y.; Qin, Q.. WEAR. 2020. Volume 444, 203177.	thus an undesired degradation in ballistic performance. In this study, a critical isothermal erosion model for a machine gun barrel is established, and a numerical simulation method is used to study the bore erosion under typical shooting conditions. The current study confirms the presence of thermal-chemical erosion as a predominant failure mechanism at the starting point of the barrel rifling. It is also noted that this thermal-chemical erosion zone expands with the increase in the number of shots fired. Increases in firing frequency, and ambient temperature, and a decrease in the interval between cartridges are found to aggravate the erosion of the barrel bore. By fitting the calculated results, a formula for predicting the maximum erosion at the starting point of the barrel rifling is constructed. The predicted results demonstrate acceptable deviations from the experimental ones, which verify the accuracy and feasibility of the newly developed method in predicting machine gun barrel lifespan.	
2	Мікроструктура та властивості керамічних термобар'єрних покриттів YSZ-Al2O3 для військового застосування	Microstructure and properties of YSZ-Al_2O_3 functional ceramic thermal barrier coatings for military applications. Ramesh, M.; Marimuthu, K.; Karuppuswamy, P.; Rajeshkumar, L. BOLETIN DE LA SOCIEDAD ESPANOLA DE CERAMICA Y VIDRIO. 2022. Volume 61. Issue 6. Page 641-652.	Current study renders its focus on the investigation of functionally graded Yttria Stabilized Zirconia (YSZ) and alumina (Al2O3) thermal barrier coatings (TBC) deposited on EN steel substrates used in gun barrel through atmospheric plasma spray (APS) process. A bond coat and the top coats was made with two distinct compositions using YSZ-Al2O3 in 75:25 and 50:50 weight ratio through APS process with two carrier gas concentrations of 3 and 4 standard cubic feet per hour (scfh). Coatings were characterized with thermal testing, X-ray Diffraction (XRD) and Field Emission Scanning Electron Microscope examination (FESEM). Surface roughness test, wear and scratch test of the uncoated and coated steel specimens was also measured. YSZ-Al2O3 coated EN36C steel possessed greater insulation performance under a carrier gas flow rate of 3 scfh compared to all other specimens. EN36C steel coated with YSZ-Al2O3 in the ratio of 75:25 has better wear and scratch resistance indicating lesser deformation compared to other materials.	https://www.webofscience.com/wos/woscc/full-record/WOS:000928290400009
3	Лазерне зміцнення підвищує трибологічну стійкість електроосаджених хромових покриттів, армованих стабілізованим оксидом цирконію та вуглецевими нанотрубками.	Laser peening enhances tribological resistance of electrodeposited Cr coatings reinforced with yttria stabilized zirconia and carbon nano tubes. Tripathi, P; Ramkumar, J.; Balani, K. SURFACE & COATINGS TECHNOLOGY. 2019. Volume 378, 124919.	Current work analyses the effect of laser shock peening on four different chromium based electrochemical coatings i.e. Cr coating, Cr reinforced with 3 mol% yttria stabilized zirconia nanoparticles i.e. Cr-YSZ, Cr reinforced with carbon nanotubes i.e. Cr-CNT, and synergistic reinforcement of YSZ and CNT in Cr i.e. Cr-YSZ-CNT. The coatings were prepared in order to improve mechanical properties as well as wear resistance for gun barrel applications. Cr coating exhibited an increase in hardness from similar to 8 GPa to similar to 9.4 GPa and maximum hardness value of up to similar to 26 GPa was observed for Cr-YSZ-CNT as a result of laser peening. The enhanced hardness can	https://www.webofscience.com/wos/woscc/full-record/WOS:000503100800021

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			be ascribed to high compressive residual stresses ranging from similar to 634-1757 MPa, induced by laser shock peening treatment. Fretting wear test results into minimum wear rate of similar to 1.8 x 10(-5) mm(3)/Nm for Cr-YSZ-CNT, also maximum dislocation density of similar to 3.0 x 10(12) cm(-2) which accrue on synergistic reinforcement with YSZ and CNT. The overall performance of coatings in terms of mechanical and tribological properties improved after laser peening, indicated by reduction in wear constant of composite coatings by three orders of magnitude in comparison to that of un-peened Cr coating. YSZ incorporation leads to the Cr matrix strengthening and multifunctional nature of CNTs leads to lubrication of the matrix. Also, intense network of CNTs inhibits the crack propagation. In the nut shell, collaborative role of YSZ and CNT in Cr matrix in addition to laser peening treatment result in establishing Cr-YSZ-CNT as superior coating material competent to limit the problems of wear and erosion not only in defence sector but its applicability can be extended to various fields such as aerospace, automotive, gas turbines, etc.	
4	Термомеханічний аналіз деградації міцності матеріалу ствола гармати 30SiMn2MoVA під час безперервної стрільби	Thermo-mechanical analysis of strength degradation of 30SiMn2MoVA gun barrel material during continuous shooting. Chen, JY; Wang, WJ; Jin, PF; Dou, CH; Zhao, C.; Li, Q.; Zhang, C. ENGINEERING FAILURE ANALYSIS. 2022. Volume 139, 106438.	The internal bore of a machine gun barrel is subjected to the complex effects of cyclic hightemperature and mechanical loadings during the continuous shooting process, resulting in the accumulation of bore damages and eventually the end of the lifespan. The correlation between the ballistic performances and the material properties is a critical issue for the development of gun barrels with a long lifespan. However, it is still not fully understood yet. In this study, the thermomechanical analysis of the strength degradation of 30SiMn2MoVA gun barrel steel during continuous shooting is investigated. Irregular rifling deformation of the failed machine gun barrel with a 12.7 mm caliber was observed. Mechanical tensile tests revealed that severe softening occurs in the 30SiMn2MoVA steel when the temperature exceeded 600 degrees C, where the yield strength decreased significantly from 862 MPa at room temperature to 114 MPa at 700 degrees C. Transmission electron microscope observations further revealed that the recrystallization of martensitic lath and the growth of cementite softened the gun barrel steel. Moreover, the finite element models are established using the Abaqus software for the evolution of the temperature and stress of the internal wall within 180 cycles. This shows that the peak temperature increases to 730-740 degrees C and the peak total stress exceeds 246 MPa during 170-180 cycles, which is much higher than the yield strength of 30SiMn2MoVA gun barrel steel. Therefore, the strength of gun	https://www.webofscience.com/wos/woscc/full-record/WOS:000812227800001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			barrel steel at 700 degrees C can be suggested as the key parameter for the development of long-life gun barrels for continuous shooting.	
5	Більш детальний огляд прецизійного твердого точіння сталі AISI4340: багатоцільова оптимізація для одночасно низької шорсткості поверхні та високої продуктивності	A Closer Look at Precision Hard Turning of AISI4340: Multi-Objective Optimization for Simultaneous Low Surface Roughness and High Productivity. Abbas, AT; Al-Abduljabbar, AA; Alnaser, IA; Aly, MF; Abdelgaliel, IH; Elkaseer, A. MATERIALS. 2022. Volume 15. Issue 6, 2106.	This article reports an extended investigation into the precision hard turning of AISI 4340 alloy steel when machined by two different types of inserts: wiper nose and conventional round nose. It provides a closer look at previously published work and aims at determining the optimal process parameters for simultaneously minimizing surface roughness and maximizing productivity. In the mathematical models developed by the authors, surface roughness at different cutting speeds, depths of cut and feed rates is treated as the objective function. Three robust multi-objective techniques, (1) multi-objective genetic algorithm (MOGA), (2) multi-objective Pareto search algorithm (MOPSA) and (3) multi-objective emperor penguin colony algorithm (MOEPCA), were used to determine the optimal turning parameters when either the wiper or the conventional insert is used, and the results were experimentally validated. To investigate the practicality of the optimization algorithms, two turning scenarios were used. These were the machining of the combustion chamber of a gun barrel, first with an average roughness (Ra) of 0.4 mu m and then with 0.8 mu m, under conditions of high productivity. In terms of the simultaneous achievement of both high surface quality and productivity in precision hard turning of AISI 4340 alloy steel, this work illustrates that MOPSA provides the best optimal solution for the wiper insert case, and MOEPCA results are the best for the conventional insert. Furthermore, the results extracted from Pareto front plots show that the wiper insert is capable of successfully meeting both the requirements of Ra values of 0.4 mu m and 0.8 mu m and high productivity. However, the conventional insert could not meet the 0.4 mu m Ra requirement; the recorded global minimum was Ra = 0.454 mu m, which reveals the superiority of the wiper compared to the conventional insert.	https://www.webofscience.com/wos/woscc/full-record/WOS:000775009500001
Механіка				
1	Динамічний аналіз напружень анізотропного ствола гармати під дією зв'язаних термомеханічних навантажень методом скінченних елементів	Dynamic stress analysis of anisotropic gun barrel under coupled thermo-mechanical loads via finite element method. Yang, YZ; Zhang, XY; Xu, C.; Fan, LX. LATIN AMERICAN JOURNAL OF SOLIDS AND	This work focused on the stress response of anisotropic 30SiMn2MoVA steel gun barrel under coupled thermo-mechanical loads, namely, the contact pressure and friction of projectile, thermal load and pressure of propellant gas. The effect of temperature on the mechanical properties of gun barrel was considered. Two thermal-displacement coupled finite element models (FEM) were built by ABAQUS software. The first was the interaction model of projectile and barrel which was to calculate the stress of barrel engraved by	https://www.webofscience.com/wos/woscc/full-record/WOS:000514609000005

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		STRUCTURES. 2020. Volume 17. Issue 1, e243.	copper jacket and steel jacket projectile. The results of barrel in the interaction model, as an initial condition, were imported to the second FEM which was applied with thermal load and pressure of propellant gas. The results show that the rifling at chamber throat has the largest stress and circumferential stress under coupled loads. It gives a request that the gun barrel should have the better circumferential mechanical properties. The plastic deformation of the rifling at the chamber throat is observed which indicates that 30SiMn2MoVA gun barrel has a low service life due to the poor mechanical properties.	
2	Аналіз вібраційних характеристик ствола танкової гармати з неоднорідним поперечним перерізом	Vibration characteristics analysis of tank gun barrel with non-uniform cross-section. Wang, X.; Rui, XT; Wang, JH; Zhang, JS; Wu, GY; Gu, JJ. ACTA MECHANICA SINICA. 2022. Volume 38. Issue 6, 521368.	The firing accuracy of a tank gun is affected significantly by the flexural motion of the barrel. For the purpose of satisfying the requirement of efficiently and accurately dynamic analysis and optimization of the tank gun barrel to ensure it has good dynamic characteristics and firing accuracy, the high-fidelity dynamic model of a tank gun barrel is developed according to the transfer matrix method for multibody system which has features of high degree of stylization and high computational speed. The transfer matrix of the non-uniform Euler-Bernoulli beam (NU-EB beam) is deduced from governing differential equations of motion utilizing the differential transform method. The orthogonality of augmented eigenvectors for the NU-EB beam is proven which can be used for its exact dynamics response analysis using the modal method. In allusion to the tank gun barrel with non-uniform cross-section, the barrel is modeled as a combination of several uniform and non-uniform transverse vibrating Euler-Bernoulli beams. The overall transfer equation and matrix of the tank gun barrel are established according to the automatic deduction theorem of the overall transfer equation of multibody system. The present method is proven to be effective by comparing the computational results to those in published literatures. The vibration characteristics of a tank gun barrel with a non-uniform cross-section are analyzed accurately and are verified by the modal test.	https://www.webofscience.com/wos/woscc/full-record/WOS:000811214000014
3	Дослідження механічної поведінки композитного електромагнітного ствола гармати на основі обмотки високої напруги	Investigation on mechanical behavior of composite electromagnetic gun barrel based on the high tension winding. Zu, L.; Xu, H.; Zhang, Q.; Jia, XL; Jin, SM; Li, DB. COMPOSITE STRUCTURES. 2020. Volume 248, 112521.	In this paper, a design of the non-axisymmetric composite electromagnetic gun barrel is proposed. A finite ele-ment model is established to simulate the mechanical behaviors of the composite electromagnetic gun barrel based on equivalent temperature cooling method. In the process of analysis, the effect of fiber tension, curing times and interaction between each composite layer are discussed. The results show that with increase of fiber layers, the fiber tension of inner layer will be released continuous, and the trend also exists between pre-cured layers. When winding layer is 118, the maximum radial displacement of the core is 0.549 mm under the action of	https://www.webofscience.com/wos/woscc/full-record/WOS:000552864700006

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			electromagnetic repulsion (6MN). And the conclusions can be used as a reference foe design of composite electromagnetic gun barrel.	
4	Уніфікована розрахункова модель термохімічної ерозії та механічного зносу артилерійського ствола з урахуванням гідродинамічного тертя	Unified computational model of thermochemical erosion and mechanical wear in artillery barrel considering hydrodynamic friction. Li, SL; Wang, LQ; Yang, GL. NUMERICAL HEAT TRANSFER PART A-APPLICATIONS. 2023. Volume 86. Issue 4. Page 777-797.	Erosion wear of the artillery barrel is divided into two primary categories: thermochemical erosion and mechanical wear. However, the majority of studies concerning this subject matter emphasize the former, and the latter has not been given enough consideration. To describe the coupling relationship of thermochemical erosion and mechanical wear, this article is inspired by the frictional behavior between the barrel and the projectile and proposes a material degradation model for thermochemical erosion considering frictional temperature rise. Under the coupling of the forced heat convection of high-temperature propellant gas and frictional heat, the friction state between the barrel and the projectile is changed from dry friction to hydrodynamic friction, resulting in a novel mechanical frictional wear model. Subsequently, numerical simulations of the thermochemical erosion and mechanical wear models are carried out. The results show that the erosion wear of the artillery barrel is divided into four regions along the axial direction: thermochemical erosion, thermochemical-mechanical erosion, transition, and mechanical wear regions. Four regions are concentrated in the interval of [0 mm, 500 mm], [500 mm, 1750 mm], [1750 mm, 4000 mm] and [4000 mm, 6800 mm], respectively.	https://www.webofscience.com/wos/woscc/full-record/WOS:000108579870 0001
5	Дослідження механізму дренажу нового ствола гармати та характеристик взаємоінтерференції газу та рідини	Research on the drainage mechanism of a novel gun barrel and the characteristics of gas-liquid mutual interference. Zhang, X.; Yu, YG; Zhang, XM; Zhang, XW. PHYSICS OF FLUIDS. 2024. Volume 36. Issue 6, 063323.	An underwater shooting method with a novel barrel structure featuring spiral grooves is designed by opening multiple spiral grooves on the gun barrel's tail inner wall, and the combustion-gas flows are guided to create multiple gas jets that are sprayed into the barrel to form a gas curtain for water drainage. A three-dimensional unsteady multiphase mathematical model was created, and the correctness of the numerical model established was verified by comparing it with the experimental results of underwater gun gas curtain drainage visualization. On this basis, the influence of different spiral grooves on the evolution process of gas jet and liquid and the drainage effects were simulated. The results indicate that the phase change happens in close proximity to the gas-liquid boundary; nonetheless, the volume percentage of vapor generated by phase change during gas-liquid interaction is less than 1%. The more grooves there are, the greater the maximum pressure at each moment inside the fully filled circular tube; the temperature at the front end of the circular tube becomes higher. When the number of grooves is increased from 4 to 6, the drainage completion time is shortened by 29.7%, the amount of gas in the	https://www.webofscience.com/wos/woscc/full-record/WOS:001247042400 0004

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			circular barrel increased by 5.2%, and the drainage rate is significantly increased. However, as the amount of grooves increased from 6 to 8, the gas volume fraction and drainage rate in the tube only increased slightly. On the contrary, it takes a little more time to complete the drainage.	
Системи автоматизованого управління				
1	Динамічне моделювання керування вібраціями маршевої танкової гармати на основі адаптивного робастного керування	Dynamic simulation on vibration control of marching tank gun based on adaptive robust control. Chen, Y.; Yang, GL; Sun, QZ. JOURNAL OF LOW FREQUENCY NOISE VIBRATION AND ACTIVE CONTROL. 2020. Volume 39. Issue 2. Page 416-434.	In order to better understand the dynamic behavior and decrease the muzzle vibration of marching tank, a mechanical-electrical-hydraulic integrated dynamic model of marching tank was established based on a novel dynamic co-simulation method. The hydraulic system model was modeled in Amesim and the dynamic model of marching tank was established in RecurDyn based on multi-body system theory, vehicle terramechanics, and gun launch dynamics. The control system model was modeled in MATLAB/Simulink. Therein, the adaptive robust control algorithm was introduced to design the vertical stabilizer controller and the simulation program of the designed controller was developed by C language. The simulation results show that the muzzle vibration of marching tank can be controlled effectively by the ARC method. Furthermore, the muzzle error compensation signal was added in the designed controller to weaken the detrimental effect of the barrel flexibility on muzzle vibration. This work provides an approach to investigate the dynamic behavior of marching tank considering effects among the mechanical, hydraulic, and control subsystems.	https://www.webofscience.com/wos/woscc/full-record/WOS:000535753400013
2	Надійне керування наведенням маршевої танкової гармати з узгодженою та неузгодженою невизначеністю	Robust Pointing Control of Marching Tank Gun With Matched and Mismatched Uncertainty. Sun, QQ; Wang, XY; Yang, GL; Chen, YH; Duan, P. IEEE TRANSACTIONS ON CYBERNETICS. 2022. Volume 52. Issue 8. Page 7303-7318.	This article focuses on a robust control scheme for pointing control of the marching tank gun. Both matched and mismatched uncertainties, which may be nonlinear (possibly fast) time varying but bounded, are considered. First, the pointing control system is constructed as a coupled, nonlinear, and uncertain dynamical system with two interconnected (horizontal and vertical) subsystems. Second, for the horizontal pointing control, robust control is proposed to render the horizontal subsystem to be practically stable. Third, for the vertical pointing control, an uncertainty bound-based state transformation is constructed in a similar way of backstepping to convert the original mismatched system (i.e., the vertical subsystem) to be locally matched and then robust control is proposed to render the transformed system to be practically stable. Finally, it is proved that when the transformed system is rendered to be practically stable, the original system renders the same performance; therefore, vertical pointing control is achieved. This work should be among the first ever endeavor to cast all the coupling, nonlinearity, and (both matched and mismatched)	https://www.webofscience.com/wos/woscc/full-record/WOS:000732876400001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			uncertainty into the pointing control framework of the marching tank gun.	
3	Активне придушення перешкод, адаптивне керування системами керування баштою та гарматою танка	Active Disturbance Rejection Adaptive Control of Tank Turret-gun Control Systems. Yuan, SS; Yao, JY; Deng, WX; Yang, GL; Ma, X. PROCEEDINGS OF THE 39TH CHINESE CONTROL CONFERENCE. 2020. Page 333-339.	Aiming at parametric uncertainties and unmodeled disturbances of tank turret-gun control systems, this paper presents an adaptive control scheme via full state feedback. The basic idea of this control scheme is to combine adaptive control with extended state observer through hack stepping method. The control scheme can effectively improve the stabilization accuracy of the marching tank. Based on the interaxial coupling nonlinear dynamic model of the tank turret-gun systems, an extended state observer is constructed to observe the unmodeled disturbance of the systems in real time to suppress its adverse effects and a parameter adaptive law is designed to learn and compensate the parametric uncertainties of the tank turret-gun control systems. The proposed active disturbance rejection adaptive control algorithm can simultaneously deal with the parametric uncertainties and unmodeled disturbances of the tank gun control systems. As a result, it can avoid the problem of high-gain feedback and improve the servo performance of the tank turret-gun control system. The controller theoretically has asymptotic tracking performance in the presence of parametric uncertainties and constant disturbances. In addition, prescribed transient tracking performance and final tracking accuracy can also he guaranteed when existing time-variant uncertain nonlinearities. A large number of comparative simulation results are obtained to verify the high performance nature of the proposed control strategy.	https://www.webofscience.com/wos/woscc/full-record/WOS:000629243500058
4	Система керування танковою гарматою з нелінійним механізмом зв'язку двигуна та механізму на основі адаптивного радіального базисного функціонального нейронного зв'язку, оптимізованого обчислювальним керуванням крутним моментом	Nonlinear motor-mechanism coupling tank gun control system based on adaptive radial basis function neural network optimised computed torque control. Zheng, HQ; Rui, XT; Zhang, JS; Gu, JJ; Zhang, SJ. ISA TRANSACTIONS. 2022. Volume 131. Page 222-235.	This study investigates the spatial pointing control of a motor-mechanism coupling tank gun. The tank gun control system (TGCS) is driven and stabilised by the motor servo system. However, complicated nonlinearities in the TGCS are inevitable, such as friction, parameter uncertainty, and modelling errors. To solve this problem, the TGCS is regarded as a coupling system composed of mechanical, motor, and control systems. Accordingly, the mechanical and motor models of the marching tank gun are developed first in this paper. The motor-mechanism coupling dynamics model is established based on the principle of equivalent torque. On this basis, a computed torque controller, whose uncertainty was estimated using a radial basis function neural network (RBFNN), is constructed. A modified adaptive algorithm is used to estimate the weights of the RBFNN, and the estimation error of the uncertain observer is compensated by a compensation controller. Simulation results under different conditions	https://www.webofscience.com/wos/woscc/full-record/WOS:000904651500001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			validated the effectiveness of the proposed control system, revealing that the proposed control system has good tracking accuracy, strong adaptability, and robustness.	
5	Покращено моделювання та активне керування придушенням перешкод у системі керування танковою гарматою	Improved modeling and active disturbance rejection control of tank gun control system. Zheng, HQ; Rui, XT; Zhang, JS; Zhang, SJ; Gu, JJ. PROCEEDINGS OF THE INSTITUTION OF MECHANICAL ENGINEERS PART I-JOURNAL OF SYSTEMS AND CONTROL ENGINEERING. 2022. Volume 236. Issue 9. Page 1649-1666.	In order to improve the stability control performance of the tank barrel at high speed, a new 2-degree-of-freedom nonlinear dynamics model of yaw and pitch bodies is established, taking into account the 6-degree-of-freedom motion of the tank chassis. By analyzing the direction of the tank barrel in space, the barrel stability control scheme for the tank gun control system with the arbitrary motion of the tank chassis in space is realized. The new dynamics equations of the tank gun control system are established by analytical mechanics. It effectively solves the problem of modeling methods for the tank gun control system in azimuth and elevation when considering the 6-degree-of-freedom motion of tank chassis. Then, an improved active disturbance rejection control strategy for tank gun control system is proposed. A smooth nonlinear function f(aln)(center dot) is constructed to avoid the switching problem of the function f(al)(center dot) at the piecewise points. Next, an improved extended state observer is designed based on the deviation principle by means of the deviation between each state variable and its observation. Afterwards, the stability of the system is analyzed by constructing a Lyapunov function. Simulations were carried out with different input signals to verify the reliability of the dynamics model and control algorithm. The improved active disturbance rejection control has a faster response speed and smaller steady state error. The results show that the stability and tracking performance of the tank gun control system has been improved using the proposed method.	https://www.webofscience.com/wos/woscc/full-record/WOS:000821094000001
Телекомунікації				
1	Проблема відстеження в системах керування танковою гарматою з періодичними опорними сигналами	The Tracking Problem in Tank Gun Control Systems With Periodic Reference Signals. Tian, JH; Yan, QZ; Cai, JP; Guan, XH. IEEE ACCESS. 2020. Volume 8. Page 132086-132094.	In this paper, the position tracking control for tank gun control systems with periodic reference signal is studied. On the basis of corresponding system modeling, a novel repetitive controller is developed by using Lyapunov synthesis. During the controller design, signal replacement mechanism is used to deal with the nonparametric uncertainties under Lipschitz-like continuous condition, and repetitive learning laws are developed to estimate the unknown periodic parameters. Meanwhile, robust learning approach is used to compensate the sum of random disturbances, whose upper bound is estimated according repetitive learning mechanism. Hyperbolic tangent function, rather than sign function, is applied to design a robust feedback term to release the occurrence of chattering phenomenon. Numerical simulations	https://www.webofscience.com/wos/woscc/full-record/WOS:000552981900001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			demonstrate the effectiveness of the proposed repetitive control scheme.	
2	Вплив магнітно обмеженої плазми на дульну швидкість снаряда гармати	Influence of Magnetically Confined Plasma on the Muzzle Velocity of Gun Projectile. Wang, Y.; Ma, TH.; Pei, DX; Chen, CX; Feng, KQ; Zhang, DB; Wu, ZB. IEEE ACCESS. 2020. Volume 8. Page 72661-72670.	Under the influence of gun barrel design, materials, and propellant, improving pirojectile muzzle velocity is the bottleneck in gun development. An innovative method based on magnetically confined plasma theory was therefore proposed to improve the projectile muzzle velocity. Compared with the traditional methods for increasing the projectile muzzle velocity, the method proposed in this study has a simpler design structure, a broad applicability to different caliber guns with lower cost, and an obvious effect on improving muzzle velocity. The core idea was to use the magnetic field to constrain the plasma generated by gunpowder combustion ionization in the gun bore to increase the projectile bottom pressure, thereby increasing the projectile muzzle velocity. First, the mechanism of increasing the projectile muzzle velocity by magnetically confined plasma in the gun barrel was analyzed. Second, a new gunpowder gas thermal ionization model was established based on interior ballistic and plasma theories. The fourth-order Runge-Kutta algorithm was used to numerically simulate the changes in plasma density and conductivity during the combustion ionization of gunpowder. The effects of different ionized seed contents and propellant forces on the density and conductivity of plasma were numerically simulated to improve the ionization efficiency of gunpowder. Adding ionized seeds or propellant force improves the ionization efficiency of gunpowder, increases the binding force of the magnetic field on plasma, and enhances the projectile muzzle velocity. Finally, shooting tests were performed with a test barrel. Experimental results verified the correctness of the theoretical analysis and numerical simulation.	https://www.webofscience.com/wos/woscc/full-record/WOS:000530827300033
3	Бар'єрний нейроадаптивний підхід до динамічного поверхневого керування для систем керування танковою гарматою з вхідним насиченням	A Barrier Neuroadaptive Dynamic Surface Control Approach for Tank Gun Control Systems With Input Saturation. Zhu, GM; Wu, XS; Cai, JP; Yan, QZ; Gao, SY. IEEE ACCESS. 2023. Volume 11. Page 43536-43545.	In harsh battlefield environments, tanks have to encounter some nonlinear characteristics including frictional moment, gear backlash and parameter drifts, etc. The existence of such nonlinear characteristics makes the controller design of tank gun control systems (TGCSs) challenging. In this paper, a barrier neuroadaptive control approach is proposed to handle the uncertainties and nonlinearities, so as to achieve satisfactory tracking performance for TGCSs. With a time-varying barrier Lyapunov function employed in controller design, the output error of TGCS is restricted within the preset bound during the control process. A radial basis function (RBF) neural network is built to approximate the uncertainties in tank gun control systems. An anti-windup control strategy is developed to deal with the input saturation nonlinearity, with a Nussbaum function used to compensate	https://www.webofscience.com/wos/woscc/full-record/WOS:000986537900001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			for the nonlinear term arising from input saturation. By reasonably applying filtering error into output-constrained adaptive backstepping control design, the three steps in the traditional backstepping control design are reduced to two steps. The asymptotic stability of the closed-loop TGCSs is proven by Lyapunov theory. Finally, a simulation example is presented to verify the effectiveness of the proposed control scheme.	
4	Нечітке системне ітеративне навчання відстеження позиції для систем керування танковою гарматою з обмеженнями на помилки	Fuzzy System-Based Position Tracking Iterative Learning Control for Tank Gun Control Systems With Error Constraints. Hong, Z.; Yan, QZ; Wu, XS; Cai, JP. IEEE ACCESS. 2022. Volume 10. Page 52462-52471.	In order to get accurate position tracking and effective system constraint together for tank gun control systems, a fuzzy system-based barrier adaptive iterative learning control scheme is proposed. Firstly, the error tracking strategy is applied to solve the initial position problem of tank gun iterative learning control systems. Then, a barrier Lyapunov function is adopted to controller design for the system constraint. In addition, a fuzzy system is used as an approximator to compensate for the nonparametric uncertainties, and difference learning learning approach is used to estimate the optimal parameters of fuzzy systems. It is shown that the system constraints are guaranteed and position tracking error converges to a tunable residual set as the iteration number increases.	https://www.webofscience.com/wos/woscc/full-record/WOS:000801999800001
5	Адаптивне робустне керування стійкістю повністю електричної танкової гармати з компенсацією за допомогою радіально-базисної нейронної мережі	Adaptive Robust Stability Control of All-Electrical Tank Gun Compensated by Radial Basis Neural Network. Wang, YM; Yuan, SS; Sun, QZ; Wang, XY; Yang, GL. IEEE ACCESS. 2023. Volume 11. Page 115968-115985.	Stability control of the tank gun has emerged as a pivotal issue for moving tank gun control systems (TGCS). As a complex electromechanical integrated system, TGCS of moving tank inevitably possesses significant parametric uncertainties and uncertain nonlinearities. To effectively enhance the stabilization control performance of TGCS, in this study, we introduce an adaptive robust control (ARC) strategy based on radial basis function neural network (RBFNN) compensation. The adaptive technique is employed to address the parametric uncertainties, while the RBFNN is constructed to approximate the uncertain nonlinearities and realize feedforward compensation. Subsequently, to suppress the residual uncertainties, a nonlinear robust feedback control rate is devised to strengthen the robustness of the developed controller. Lyapunov analysis shows that the proposed controller achieves uniform ultimate bounded stability. Extensive simulation and electromechanical experimental results confirm the effectiveness of the proposed controller, which shows outstanding performance in handling strong parametric uncertainties and uncertain nonlinearities.	https://www.webofscience.com/wos/woscc/full-record/WOS:001091425000001
Термодинаміка				
1	Метод розрахунку внутрішнього балістичного двофазного потоку з	A calculation method of interior ballistic two-phase flow	The theory of interior ballistic two-phase flow (IBTPF) is the primary means to study the distributions of physical quantities in gun chamber.	https://www.webofscience.com/wos/woscc/full-

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
	урахуванням віддачі ствола гармати	considering the recoil of gun barrel. Dong, XL; Rui, XT; Li, C.; Wang, Y.; Fan, LL. APPLIED THERMAL ENGINEERING. 2021. Volume 185, 116239.	In previous calculations, the gun breech is usually simplified as a fixed wall boundary, totally ignoring the effect of gun barrel recoil on interior ballistic processes. Thus to truly describe the interior ballistic process of the self-propelled gun (SPG), the transfer matrix method of multibody system (MSTMM) is combined with the theory of IBTPF in this paper. By simultaneously solving the generalized coordinate equations of multibody system and the conservation equations of IBTPF, the gun barrel recoil is converted to the moving boundary of the gun breech, and a more accurate calculation method of IBTPF is established. The results show that the simulated vibration characteristics, dynamic response during launch as well as interior ballistic performance of the SPG are all in good agreement with test values. Compared with no recoil, the gun barrel motion affects the growth regularity of the chamber volume behind the projectile, and eventually results in the changes of interior ballistic performance indexes such as maximum breech pressure and muzzle velocity. Overall, this study provides a more accurate prediction and simulation tool to enable better insight into such complicated interior ballistic processes, which is of great significance to the launch safety analysis and subsequent ballistic calculations.	record/WOS:000607843900007
2	Експериментальний та чисельний аналіз термохімічної ерозії гарматної сталі	Experimental and numerical analysis of thermo-chemical erosion in gun steel. Rezgui, N.; Mickovic, DM; Zivkovic, SZ; Ivanovic, IB. THERMAL SCIENCE. 2019. Volume 23. Issue 2. Page 599-612.	Various factors of thermo-chemical erosion process in gun steel were analysed. The factors are mainly related to the thermal load of gun barrel inside surface, characteristics of barrel surface and chemical interactions between propellant combustion products and barrel surface. The experimental simulation of conditions in gun barrel was carried out by vented vessel firings in the device based on modification of 37 mm M39 gun. The nozzle mass loss during firing was the measure of gun steel erosion. The main thermal factor of erosion is maximum nozzle inner surface temperature. This temperature was determined experimentally by micro thermocouples measurements at specified distance away from the inner surface and by numerical analysis of the inverse heat conduction problem. Modelling of two-phase flow of propellant combustion products and unburned propellant grains in the vented vessel and heat transfer to the nozzle were conducted using developed 1-D interior ballistic code and CFD simulation in FLUENT. Influence of different propellants, TiO2/wax wear reducing liner and tungsten-disulfide nanoparticles layer on nozzle erosion was analysed. Good agreement between experimental and computational results was achieved.	https://www.webofscience.com/wos/woscc/full-record/WOS:000462414100016

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
3	Модель внутрішнього балістичного двофазного потоку та її розрахунок для структури змішаного заряду	Interior ballistic two-phase flow model and its calculation for a mixed charge structure Dong, XL; Rui, XT; Li, C. INTERNATIONAL COMMUNICATIONS IN HEAT AND MASS TRANSFER. 2023. Volume 144, 106788.	The mixed charge for guns generally consists of two or more kinds of propellants. Medium and large caliber guns usually adopt the typical combination of tubular and granular propellants, not only meeting interior ballistic indexes but also improving launch safety. However, numerical investigations, charge design, and optimizations of such charge structures rely heavily on classical interior ballistic theory. To gain insight into some crucial phenomena in this complex interior ballistic process, a two-phase flow dynamic model of a 125 mm smoothbore gun with mixed charge (granular propellants, tubular propellants, and a combustible cartridge case) is developed. Unlike the previous form of solid governing equations, the conservation equations, surface temperature and combustion law functions are simultaneously established. The space-time conservation element and solution element (CE/SE) method is used to solve the mathematical model, simplifying the calculations of partial derivatives in source terms. Results show that the model can describe the combustion and flow, and the predicted projectile velocity agrees well with the measured one. In addition, the effects of the mass ratio of mixed propellants on interior ballistic performance are discussed in detail. As the tubular propellant mass decreases, ignition consistency deteriorates, particle accumulation intensifies, and the maximum pressure exceeds the permitted one, all of which may affect launch safety. The work in this paper provides a powerful tool for observing and predicting the interior ballistic process of the mixed charge.	https://www.webofscience.com/wos/woscc/full-record/WOS:000103063850001
4	Визначення розподілу температури стінок ствола гармати та його експериментальне підтвердження під час процесу стрільби кількома пострілами	Determination of the gun barrel walls temperature distribution and its experimental validation during multiple-shots firing process. Abaci, WB; Hristov, N.; Ahmed, NZ; Jerkovic, D.; Drakulic, M. INTERNATIONAL JOURNAL OF THERMAL SCIENCES. 2022. Volume 179, 107667.	The different parameters of the combustion gases mixture were calculated allowing the calculation of the heat convection coefficient between the gases and the bore surface of the gun barrel. The heat conduction in the barrel was reduced to two axisymmetric problems. It was solved numerically using one-dimensional and twodimensional heat conduction equations. Experiments were conducted to measure the exterior gun wall temperatures using thermal camera. The agreement between the measured and the calculated results enable the validation of the calculation models for both the gases parameters and the temperature distribution in the gun barrel.	https://www.webofscience.com/wos/woscc/full-record/WOS:000808359500003
5	Нова структура для запобігання ерозії ствола, спричиненої тепловими ефектами в рушійній системі	A novel structure to inhibit barrel erosion induced by thermal effects in a propulsion system. Wang, YT; Ding, SK; Zhang, XB. INTERNATIONAL COMMUNICATIONS IN	Barrel erosion induced by thermal effects is an unavoidable issue in gun propulsion systems driven by internal combustion. Different from traditional schemes, a flow-collecting groove was proposed to inhibit barrel erosion induced by thermal effects. A coupled model of propellant combustion in a propulsion system was presented. The model can obtain both flow behaviors of combustion products and transient heat conduction in gun barrels. To validate the coupled model,	https://www.webofscience.com/wos/woscc/full-record/WOS:001060964100001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		HEAT AND MASS TRANSFER. 2023. Volume 147, 106991.	numerical results were compared with analytical solutions. Based on the coupled model, the inhibition mechanism of the flow-collecting groove on barrel erosion was discussed. Results show that the groove changes the flow characteristics of fluid near the barrel surface. Meanwhile, the groove decreases the temperature peak of the gun barrel, which has a beneficial effect on the thermal safety of guns. Furthermore, the performances of grooves with different collecting cone angles were discussed to optimize the structural design. Finally, the inhibition effect of the groove on barrel erosion was verified by experiment. The use of the flowcollecting groove can reduce barrel erosion by 50%. The findings have a deep understanding of barrel erosion and will be used in the design of gun propulsion systems.	
Реактивна артилерія				
Інженерія				
1	Стратегії маневрування проникнення балістичних ракет на основі глибокого навчання з підкріпленням	Maneuvering penetration strategies of ballistic missiles based on deep reinforcement learning. Qiu, XQ; Gao, CS; Jing, WX. PROCEEDINGS OF THE INSTITUTION OF MECHANICAL ENGINEERS PART G-JOURNAL OF AEROSPACE ENGINEERING. 2022. Volume 236. Issue 16. Page 3494-3504.	In this paper, a ballistic missile terminal penetration scenario is studied, which contains three participants: target, missile, and defender. The ballistic missile attempts to hit the target while evading the defender. A maneuvering penetration guidance strategy that balances both the guidance accuracy and penetration capability is proposed through deep reinforcement learning. Reward shaping and random initialization are applied to improve training speed and generalization, respectively. The proposed strategy is developed based on the twin delayed deep deterministic policy gradient algorithm. It directly maps observations to actions and is an end-to-end guidance scheme that does not require an accurate model. The simulation results show that the proposed strategy has higher penetration probabilities than conventional strategies for different initial heading errors and even for defenders with different guidance laws, which indicates its good robustness and generalization. For different initial heading errors, it has learned different maneuvering modes and has certain intelligence. In addition, it is computationally small, does not consume much memory, and can be easily applied on modern flight computers.	https://www.webofscience.com/wos/woscc/full-record/WOS:000789257900001
2	Чисельне дослідження теплових навантажень під час маневру зворотного руху надзвукової ракети	Numerical Study on the Thermal Loads During a Supersonic Rocket Retropropulsion Maneuver. Ecker, T.; Karl, S.; Dumont, E.; Stappert, S.; Krause, D. JOURNAL OF SPACECRAFT AND ROCKETS. 2020. Volume 57. Issue 1. Page 131-146.	The return and vertical landing of the first launch stage is a concept enabling reusable launch systems and has been successfully applied by SpaceX with the Falcon 9. The Falcon 9 first stage descends by two or three phases of retropropulsion. Especially the supersonic retropropulsion phase, using three of its nine engines, is of interest because it exhibits conditions close to Mars reentry. During retropropulsion, the first stage is partially submerged in the hot exhaust plume. In this study, a generic model based on the Falcon 9's features and dimensions is used to perform a numerical investigation of the	https://www.webofscience.com/wos/woscc/full-record/WOS:000511884100011

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			plume-vehicle interaction. Using large-eddy simulation and Reynolds-averaged Navier-Stokes equations (RANS)-based computational methods, the flowfield is characterized at different trajectory points during retropropulsion. Based on several steady RANS calculations, an aerothermal database is created and coupled into a simple finite element structural heating model of the casing. The results show that, despite the high gas temperatures, the low gas density leads to a manageable heat flux and only a moderate temperature increase on the cylindrical walls when using conventional aluminum materials.	
3	Чисельне дослідження керування вектором ударної хвилі в прямокутному надзвуковому соплі	Numerical study on the shock vector control in a rectangular supersonic nozzle. Wu, K Кім (Wu, Kexin) [1] Kim, HD (Kim, Heuy Dong). PROCEEDINGS OF THE INSTITUTION OF MECHANICAL ENGINEERS PART G-JOURNAL OF AEROSPACE ENGINEERING. 2019. Volume 233. Issue 13. Page 4943-4965.	In recent decades, the fluidic thrust vector control technique is one of the core strategies to redirect various aerospace vehicles, such as modern launch rockets, supersonic aircraft, and guided missiles. The fundamental theory of the shock vector control is that the gas is injected into the supersonic part of a conventional convergent-divergent nozzle from the transverse to cause interactions between the shock waves and boundary layers. Then, the deflection of the primary jet can be easily realized by the induced oblique shock waves. It was evident that the shock vector control is a very simple, low weight, low cost, and quick vectoring response technique to gain high thrust vectoring performance. In the present work, computational fluid dynamics studies were performed at different control parameters in a three-dimensional rectangular supersonic nozzle with the slot injector. For the validation of the numerical methodology, computational results were compared with experimental data referred to the NASA Langley Research Center. The static pressure distributions along the upper and lower nozzle surfaces in the symmetry plane were matched with the test data excellently. Numerical simulations were based on the well-assessed shear stress transport k-omega turbulence model. Second-order accuracy was selected to reveal more details of the flow-field as much as possible. Lots of factors were investigated, such as the momentum flux ratio, length-to-width ratio, injection location, and injection angle. The performance variations for different affecting factors were illustrated and some constructive conclusions were obtained to provide the reference for further investigations in fluidic thrust vector control field.	https://www.webofscience.com/wos/woscc/full-record/WOS:000483493400020
4	Прогнозування траєкторії балістичних ракет з використанням моделі помилок гаусівського процесу	Trajectory prediction of ballistic missiles using Gaussian process error model. Ji, RP; Liang, Y.;.Xu, LF.; Wei, ZW. CHINESE JOURNAL OF AERONAUTICS. 2022.	Ballistic Missile Trajectory Prediction (BMTP) is critical to air defense systems. Most Trajectory Prediction (TP) methods focus on the coast and reentry phases, in which the Ballistic Missile (BM) trajectories are modeled as ellipses or the state components are propagated by the dynamic integral equations on time scales. In contrast, the boost-phase TP is more challenging because there are many unknown forces acting	https://www.webofscience.com/wos/woscc/full-record/WOS:000792553500008

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		Volume 35. Issue 1. Page 458-469.	on the BM in this phase. To tackle this difficult problem, a novel BMTP method by using Gaussian Processes (GPs) is proposed in this paper. In particular, the GP is employed to train the prediction error model of the boost-phase trajectory database, in which the error refers to the difference between the true BM state at the prediction moment and the integral extrapolation of the BM state. And the final BMTP is a combination of the dynamic equation based numerical integration and the GP-based prediction error. Since the trained GP aims to capture the relationship between the numerical integration and the unknown error, the modified BM state prediction is closer to the true one compared with the original TP. Fur -thermore, the GP is able to output the uncertainty information of the TP, which is of great signif-icance for determining the warning range centered on the predicted BM state. Simulation results show that the proposed method effectively improves the BMTP accuracy during the boost phase and provides reliable uncertainty estimation boundaries.	
5	Багатопрофільне проектування та оптимізація крилатих архітектур для багаторазових ракет-носіїв	Multidisciplinary design and optimization of winged architectures for reusable launch vehicles. Balesdent, M.; Brevault, L.; Paluch, B.; Thépot, R.; Wuilbercq, R.; Subra, N.; Defoort, S.; Bourgaie, M.; Vieille, B (Vieille, Bruno). ACTA ASTRONAUTICA. 2023. Volume 211. Page 97-115.	Partially reusable launch vehicle design has raised a great interest in order to minimize the costs of space transportation by recovering and refurbishing the first stage. Several configurations such as toss-back architectures are now operational. These concepts require additional rocket propellant in order to carry the boost-back and landing maneuvers, that induce several losses in terms of payload mass performance for the ascent mission. In order to limit these losses, this paper focuses on the design of two types of architectures to carry out the return-to-launch-site mission. The first, named glide-back, uses the main propulsion system of the first stage to perform a boost-back burn and returns to the landing site by a gliding mode using additional lifting surfaces. The second, named, fly-back, performs the return-to-launch-site mission using several air -breathing engines located in the nose of the first stage combined with lifting surfaces. In this paper, the design of a reusability kit, allowing to provide the first stage with both expendable and reusable capabilities, is investigated. This kit is composed of the lifting surfaces, the nose including the air-breathing propulsive system (for fly-back configuration), landing gears and additional avionics. This paper addresses the design of such reusability kits and presents the mission specifications, the design process relying on Multidisciplinary Design Optimization techniques, the vehicle performance and the optimal trajectories. Different analyses (aero-propulsive, optimal control, operational considerations, etc.) are detailed and trade-offs between the studied configurations are assessed.	https://www.webofscience.com/wos/woscc/full-record/WOS:001022900800001
Інформатика				

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
1	Наближений підхід динамічного програмування для порівняння правил стрільби в мережевому середовищі протиповітряної оборони	An approximate dynamic programming approach for comparing firing policies in a networked air defense environment. Summers, DS.; Robbins, MJ.; Lunday, BJ. COMPUTERS & OPERATIONS RESEARCH. 2020. Volume 117, 104890.	An objective for effective air defense is to identify the firing policy for interceptor allocation to incoming missiles that minimizes the expected total damage to defended assets over a sequence of engagements. We formulate this dynamic weapon target assignment problem as a Markov decision process and utilize a simulation-based, approximate dynamic programming (ADP) approach to solve problem instances based on a representative scenario. Least squares policy evaluation and least squares temporal differences algorithms are developed to determine approximate solutions. A designed experiment investigates problem features such as conflict duration, attacker and defender weapon sophistication, and defended asset values. An empirical comparison of the ADP policies and two baseline policies (i.e., firing either one or two interceptors at each incoming theater ballistic missile (TBM)) yields several insights: the ADP policies outperform both baseline polices when conflict duration is short and attacker weapons are sophisticated; firing one interceptor at each TBM (regardless of inventory status) outperforms the tested ADP policies when conflict duration is long and attacker weapons are less sophisticated; and firing two interceptors at each TBM (regardless of inventory status), which is the United States Army's currently implemented policy, is never the superlative policy for the test instances investigated. Published by Elsevier Ltd.	https://www.webofscience.com/wos/woscc/full-record/WOS:000519653000008
2	Адаптивна модель призначення зброї цілі на основі прогнозування ймовірності влучання в реальному часі	Adaptive Weapon-to-Target Assignment Model Based on the Real-Time Prediction of Hit Probability. Jang, J.; Yoon, HG; Kim, JC; Kim, CO. IEEE ACCESS. 2019. Volume 7. Page 72210-72220.	Weapon-to-target assignment (WTA), which minimizes the damage to our forces by launching interceptor missiles (weapons) against ballistic missiles of the enemy (targets), is a critical decision-making problem of ballistic missile defense missions. The primary objective is to launch an interceptor with a high hit probability for each target. The existing research on WTA assumes that the hit probability is known before an engagement regardless of whether the probability varies during the engagement. However, the hit probability in actual engagement situations is a time-dependent variable that changes in accordance with the flight states of the target and interceptor that are unknown in advance. Therefore, a rolling horizon-based decision approach is necessary. In this research, we propose an adaptive WTA (AWTA) model that makes WTA decisions at each radar scanning time based on the hit probability predicted using radar information about the engagement situation-for each target, an interceptor with a hit probability higher than a threshold is launched, thereby maximizing the total hit result. A machine learning model is suggested to learn the probabilistic relationship between the flight states and hit results, and this model is embedded in the solution procedure of the AWTA model. The performance of the AWTA model is evaluated via a simulation-	https://www.webofscience.com/wos/woscc/full-record/WOS:000472185400001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			based experiment, and the results confirm that the proposed AWTA model is appropriate for real-time engagement situations.	
3	Реалізація проникнення в середині курсу за допомогою глибокого навчання з підкріпленням	Realizing Midcourse Penetration With Deep Reinforcement Jiang, L; Nan, Y; Li, ZH. IEEE ACCESS. 2021. Volume 9 89812-89822.	A midcourse maneuver controller is obtained using deep reinforcement learning to maintain the survivability of a ballistic missile. First, the midcourse is abstracted as a Markov decision process (MDP) with an unknown system state equation. Then, a controller formed by the Dueling Double Deep Q (D3Q) neural network is used to approximate the state-action value function of the MDP. In order to make the controller's intelligence improved by deep reinforcement learning, the state space, action space, and instant reward function of the MDP are customized. The controller uses a real-time situation as input and outputs the ignition states of pulse motors. Offline training shows that deep reinforcement learning can achieve the optimal strategy's convergence after approximately 65 hours. Online tests demonstrate the controller's ability to avoid an interceptor intelligently and to account for an entry error. In scenarios with multiple random factors, the controller achieved a penetration probability of 100% and a mean re-entry error of less than 5000 m.	https://www.webofscience.com/wos/woscc/full-record/WOS:000673652600001
4	Одновимірна згорткова нейронна мережа з груповим об'єднанням для розпізнавання профілю дальності балістичної цілі з високою роздільною здатністю та пошаровими допоміжними класифікаторами	Group-Fusion One-Dimensional Convolutional Neural Network for Ballistic Target High-Resolution Range Profile Recognition with Layer-Wise Auxiliary Classifiers. Xiang, Q.; Wang, XD; Lai, J.; Song, YF.; Li, R.; Lei, L. INTERNATIONAL JOURNAL OF COMPUTATIONAL INTELLIGENCE SYSTEMS. 2023. Volume 16. Issue 1, 190.	Ballistic missile defense systems require accurate target recognition technology. Effective feature extraction is crucial for this purpose. The deep convolutional neural network (CNN) has proven to be an effective method for recognizing high-resolution range profiles (HRRPs) of ballistic targets. It excels in perceiving local features and extracting robust features. However, the standard CNN's fully connected manner results in high computational complexity, which is unsuitable for deployment in real-time missile defense systems with stringent performance requirements. To address the issue of computational complexity in HRRP recognition based on the standard one-dimensional CNN (1DCNN), we propose a lightweight network called group-fusion 1DCNN with layer-wise auxiliary classifiers (GFAC-1DCNN). GFAC-1DCNN employs group convolution (G-Conv) instead of standard convolution to effectively reduce model complexity. Simply using G-Conv, however, may decrease model recognition accuracy due to the lack of information flow between feature maps generated by each G-Conv. To overcome this limitation, we introduce a linear fusion layer to combine the output features of G-Convs, thereby improving recognition accuracy. Additionally, besides the main classifier at the deepest layer, we construct layer-wise auxiliary classifiers for different hierarchical features. The results from all classifiers are then fused for comprehensive target recognition. Extensive experiments demonstrate that GFAC-1DCNN with such	https://www.webofscience.com/wos/woscc/full-record/WOS:001111136500001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			simple and effective techniques achieves higher overall testing accuracy than state-of-the-art ballistic target HRRP recognition models, while significantly reducing model complexity. It also exhibits a higher recall rate for warhead recognition compared to other methods. Based on these compelling results, we believe this work is valuable in reducing workload and enhancing missile interception rates in missile defense systems.	
5	Нейронні мережі на основі довготривалої короткочасної пам'яті для прогнозування траєкторій маневрів ракет	Long Short-Term Memory-Based Neural Networks for Missile Maneuvers Trajectories Prediction. IEEE ACCESS. IEEE,2023. Volume 11. Page 30819-30831	Due to its extensive applications in different contexts, moving target tracking has become a hot topic in the last years, above all in the military field. Specifically, missile tracking research received a great effort, mainly for its importance in terms of security and safety. Herein, traditional solutions, e.g. Interacting Multiple Model (IMM) based on the Kalman estimation theory, achieve good performance under the main restrictive assumption of the a priori knowledge of the target model, so neglecting the unavoidable presence of model uncertainties and limiting the achievable tracking accuracy only by the presence of the measurement noise. With the specific aim of overcoming this narrowness, this work investigates the capability of deep neural networks in predicting the missile maneuvering trajectories in a model-free fashion. The idea is to leverage the Long-Short Term Memory (LSTM) net due to its excellent capability in learning long-term dependencies of temporal information. Two different LSTM-based architectures have been hence designed to predict both position and velocity of a missile using raw and noisy measurements provided by a realistic radar system, exploiting a large database abundant of realistic off-line data. Training results and theoretical derivations are verified through non-trivial scenarios in order to assess the capability of predicting unknown and realistic 3D missile maneuvers. Finally, the proposed approach has been also compared with a performing model-based IMM algorithm, suitably tuned to deal with realistic missile maneuvers, confirming the excellent generalization abilities of the developed data-driven architectures for different datasets.	https://www.webofscience.com/wos/woscc/full-record/WOS:000967299600001
Матеріалознавство				
1	Виготовлення гетерогенних пластин з високоміцних та пластичних алюмінієвих сплавів з використанням адитивного виробництва та гарячого прокату	Fabrication of high strength-ductility aluminum alloy heterogeneous plates using additive manufacturing and hot rolling process. Xiang, HL; Xu, CC; Zhan, T.; Guo, PC, Li, LX. JOURNAL OF	Aluminum alloy heterogeneous plate has great potential applications in automotive, military, aerospace, and other fields due to its excellent mechanical properties and ability to resist ballistic missile penetration. In the present work, a 5356/7A48 aluminum alloy heterogeneous plate with high strength-ductility and excellent interfacial metallurgical bonding strength was prepared using wire-arc additive manufacturing and hot rolling (WAAM+HR) process. The yield strength and ultimate tensile strength were 280.2 MPa and 392.3 MPa, respectively, both of	https://www.webofscience.com/wos/woscc/full-record/WOS:001262838100001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		MATERIALS PROCESSING TECHNOLOGY. 2024, 118451.	which were between 5356 and 7A48 alloys, but the elongation was excellent, up to 22%. Its excellent comprehensive mechanical properties far exceed those of Al/Al heterogeneous plates reported in previous studies. In addition, compared with traditional clad plates, its fracture displacement is improved by 48.8%, showing remarkably high interlayer bonding strength. The soft layer 5356 and the hard layer 7A48 beared the main plastic strain and normal stress respectively, resulting in back-stress strengthening at the interlayer interface, which was the fundamental reason for the synergistic effect of strength and plasticity. Furthermore, even at the maximum bending angle of 180 degrees, the heterogeneous plate did not show any sign of fracture, thanks to the fact that the outer soft-clad layer accommodated most of the bending deformation. The heterogeneous lamella structure, high constraint of hard layer to soft layer, and high geometrically necessary dislocations (GNDs) density of interfaces effectively stimulated the back stress strengthening and dislocation hardening, so that the 5356/7A48 aluminum alloy heterogeneous plate exhibited excellent comprehensive mechanical properties. The proposed WAAM+HR process provides an approach for the preparation of multifunctional heterogeneous plates with high strength-ductility and superior bonding strength.	
2	Параметричне дослідження методу керування відривом потоку в соплах ракет	Parametric study on a method to control flow separation in rocket nozzles. Sreerag, VN; Mohammad, F.; Nandan, V.; Pramod, A.; Subhajayan, KP; Jash, S. MATERIALS TODAY-PROCEEDINGS. 2021. Volume 46. Page 9950-9955.	The quest for enhancing the performance of rocket launcher has led to the development of rocket nozzles with a high expansion ratio. Even though high area ratio rockets give better efficiency at high altitude conditions, the same nozzle when operated at the low altitude results in separation of flow well within the nozzle. This unsteady and asymmetric separation of flow from the divergent wall leads to uncontrollable side loads and high dynamic loads. If this problem were to overcome, the rocket engine performance will improve substantially. In the paper, flow separation in the main nozzle is eliminated with secondary injection at the lip of the main nozzle. This prevents the entry of atmospheric air into the separation zone and full-flowing conditions are achieved in the main nozzle at a relatively lower chamber pressure of main nozzle. The impact of inlet pressure of the main nozzle, the secondary injection, its pressure, and the angle of introduction on the main nozzle flow are studied using computational methods. It was observed that the injection of the secondary nozzle flow parallel to the main nozzle gives better results. The increase in secondary injection pressure seems to be favourable in eliminating flow separation in the main nozzle.	https://www.webofscience.com/wos/woscc/full-record/WOS:000706866200018

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
3	Про багатопрофільну конструкцію гібридної ракетної установки з композитною обгорткою корпусу високого тиску	On the Multidisciplinary Design of a Hybrid Rocket Launcher with a Composite Overwrapped Pressure Vessel. Souza, A.; Gonçalves, PT; Afonso, F.; Lau, F.; Rocha, N.; Suleman, A. JOURNAL OF COMPOSITES SCIENCE. 2024. Volume 8. Issue 3, 109.	A multidisciplinary design optimisation (MDO) study of a hybrid rocket launcher is presented, with a focus on quantifying the impact of using composite overwrapped pressure vessels (COPVs) as the oxidiser tank. The rocket hybrid propulsion system (RHPS) consists of a combination of solid fuel (paraffin) and liquid oxidiser (NOx). The oxidiser is conventionally stored in metallic vessels. Alternative design concepts involving composite-based pressure vessels are explored that could lead to significant improvements in the overall performance of the rocket. This design choice may potentially affect parameters such as total weight, thrust curve, and maximum altitude achieved. With this eventual impact in mind, structural considerations such as wall thickness for the COPV are integrated into an in-house MDO framework to conceptually optimise a hybrid rocket launcher.	https://www.webofscience.com/wos/woscc/full-record/WOS:001192740500001
4	Збільшення підйомної сили твердопаливного прямоточного реактивного двигуна (SFDR) зі збільшенням керуючої поверхні	Enhancement in the lift force of the Solid Fuel Ducted Ramjet (SFDR) with an increase in the controlling surface. Kothari, V.; Mehta, Y.; Shrivastav, D.; Panchal, K. MATERIALS TODAY-PROCEEDINGS. 2022. Volume 50. Page 1878-1882.	The solid fuel ducted Ramjet systems (SFDR) are extremely capable of propelling high-speed missiles. They have a specific application in the configuration of air-to-air missiles with a high degree of interception. It is a modification from the traditional solid fuel ramjet system by using an external duct for thrust variation. This system provides higher effectiveness against maneuvering jets compared to single and dual pulse rocket system as it can vary thrust by varying fuel and air quantity for combustion. Even though with high effectiveness, an enemy fighter jet that is having higher thrust engines can outmaneuver SFDR by gaining significant lift during the end-stage which reduces its killing probability; this emphasized the development of a new missile system that provides more lift during the end-stage. A new SFDR concept is proposed in the present work that can gain more lift. The provision of a deflector is made in the duct to study the lift characteristics. Optimum lift force was obtained from the detailed analysis. Moreover, the study was extended by changing the deflector dimensions. Fluent fluid flow analysis is performed in simulation software named ANSYS to study the lift characteristics. Before that, 3D modelling is done with the help of NX software.	https://www.webofscience.com/wos/woscc/full-record/WOS:000753375000026
5	Прогнозування можливостей довгострокового зберігання композитних керуючих снарядів у реактивних системах залпового вогню: врахування впливу реальних умов фактичного середовища	Long-Term Storage Capability Prediction for Composite Directors in MLRS: Considering the Influence of Actual Environment. Zhong, JL; Sun, TS; Yu, CG; Ren, J. MECHANICS OF COMPOSITE MATERIALS.	To predict the long-term storage capability (LTSC) of composite directors for multiple launch rocket system (MLRS) in the actual environment, a creep constitutive model was established in a three-dimensional nonlinear form, which considered the moisture effect by introducing a moisture shift factor that related to moisture absorption (MA) into the nonlinear Schapery equation. The constitutive model in integral form was transformed into the incremental-iterative form to realize the numerical finite element solution. Quasi-static experiments	https://www.webofscience.com/wos/woscc/full-record/WOS:001058330800005

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		2023. Volume 59. Issue 4. Page 631-644.	and short-term creep-recovery tests for E-glass/6509 epoxy resin laminate were performed to obtain the moisture and stress dependent parameters. A coupled numerical model in multi-physical field of moisture diffusion-nonlinear creep was established, and the MA process and creep deformation of composite directors during storage were predicted. The influence law of creep strain on rocket launching was further investigated by establishing the coupled rocket-directors launching dynamics model. The results show that the water diffuses to the inner surface of directors after storage one year in the environment of temperature of 30 degrees C and relative humidity of 70% RH, while a saturated MA state was reached after 8 years storage. Maximum residual strain (RS) in 20 directors locates between the 2nd and 3rd positioning mounting rings, whose distribution likes a saddle-shape. The residual strains of the middle position in the upper and lower rows are the greatest, with a value of 0.38 mm; and the middle position in the left and right columns are the smallest, with a value of 0.33 mm. The creep strain increases the angular displacement and rate in the pitch and yaw directions of the rocket axis.	
Механіка				
1	Ефективне та модульне моделювання динаміки запуску трубчастих ракет на рухомій пусковій установці	An efficient and modular modeling for launch dynamics of tubed rockets on a moving launcher. Zhou, QB; Rui, XT; Wang, GP; Zhang, JS. DEFENCE TECHNOLOGY. 2021. Volume 17. Issue 6. Page 2011-2026.	This paper develops a modular modeling and efficient formulation of launch dynamics with marching fire (LDMF) using a mixed formulation of the transfer matrix method for multibody systems (MSTMM) and Newton-Euler formulation. Taking a ground-borne multiple launch rocket systems (MLRS), the focus is on the launching subsystem comprising the rocket, flexible tube, and tube tail. The launching subsystem is treated as a coupled rigid-flexible multibody system, where the rocket and tube tail are treated as rigid bodies while the flexible tube as a beam with large motion. Firstly, the tube and tube tail can be elegantly handled by the MSTMM, a computationally efficient order-N formulation. Then, the equation of motion of the in-bore rocket with relative kinematics w.r.t. the tube using the Newton-Euler method is derived. Finally, the rocket, tube, and tube tail dynamics are coupled, yielding the equation of motion of the launching subsystem that can be regarded as a building block and further integrated with other subsystems. The deduced dynamics equation of the launching subsystem is not limited to ground-borne MLRS but also fits for tanks, self-propelled artilleries, and other air-borne and naval-borne weapons undergoing large motion. Numerical simulation results of LDMF are given and partially verified by the experiment.	https://www.webofscience.com/wos/woscc/full-record/WOS:000731355700002

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
2	Дослідження методу випробування динаміки стрільби з неповним заряджанням для реактивної системи залпового вогню	Study on test dynamics method of non-full loading firing for multiple launch rocket system. Miao, YF; Wang, GP; Rui, XT; Tu, TX. MECHANICAL SYSTEMS AND SIGNAL PROCESSING. 2019. Volume 122. Page 463-479.	This paper studies the test dynamics method of non-full loading firing for multiple launch rocket system (MLRS), and provides a new method for dynamics analysis of the MLRS coupled with rigid bodies and elastic bodies. The launch dynamics model, eigenfrequency equations and dynamics response equations of the MLRS are established using the launch dynamics and transfer matrix method for multibody systems (MSTMM). The corresponding vibration characteristics and dynamics response are simulated, and the simulated results are verified by a series of tests directly, including modal test, pulse thrust test. Then, the simulation system of launch and flight dynamics of the MLRS is developed combining the Monte Carlo simulation technology. The initial disturbance and firing precision are simulated and verified by the live firing test. On above basis, the relationship between the dynamics characteristics and firing precision of the MLRS is analyzed. And then, the test dynamics method of non-full loading firing is proposed for reducing the rocket consumption in firing precision test by optimizing the launch modes of the MLRS. Finally, a seven-shot non-full loading firing test scheme for a practical MLRS is designed. And the correctness of the scheme is proved by practical contrastive firing test. The test results show that the amount of the rockets consumption in firing precision test is reduced by 61% compared with the conventional test method.	https://www.webofscience.com/wos/woscc/full-record/WOS:000457948600024
3	Прогнозування точки зіткнення балістичної ракети в умовах високоманеврового проникнення	Impact point prediction guidance of ballistic missile in high maneuver penetration condition. Xian, Y.; Ren, LL; Xu, YJ; Li, SP; Wu, W.; Zhang, DQ. DEFENCE TECHNOLOGY. 2023. Volume 26. Page 213-230.	An impact point prediction (IPP) guidance based on supervised learning is proposed to address the problem of precise guidance for the ballistic missile in high maneuver penetration condition. An accurate ballistic trajectory model is applied to generate training samples, and ablation experiments are conducted to determine the mapping relationship between the flight state and the impact point. At the same time, the impact point coordinates are decoupled to improve the prediction accuracy, and the sigmoid activation function is improved to ameliorate the prediction efficiency. Therefore, an IPP neural network model, which solves the contradiction between the accuracy and the speed of the IPP, is established. In view of the performance deviation of the divert control system, the mapping relationship between the guidance parameters and the impact deviation is analysed based on the variational principle. In addition, a fast iterative model of guidance parameters is designed for reference to the Newton iteration method, which solves the nonlinear strong coupling problem of the guidance parameter solution. Monte Carlo simulation results show that the prediction accuracy of the impact point is high, with a 3 s prediction error of 4.5 m, and the guidance method is robust,	https://www.webofscience.com/wos/woscc/full-record/WOS:001072930500001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			with a 3 s error of 7.5 m. On the STM32F407 single -chip microcomputer, a single IPP takes about 2.374 ms, and a single guidance solution takes about 9.936 ms, which has a good real-time performance and a certain engineering application value.	
4	Спрощена динамічна модель та керування для системи залпового вогню	A simplified dynamic model and control for a multiple launch rocket system. Li, B.; Rui, XT; Wang, GP. JOURNAL OF VIBRATION AND CONTROL. 2022. Volume 28. Issue 17-18. Page 2288-2300.	Multiple launch rocket system, a type of launching platform used to launch kinetic load to hit the target, is an extremely complicated mechanical system with strong vibration because of the jet force. In this study, a nonlinear dynamic model and vibration control of a multiple launch rocket system are presented to reduce vibration and improve position accuracy. A simplified dynamic model of the multiple launch rocket system is derived using the Newton-Euler method, which facilitates the controller design considering the strong complexity of the multiple launch rocket system. On this basis, the feedback linearization technique is introduced to design a nonlinear controller based on the deduced dynamic model. The simulated and experimental results show that the simplified dynamic model-based control effectively can reduce vibration level of the launching system and make the azimuth and elevation angles reach the desired values with smaller error despite of each rocket's jet force.	https://www.webofscience.com/wos/woscc/full-record/WOS:000682968400001
5	Нова система контролю вібрації з використанням кільцеподібно розташованих рушіїв для системи залпового вогню в процесі запуску	A Novel Vibration Control System Applying Annularly Arranged Thrusters for Multiple Launch Rocket System in Launching Process. Gu, LL; Rui, XT; Wang, GP; Yang, FF; Wei, M. SHOCK AND VIBRATION. 2020. Volume 2020, 7040827.	Multiple Launch Rocket System (MLRS) has been widely used in recent years; vibration control in launching process is an effective way to improve its dispersion characteristics. In this paper, a novel vibration control system applying Annularly Arranged Thrusters (AAT) for MLRS in launching process is introduced and the prototype of the proposed system is built. The dynamic model of the MLRS with the AAT is established based on the Transfer Matrix Method for Multibody Systems (MSTMM). The LQR-PID control law and the management for the AAT are presented. The simulation and experiment of the proposed system are carried out and analyzed. The results show that the vibration of MLRS is effectively attenuated by the proposed control system. The study in this paper provides a new idea to improve the dispersion characteristic by reducing the vibration of MLRS in launching process.	https://www.webofscience.com/wos/woscc/full-record/WOS:000544604800002
Системи автоматизованого управління				
1	Вплив поздовжніх ультразвукових коливань на механізм шліфування при боковому та торцевому шліфуванні композитів 2.5D Cf/SiC	Longitudinal ultrasonic vibration effects on grinding mechanism in side and end grinding of 2.5D Cf/SiC composites. Duan, ZY; Chen, T.; Li, HB; Zhang, CD; Liu, FY.	As typical ablation-resistant materials, carbon fiber-reinforced ceramic matrix composites (CMCs) are widely used as hot-end components such as rocket launcher nozzles. Nevertheless, their characteristics of anisotropic and hard-brittle bring processing challenges. Rotary ultrasound-assisted machining (RUM) is an effective machining method for hard-brittle materials. In this paper, we established a single	https://www.webofscience.com/wos/woscc/full-record/WOS:001205210700003

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		INTERNATIONAL JOURNAL OF ADVANCED MANUFACTURING TECHNOLOGY. 2023. Том 129. Volume 9-10. Page 4185-4199.	abrasive grit trajectory model and elucidated the trajectory characteristics of the grits under ultrasonic-assisted side grinding (UASG) and ultrasonic-assisted end grinding (UAEG). Then the effects of longitudinal ultrasonic vibration on the grinding force, and surface quality in UASG and UAEG of 2.5D C-f/SiC composites were investigated by the single-factor test. Finally, the grinding mechanism under the two processing methods was revealed. The experimental results showed that the longitudinal vibration in the two machining methods has different effects on the grinding force and surface roughness. After the application of longitudinal vibration, the reduction of grinding force in the side grinding process was the largest. However, the reduction of surface roughness in the end grinding process was the largest, which was 35.6%. For the removal of each phase of 2.5D C-f/SiC composites, the brittle fracture, fiber debonding, and breakage of the matrix could be reduced after applying ultrasonic vibration in both processing methods.	
2	Багатопрофільне інтегроване проектування балістичної ракети великої дальності з використанням алгоритму оптимізації рою частинок	Multidisciplinary integrated design of long-range ballistic missile using PSO algorithm. Zheng, X.; Gao, YJ; Jing, WX; Wang, YS. JOURNAL OF SYSTEMS ENGINEERING AND ELECTRONICS. 2020. Volume 31. Issue 2. Page 335-349.	In the case of the given design variables and constraint functions, this paper is concerned with the rapid overall parameters design of trajectory, propulsion and aerodynamics for long-range ballistic missiles based on the index of the minimum take-off mass. In contrast to the traditional subsystem independent design, this paper adopts the research idea of the combination of the subsystem independent design and the multisystem integration design. Firstly, the trajectory, propulsion and aerodynamics of the subsystem are separately designed by the engineering design, including the design of the minimum energy trajectory, the computation of propulsion system parameters, and the calculation of aerodynamic coefficient and dynamic derivative of the missile by employing the software of missile DATCOM. Then, the uniform design method is used to simplify the constraint conditions and the design variables through the integration design, and the accurate design of the optimized variables would be accomplished by adopting the uniform particle swarm optimization (PSO) algorithm. Finally, the automation design software is written for the three-stage solid ballistic missile. The take-off mass of 29 850 kg is derived by the subsystem independent design, and 20 constraints are reduced by employing the uniform design on the basis of 29 design variables and 32 constraints, and the take-off mass is dropped by 1 850 kg by applying the combination of the uniform design and PSO. The simulation results demonstrate the effectiveness and feasibility of the proposed hybrid optimization technique.	https://www.webofscience.com/wos/woscc/full-record/WOS:000530866600011

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
3	Керування на основі нейронної мережі для невизначеної системи залпового вогню з затримкою виконавчого механізму	Neural-network-predictor-based control for an uncertain multiple launch rocket system with actuator delay. Li, B.; Rui, XT; Tian, W; Cui, G. MECHANICAL SYSTEMS AND SIGNAL PROCESSING. 2020. Volume 141, 106489.	Development of multiple launch rocket system (MLRS) has been restricted for several decades due to the poor dispersion characteristics of rockets, which is caused by the orientation of the MLRS departing from that intended. Hence, it is vital to maintain the angles of MLRS at a desired value via a proper control strategy. In this paper, a new neural network predictive control is developed for orienting control of the MLRS with actuator delay. First, the dynamic model of motor-mechanism coupling system is established using Lagrange method and field-oriented control theory. Then, for cancelling the effects of nonlinearities and uncertainties, the concept of feedback linearization and a dynamic recurrent neural network are introduced. In addition, a modified Smith predictor is employed to maintain the desirable orienting performance in the occurrence of actuator delay. For the stability analysis, Lyapunov's method is utilized to ensure uniform ultimate boundedness of the closed-loop system. The simulated and experimental results demonstrate the effectiveness of the proposed controller.	https://www.webofscience.com/wos/woscc/full-record/WOS:000529084500018
4	Неоптимальне проектування наведення на середній лінії траєкторії з використанням узагальненого моделювання прогнозованого розповсюдження	Suboptimal midcourse guidance design using generalized model predictive spread control. Ebrahimi, A.; Mohammadi, A.; Kashaninia, A. TRANSACTIONS OF THE INSTITUTE OF MEASUREMENT AND CONTROL. 2020, 0142331220928888.	A new generalized model predictive spread control technique is presented for the midcourse guidance of interceptors that are designed to intercept high-speed ballistic missile targets. Because of using the basis functions, this new technique is further computationally efficient over the model predictive static programming technique. Also, the smoothness of the control variable is guaranteed for the smooth basis functions. For demonstrating the performance of the proposed technique, an interceptor midcourse guidance problem with an angle constraint is formulated and solved to intercept an incoming ballistic missile target successfully. Additionally, the results are compared with those of the midcourse guidance design using the model predictive static programming technique. A comparative study of the new technique has also been conducted with the quasi-spectral model predictive static programming technique proposed earlier in the literature. It has been observed that the orthogonality of the basis functions is a necessary assumption and without that, the quasi-spectral model predictive static programming technique is not a near-optimal technique. By using the new technique based on Legendre basis functions, the solution converges to the model predictive static programming method solution by increasing the number of basis functions with less computational load.	https://www.webofscience.com/wos/woscc/full-record/WOS:000542406500001
5	Алгоритм виправлення помилок акселерометра для інтегрованої системи SINS/CNS (безплатформна	A Correcting Accelerometer Errors Algorithm for SINS/CNS Integrated System.	Strapdown inertial navigation system/celestial navigation system (SINS/CNS) is commonly used to high-precision missile navigation. Conventional SINS/CNS based on attitude measurement estimates the	https://www.webofscience.com/wos/woscc/full-

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
	інерціальна навігаційна система / система небесної навігації)	Shi, CF; Chen, XY; Wang, JW; Yan, L.; Duan, H.; Deng, Y. ADVANCES IN GUIDANCE, NAVIGATION AND CONTROL. 2023. Volume 845. Page 4651-4660.	gyro drifts effectively. However, it does nothing about the accelerometer bias, which affect the positioning accuracy. Aiming at this problem, an improved SINS/Refraction and Kinematic-CNS (SINS/RK-CNS) method is proposed based on the indirect horizon reference measurement of star refraction. In this method, the relationship between refraction apparent height and missile position is deduced, and a new nonlinear integrated navigation model is established with the kinematic constraint of missile. Furthermore, corresponding observation noise model is developed to improve the positioning accuracy and the system robustness. Finally, simulations are conducted to test the performance with ballistic missile. Systematic position errors are calculated by traditional SINS/CNS method and SINS/RK-CNS based on EKF and UKF under different initial misalignment errors. The results confirm that the proposed SINS/RK-CNS has a significant effect on estimating the accelerometer bias. Compared to the traditional approach, three-axis position errors are decreased by 84.27%, 89.53% and 85.02%, respectively.	record/WOS:001463221800451
Телекомунікації				
1	Новий алгоритм класифікації балістичної цілі на основі HRRP-кадру.	Novel Classification Algorithm for Ballistic Target Based on HRRP Frame. Persico, AR; Ilioudis, CV; Clemente, C.; Soraghan, JJ. IEEE TRANSACTIONS ON AEROSPACE AND ELECTRONIC SYSTEMS. 2019. Volume 55. Issue 6. Page 3168-3189.	Nowadays, the identification of ballistic missile warheads in a cloud of decoys and debris is essential for defense systems in order to optimize the use of ammunition resources, avoiding to run out of all the available interceptors in vain. This paper introduces a novel solution for the classification of ballistic targets based on the computation of the inverse Radon transform of the target signatures, represented by a high-resolution range profile frame acquired within an entire period of the main rotation of the target. Namely, the precession for warheads and the tumbling for decoys are taken into account. The pseudo-Zernike moments of the resulting transformation are evaluated as the final feature vector for the classifier. The extracted features guarantee robustness against target's dimensions and rotation velocity, and the initial phase of the target's motion. The classification results on simulated data are shown for different polarizations of the electromagnetic radar waveform and for various operational conditions, confirming the validity of the algorithm.	https://www.webofscience.com/wos/woscc/full-record/WOS:000507917800042
2	Оцінка параметрів прецесії боєголовки з плавниками на основі мікроефекту Доплера та радіолокаційної мережі	Precession Parameter Estimation of Warhead With Fins Based on Micro-Doppler Effect and Radar Network. Zhang, RZ; Wang, Y.; Yeh, CM; Lu, XF. IEEE	Precession is a typical micromotion of a ballistic missile warhead in the middle of the trajectory. The modulation of the narrow-band radar echo by the precession warhead is mainly reflected in the micro-Doppler effect, which is manifested as the Doppler frequency of the echo periodically changing with time. In the article, an estimation method of precession parameters for warhead with fins using time-	https://www.webofscience.com/wos/woscc/full-record/WOS:000967164400001

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		TRANSACTIONS ON AEROSPACE AND ELECTRONIC SYSTEMS. 2023. Volume 59. Issue 1. Page 443-459.	frequency analysis and dual radars is proposed. The estimated parameters include precession angle, spinning angular velocity, and coning angular velocity. The geometric and signal model of the precession warhead are established and the analytical expression of the Doppler frequency is deduced. Then, the precession parameters are obtained using the dual view angles of dual radars in this article. Simulation experimental results illustrate the effectiveness of the proposed method.	
3	Керування траєкторією руху для перехоплення поза атмосферою з використанням формування траєкторії на основі даних про реагуючу поверхню	Midcourse Guidance for Exoatmospheric Interception Using Response Surface Based Trajectory Shaping. Ann, S.; Lee, S.; Kim, Y.; Ahn, J. IEEE TRANSACTIONS ON AEROSPACE AND ELECTRONIC SYSTEMS. 2020. Volume 56. Issue 5. Page 3655-3673.	An exoatmospheric midcourse guidance law is proposed to intercept a ballistic missile during the free-flight phase. The proposed guidance law generates a thrust direction command for an antiballistic missile to hit the target at the predicted intercept point. For the predicted intercept point, the zero-effort-miss and zero-effort-velocity are determined based on the solutions of the two-body orbital boundary/initial value problems. The intercept point is predicted by using the trajectory shaping parameter that combines the zero effort trajectory and minimum time trajectory. A response surface model for the minimum interception time is constructed as a database, which is the polynomial function of the initial condition. The response surface model provides a predicted minimum time interception position for the midcourse guidance. Case studies are performed to demonstrate the performance of the proposed guidance law considering various uncertainties.	https://www.webofscience.com/wos/woscc/full-record/WOS:000578773300023
4	Оптимальне розташування систем протиракетної оборони з урахуванням ймовірності знищення	Optimal Arrangement of Missile Defense Systems Considering Kill Probability. Na, H.; Lee, JI. IEEE TRANSACTIONS ON AEROSPACE AND ELECTRONIC SYSTEMS. 2020. Volume 56. Issue 2. Page 972-983.	This paper proposes an optimal arrangement framework of ballistic missile defense systems, such as a launcher and radar to maximize the survivability of protected assets. In order to solve the optimization problem through a probabilistic approach, we derive a single shot kill probability (SSKP) model based on engagement geometries, trajectory characteristic of an interceptor and a ballistic missile, and error models embedded in both an interceptor and radar. This SSKP model is useful to predict a performance of defense systems in early design phase or to draw requirements of subsystems. After an SSKP model is derived, we present a framework to calculate the survivability of protected assets. In the framework, we establish a concept of survivability distributions of the protected assets, which vary with the arrangement of defense systems. By using the survivability distributions for given protected assets, the optimal location of a launcher and radar can be derived. The potential significance of the proposed framework is that it can be directly applicable in real defense systems by just substituting SSKP models derived in this paper with more sophisticatedly derived SSKP distributions. Finally, the optimal arrangements are derived by the	https://www.webofscience.com/wos/woscc/full-record/WOS:000528545800010

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			proposed framework and the effectiveness of the results is evaluated through various case studies.	
5	Керування відстеженням вхідного опорного сигналу високого порядку з використанням методу зворотного зв'язку за станом інтегралів та налаштування діаграми коефіцієнтів	Tracking Control of High Order Input Reference Using Integrals State Feedback and Coefficient Diagram Method Tuning. Ma'Arif, A.; Cahyadi, AI; Herdjunanto, S.; Wahyunggoro, O. IEEE ACCESS. 2020. Volume 8. Page 182731-182741.	The purpose of the research is tracking control to follow the input reference signal such as step, ramp, parabolic, and high order reference stably. The challenge is rising when high order input references, such as parabolic or polynomial, are used in the advanced system. Like in satellite and missile launcher systems, the triple integrator systems have to follow parabolic or polynomial trajectory with high stability required. The research proposed an integrals state feedback controller to combine simple state feedback control with cascade-layered integral control. The order of the input reference defines the structure and number of integrals used. Along with Coefficient Diagram Method in its tuning process, the proposed controller is guaranteed to have good stability and zero steady-state error. Simulation results and mathematical proofs of stability and zero steady-state error are provided on the paper. The proposed method can follow various input references such as the ramp, parabolic, polynomial, and higher-order reference based on the simulation and mathematical proofs. The stability using the pole location also shown the negative poles that give a stable system.	https://www.webofscience.com/wos/woscc/full-record/WOS:000579598200001
Термодинаміка				
1	Експериментальні дослідження векторизації тяги надзвукового сопла з керованою стійкою	Experimental Investigations on the Strut Controlled Thrust Vectoring of a Supersonic Nozzle. Thillaikumar, T.; Bhale, P.; Kaushik, M. JOURNAL OF APPLIED FLUID MECHANICS. 2020. Volume 13. Issue 4. Page 1223-1232.	The attitude control of a rocket engine using the control surfaces becomes cumbersome particularly in larger rockets with high payload. In such cases, a more effective means of producing forces for controlling the flight is the deflection of exhaust gases, referred to as the gas-dynamic steering or the thrust vector control. In this study, the effect of a strut on the exhaust gas deflection, deployed at the locations; 0.62 L, 0.72 L and 0.8 L in the divergent-portion of a Mach 1.84 nozzle at over-expanded, correctly-expanded and under-expanded states of the jet, has been experimentally investigated. The level of expansion at the nozzle exit is varied by changing the settling chamber pressures from 4 bar to 8 bar, in steps of 2 bar. Further, to study the effect of aspect ratio, the height of strut is varied as 1.5 mm, 2.5 mm and 3.5 mm. The strut of height 3.5 mm, deployed at x/L = 0.72, is found to be the most effective thrust vector control at overexpanded conditions; with a maximum jet deflection of about 3.6o, obtained at a settling chamber pressure of 4 bar. The Schlieren flow visualization images confirm the findings of wall static pressure data.	https://www.webofscience.com/wos/woscc/full-record/WOS:000563783600015

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
2	Рівномірна теплопередача зі струменевим зіткненням з використанням пористої вуглецевої піни	Uniform heat transfer with jet impingement using porous carbon foam. Yogi, K.; Krishnan, S.; Prabhu, SV. INTERNATIONAL JOURNAL OF THERMAL SCIENCES. 2024. Volume 203, 109158.	Applications requiring high heat transfer rates, such as cooling of high-density electrical equipment, cooling of gas turbine components, cooling of rocket launcher components, cryosurgery, etc., are frequently use impinging jets. Non-uniformity in the heat transmission from the impingement surface is the main drawback of jet impingement heat transfer. In order to achieve uniform heat transfer, the current study examines the presence of porous carbon foam on a targeted surface. Using a thin metal foil and infrared thermography, the local heat transfer distribution of a porous carbon foamed surface is determined. The findings of the porous carbon foamed surface are compared to the bare surface (smooth surface without foam) for local Nusselt number and uniformity in the heat transfer (coefficient of variance). The effects of Reynolds number, foam height, and the distance between the nozzle exit to the targeted plate are examined. The results of the carbon foamed surfaces are also compared with the aluminium metal foamed surface results available in the literature. The current work also describes the separation of the modes of heat transfer that exist with porous carbon foamed surfaces while under jet impingement. The findings imply that, depending on the height of the carbon foam, the porous carbon foam on a targeted surface gives a lower or equivalent heat transfer rate compared to a bare surface. In comparison to a bare surface, carbon foam on a targeted surface provides uniform heat transfer that is independent of foam height. The study of the separation of modes of heat transfer suggests that heat from the porous carbon foamed surface is conveyed by conduction induced by carbon foam and convection induced by jet fluid. The convection provided by the jet fluid is compromised by the carbon foam on a targeted surface. The conduction induced by carbon foam makes the heat transfer from the targeted surface more uniform. The conduction and convection factors can be used to present the conduction and convection heat transfer from porous carbon foamed surfaces, respectively. Regression analysis is used to develop a region-wise correlation for the conduction and convection components. The local Nusselt number of a carbon foamed flat plate can be predicted using the local Nusselt of a bare surface utilizing the provided correlations for conduction and convection factor.	https://www.webofscience.com/wos/woscc/full-record/WOS:001249052800001
3	Стратегія слабозв'язаного аналізу для моделювання плавлення-абляції теплозахисного матеріалу в надзвуковому двофазному потоці газу та частин	Loosely coupled analysis strategy for melt-ablation modeling of thermal protection material in supersonic gas-	In this study, a two-way fluid-thermal-ablation loosely coupled analysis strategy is used to investigate the melt-ablation process of the copper specimen plate in the scaled ducted launcher. By coupling a discrete-phase model for simulate the supersonic gas-particle two-phase exhaust plume impingement flow field of a small scaled solid	https://www.webofscience.com/wos/woscc/full-record/WOS:001082511600001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		particle two-phase impingement flow. Lai, CY; Leu, TS. CASE STUDIES IN THERMAL ENGINEERING. 2023. Volume 50, 103486.	propellant rocket and a solidification/ melting model for simulate the melt-ablation process of a copper specimen plate, the ablation depth profile of the copper specimen plate at a burn time of 3.6 s is successfully estimated. The numerical model is validated by experimental-scale test which shows that the simulation results using the two-way fluid-thermal-ablation loosely coupled analysis strategy can accurately predict the ablation depth profile of the copper specimen plate.	
4	Перша ступінь зондування ракети на твердому паливі	A Sounding Rocket Solid Propellant First Stage. Berndl, M.; Eineder, L; Esterl, R.; Fechler, G; Hacker, A.; Kuhn, M.; Meyer, T.; Müller, I.; Naumann, KW; Rest, S.; Stadler, L.; Stangl, D.; Steinfeld, H.; Vetter, M.; Weigand, A.; Kirchhartz, R; Scheuerpflug, F. AIAA PROPULSION AND ENERGY 2021 FORUM, 2021.	The Sounding Rocket Motor named "Red Kite (R)" is a development for the German Aerospace Center (DLR) and its Mobile Rocket Base (MORABA) with a propellant mass of about 1 metric ton. The challenge for the program is a three year period of time for development and qualification. The use of proven materials, methods and components is one applied method to reduce risk. The interfaces fit existing components without any modifications. The development of Bayern-Chemie's biggest solid rocket motor so far paves the way for the development and qualification of further solid rocket motors for micro-launcher stages.	https://www.webofscience.com/wos/woscc/full-record/WOS:001327980305074
5	Випробувальна установка для визначення терміну служби кріогенних високошвидкісних підшипників	A Test Facility for the Lifetime Characterization of Cryogenic High-Speed Bearings. Pasini, A.; Brotini, G.; Apollonio, A.; D'Agostino, L.; De Rosa, M.; Leonardi, M.; Simi, R. Brotini, G., Apollonio, A.; D'Agostino, L.; De Rosa, M.; Leonardi, M. AIAA PROPULSION AND ENERGY 2021 FORUM. 2021.	Currently, reusable rockets are the most promising design solution to reduce launcher costs. A truly reusable rocket engine to be economically viable should ensure the increase of frequency launch with virtually no maintenance effort. The rocket engine reusability can be reached by developing long-life turbopumps with a lifetime requirement of several hours. The replacement of rolling bearing, which represents a critical component for reusability, with journal bearing has been considered the most promising solution to increase turbopump lifetime. The propulsion team of the Department of Civil and Industrial Engineering of the University of Pisa, UniPi, is currently pursuing the development of high-speed hybrid bearings for reusable pump-fed liquid rocket engines in the framework of the ESA's project "Long Life Journal Bearings for Turbopumps." UniPi's team selected the two most promising candidate journal bearings: a square-recessed journal bearing with 45 degrees orifices, a radial-orifice compensated bearing. Inconel 718 and ceramic matrix composite, CMC, are the chosen materials that minimize the possible surface wear of the bearings and ensure the material compatibility with LCH4. The geometry and material configurations will be tested in a cryogenic test facility suitably developed to characterize the performance of journal bearings employing liquid methane in a representative turbopump environment of future pump-fed LOX-CH4 rocket engines. This paper	https://www.webofscience.com/wos/woscc/full-record/WOS:001327980304028

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			illustrates the selection of the test journal bearings and presents the novel test apparatus, and a facility designed for the bearing experimental lifetime characterization.	
ПРОТИТАНКОВА АРТИЛЕРІЯ				
Інженерія				
1	Експериментальне та числове дослідження впливу заповнення порожнини кумулятивної гільзи заряду на характеристики проникнення струменя у сталеві мішені	Experimental and numerical study on the influence of shaped charge liner cavity filing on jet penetration characteristics in steel targets. Zochowski, P.; Warchol, R. DEFENCE TECHNOLOGY. 2023. Volume 23. Page 60-74.	Penetration characteristic (size and shape of penetration craters made in high hardness ARMSTAL 30PM steel) of shaped charge jets formed after detonations of modified PG-7VM warheads was analyzed in the article. Modifications consisted in removing the frontal part of the grenade (fuse, ballistic cap and conductive cone) and introducing of the liner cavity filling made of polyacetal copolymer POM-C. The filings in the form of solid cones with three different heights (33%, 66% and 100% of H -the height of original PG-7VM liner) were placed inside of the hollow cone shaped charge liner. As opposed to the vast majority of previously published works (in which warhead optimization studies were focused on increasing of the depth of penetration in rolled homogeneous armor steel) the main aim of the presented modifications was to maximize the damage ratio (diameters of craters, inlet and outlet holes) of target perforated by shaped charge jet at the cost of the loss of part of the jet penetration capability. According to the best knowledge of the authors such approach to the use of the old PG-7VM warheads has not been analyzed so far. Taking into consideration high stock levels of PG-7VM warheads, and the fact that they are continuously being replaced by more efficient and more sophisticated high-explosive anti-tank warheads, it seems reasonable to look for alternate applications of the warheads withdrawn from the service. Thanks to the introduction of proposed modifications the warheads could be used by special forces or other assault units as directional mines or statically detonated cutting shaped charges as well as by combat engineers as universal charges used in various types of engineering or sapper works. The research included experimental penetration tests and their numerical reproduction in the LS-Dyna software with the simulation methodology defined and validated in previous works of the authors. Small differences (average error = 10-20%) were identified between the experimental and numerical results (dimensions of craters made in steel targets were compared) what confirmed the reliability of the modelling methodology and enabled its use for further optimization of the shapes of fillings. Within the analyzed variants of warheads modifications maximum diameters of penetration craters were obtained for the filling of the height of h =	https://www.webofscience.com/wos/woscc/full-record/WOS:000995852900001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			2/3H. The diameters of holes in individual steel plates were increased by 164%, 70%, 65% (for the first, second and third plate, respectively) in relation to the variant without filling. The results of the study indicated that with the use of different materials of fillings and their various heights it is possible to control the shape of penetration craters pierced in the steel targets.	
2	Вплив природної конвекції на затвердіння тротилу всередині кумулятивної форми заряду	Natural convection effects on TNT solidification inside a shaped charge mold. Susantez, C.; Caldeira, AB.; Loiola, BR. DEFENCE TECHNOLOGY. 2022. Volume 18. Issue 9. Page 1653-1661.	High Explosive Anti-Tank (HEAT) warheads and ammunitions are frequently produced by explosive casting inside an axis-symmetric mold with an inverted conical geometry in the basis. In order to prevent manufacturing defects, the solidification process must be controlled. In this study, a dimensionless solidification model has been proposed to investigate the heat transfer considering the natural convection inside the liquid explosive and the numerical simulations were performed by using COMSOL Multiphysics and Modeling Software, employing trinitrotoluene (TNT) thermophysical properties. The effect of three different boundary conditions on the top of the mold have been evaluated: convection, adiabatic and isothermal. It has been observed that solidification process was faster for convection case and slower for isothermal case, while an intermediary total solidification time value was found for adiabatic case. Moreover, liquid explosive was completely surrounded by solid explosive during the solidification process for convection case and also for adiabatic case through the end of the process. Otherwise, it was not observed for isothermal case. The natural convection effects promoted a vortex inside the liquid explosive, accelerating the heat transfer process. It has been concluded that isothermal mold top boundary condition should be preferred to prevent manufacturing defects, avoiding high thermal stress.	https://www.webofscience.com/wos/woscc/full-record/WOS:000863299600005
3	Захист броньованої техніки від хімічного, біологічного та радіологічного зараження	Protection of armoured vehicles against chemical, biological and radiological contamination. Wisniewski, A.; Pirszel, J. DEFENCE TECHNOLOGY. 2021. Volume 17. Issue 2. Page 384-392.	The article presents problems related to mechanical protection of vehicles with different add-on armours against chemical, biological and radiological contamination. This applies to vehicles with additional passive, reactive and hybrid protection in the form of cassettes against piercing with anti-tank projectiles, piercing with their kinetic energy of impact, and as a result of chemical energy of shaped charges as well as explosively formed projectiles. It has been shown how increased ballistic protection of these vehicles at the same time reduces their decontaminability in various places of the vehicle due to the increased additional surface of the vehicle with cassettes. Prevention of contamination of these cassettes has been presented as a way of reducing hard to reach surface for decontamination and a method of insulating construction elements (stands), fixing these cassettes to the vehicle, from the environment to prevent contact with	https://www.webofscience.com/wos/woscc/full-record/WOS:000632640700007

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			contaminated liquids and dusts. The selection of appropriate materials is shown, which may affect the improvement of the decontamination efficiency of the vehicle with such cassettes. This applies to the use of materials with low absorption of chemical warfare agents, which prevent the accumulation of large amounts of these agents on contaminated surfaces and improve the effectiveness of decontamination. It also shows how to ensure better access of the disinfectant to as much of the vehicle surface as possible, covered with cassettes that have been contaminated. It shows how a vehicle, in particular with such cassettes, can provide protection against radar detection when Radar Absorbent Material is used on vehicle cassettes.	
4	Генерація маневру ухилення від ракетного удару за допомогою безмодельного глибокого навчання з підкріпленням	Missile Evasion Maneuver Generation with Model-free Deep Reinforcement Learning. Özbek, MM; Koyuncu, E. IEEE. 10TH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN AIR AND SPACE TECHNOLOGIES, RAST, 2023.	Unmanned Combat Aerial Vehicles (UCAVs) play a significant role in modern military conflicts as they can perform intelligence, surveillance, reconnaissance, and target acquisition missions while carrying aircraft ordnance like missiles and bombs, and Anti-Tank Guided Missiles (ATGMs). However, the increased use of UCAVs has also led to more advanced anti-UCAV solutions in air defense. The paper proposes a deep reinforcement learning approach for generating online missile-evading maneuvers for combat aerial vehicles. The problem is made complicated by the missile's 8 Mach speed and the aircraft's limited 2.5 Mach speed. The system employs Twin Delayed Deep Deterministic Policy Gradient(TD3), one of the most known deep reinforcement learning algorithms, to train an agent to make real-time decisions on the best evasion tactics in a complex combat environment. A two-term reward function is used, with sparse rewards at terminal states and continuous rewards through the geometry of the combat. Aileron, rudder, and elevator controls are given directly to the algorithm to ensure all potential escape maneuvers are visible. The proposed methodology achieved a 59% success rate in extensive simulations, demonstrating its potential to enhance aerial vehicles' combat capabilities.	https://www.webofscience.com/wos/woscc/full-record/WOS:001055074600020
5	Нелінійні закони наведення протитанкової керованої ракети для перехоплення маневруючих танкових цілей з використанням оптимальної динаміки помилок та відносної віртуальної моделі	Nonlinear Guidance Laws for Anti-tank Guided Missile to Intercept Maneuvering Tank Targets Using Optimal Error Dynamics and Relative Virtual Model. Van, HT; Ngoc, DN; Trung, DP.; Nguyen, TT. JOURNAL OF AEROSPACE TECHNOLOGY AND	Th is paper introduces a new method for synthesizing guidance laws for anti-tank guided missiles (ATGM) to intercept maneuvering tank targets. It utilizes a nonlinear relative model in the two-dimensional horizontal plane and optimal error dynamics (OED) theory. Th e nonlinear relative model simplifies fi es the problem of targeting a moving target into attacking a stationary target, making the guidance law synthesis task easier. Th e selection of OED allows for the design of a guidance command that ensures the zero effort ff ort miss (ZEM) error decreases to zero within a fi nite time, ensuring successful target interception. Th e paper also introduces an exponential decay	https://www.webofscience.com/wos/woscc/full-record/WOS:001325195300002

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		MANAGEMENT. 2024. Volume 16, e2424.	weighting function of remaining time-to-go to optimize the distribution of command accelerations throughout the guidance process, thereby reducing initial command requirements and converging acceleration commands towards zero at the end time. Th e synthesized guidance laws are derived based on the nonlinear relative model and OED without making any small-angle linearization assumptions, allowing them to address various nonlinear scenarios. Numerical simulations illustrate the proposed guidance law's performance.	
Інформатика				
1	Аналіз керування протитанковою ракетою з векторизацією ракетного двигуна за допомогою модифікованого методу лінійно-квадратичного регулятора	Control Analysis with Modified LQR Method of Anti-Tank Missile with Vectorization of the Rocket Engine Thrust. Nocon, L.; Grzyb, M.; Szmidt, P.; Koruba, Z.; Nowakowski, L. ENERGIES. 2022. Volume 15. Issue 1, 356.	This article approaches the issue of the optimal control of a hypothetical anti-tank guided missile (ATGM) with an innovative rocket engine thrust vectorization system. This is a highly non-linear dynamic system; therefore, the linearization of such a mathematical model requires numerous simplifications. For this reason, the application of a classic linear-quadratic regulator (LQR) for controlling such a flying object introduces significant errors, and such a model would diverge significantly from the actual object. This research paper proposes a modified linear-quadratic regulator, which analyzes state and control matrices in flight. The state matrix is replaced by a Jacobian determinant. The ATGM autopilot, through the LQR method, determines the signals that control the control surface deflection angles and the thrust vector via calculated Jacobians. This article supplements and develops the topics addressed in the authors' previous work. Its added value includes the introduction of control in the flight direction channel and the decimation of the integration step, aimed at speeding up the computational processes of the second control loop, which is the LQR based on a linearized model.	https://www.webofscience.com/wos/woscc/full-record/WOS:000756726700001
2	Оптимізація траєкторії високошвидкісної протитанкової ракети з кінетичною енергією та імпульсною корекцією	Trajectory optimization of high-speed kinetic energy anti-tank missile with pulse correction. Ma, J.; Miao, HC; Li, HQ; Zhang, YJ. PROCEEDINGS OF THE 40TH CHINESE CONTROL CONFERENCE (CCC), 2021. Page 1581-1585.	High speed kinetic energy antitank missile is an important development direction of antitank weapons in the future. Aiming at the high-speed kinetic energy antitank missile system with pulse correction engine as actuator and three-point guidance scheme, a trajectory optimization method in the lead-in phase is designed, which can be applied in engineering. Firstly, the principle and mathematical model of the pulse correction high-speed kinetic energy antitank missile system are described in detail. Then, the trajectory optimization scheme of the pulse correction high-speed kinetic energy missile in the lead-in phase is described, and the trajectory optimization model is established. Then, taking a certain type of high-speed kinetic energy missile as an example, the trajectory optimization scheme of the lead-in phase is verified and analyzed by mathematical simulation. The real results	https://www.webofscience.com/wos/woscc/full-record/WOS:000931046701121

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			show that the designed trajectory optimization algorithm can effectively reduce the pulse energy consumption in the lead-in phase.	
3	Онлайн-ідентифікація замкнутої системи для виконавчого механізму літаючого апарату	Online closed loop system identification for the actuator of a flying vehicle. Ouda, AN. INTERNATIONAL JOURNAL OF AUTOMATION AND CONTROL. 2021. Volume 15. Issue 3. Page 275-317.	The frequent minor wars have brought to the fore guided missiles as the main weapon against all types of military targets. Restoring the single shot kill probability can be achieved by using two methods as follows: first, using large warhead with the large lethal area; second, design a robust guidance system to reduce the miss-distance with high single shot kill probability. The performance of an anti-tank guided missile can be enhanced by select the nominal model to design the guidance computer system. Furthermore, an online closed-loop system identification is required to adaptive autopilot design. This paper is devoted to using system identification in position control robotic benchmark via open and closed loops system identification. Hence, applying the closed-loop methods to identify the actuator and airframe of the intended plant in order to design a self-tuning controller. The online system identification is based on the recursive least square method.	https://www.webofscience.com/wos/woscc/full-record/WOS:000651432600001
4	Розподілений закон спільного наведення для кількох ракет із затримкою входу та перемиканням топології	Distributed cooperative guidance law for multiple missiles with input delay and topology switching. Yu, H.; Dai, K.; Li, HJ; Zou, Y.; Ma, X.; Ma, SJ; Zhang, H. JOURNAL OF THE FRANKLIN INSTITUTE. 2021. Volume 358. Issue 17. Page 9061-9085.	This paper considers the simultaneous attack of a stationary target by multiple missiles. A novel fixed-time distributed guidance law based on the proportional navigation (PN) guidance law is designed by integrating a consistent control technique into the guidance strategy. This guarantees that the time-to-go of the missile becomes consistent. The guidance law adopts a discrete design, and a compensation item driven by normal acceleration is added to tangential acceleration. This eliminates the potential singularity problem when the heading angle is zero before the consistency is obtained, and thus the multiple missile system still converges in fixed time. In addition, the proposed guidance law can be applied to both undirected and directed graphs. Furthermore, two improved guidance laws are proposed to improve the robustness of the system against adverse effects caused by input delays and topology switching failures and to provide a theoretical proof. Finally, a simulation is used to verify the performance of the distributed guidance law and its robustness against the above failures.	https://www.webofscience.com/wos/woscc/full-record/WOS:000739703900012
5	Розподілений закон спільного наведення з фіксованим часом для одночасної атаки з обмеженням кута удару	Distributed Fixed-Time Cooperative Guidance Law for Simultaneous Attack With Impact Angle Constraint Zhang, Y.; Sun, SY. IEEE ACCESS, 2025. Volume 13. Page 95307-95320.	Multi-missile cooperative guidance is an important way to improve the strike effect of missiles, and the fast convergence of guidance commands can effectively ensure the stability of multi-missile systems. The cooperative guidance method based on the fixed-time consistency theory has been proved to be suitable for multi-missile coordinated attack, but the non-singularity problem of the controller itself will have a large impact on the striking effect of the multi-missile system, so this paper designs a fixed-time fast non-singular distributed cooperative	https://www.webofscience.com/wos/woscc/full-record/WOS:001504135500038

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			guidance law to solve the above problem. First, a fixed-time cooperative guidance law with fast convergence is designed in the line-of-sight (LOS) direction and an auxiliary function is designed to solve the singularity problem; after that, a cooperative guidance law in the LOS normal direction is designed to ensure that each missile attacks the target simultaneously at the desired attack angle. Finally, the effectiveness, superiority and robustness of the designed guidance law are demonstrated by numerical simulations.	
Матеріалознавство				
1	Експериментальне та числове дослідження характеристик бойової частини PG-7VM у порівнянні з високотвердою броньовою сталлю	Experimental and Numerical Study on the PG-7VM Warhead Performance against High-Hardness Armor Steel. Zochowski, P.; Warchol, R.; Miszczak, M.; Nita, M.; Pankowski, Z.; Bajkowski, M. MATERIALS. 2021. Volume 14. Issue 11, 3020.	Analyses presented in the article were carried out in order to characterize the main parameters of the shaped charge jet formed due to detonation of the PG-7VM warhead. As opposed to the previously published studies in which rolled homogeneous armored steel was mainly used as a target, in the current work the warhead penetration capability was determined against more contemporary high-hardness (500 HB) ARMSTAL 30PM steel armor with precisely determined mechanical properties. The research included experimental depth of penetration tests and their numerical reproduction in the LS-Dyna software. Special attention was paid to factors that could perturbate the shaped charge jet formation process and under- or overestimate its penetration capability. For this reason, warheads were X-ray inspected for structural discrepancies (voids or air inclusions in explosive, misalignment between the body, explosive, and liner, or lack of contact between the explosive and the liner) and properties of materials (explosive, targets, and most important warhead components) were analyzed before the experiments. The numerical model of the warhead was defined more accurately than in previously published studies, since it was based on the real grenade dimensions and its technical documentation. Thanks to this, the depth of penetration of the target made of ARMSTAL 30PM armored steel plates by the shaped charge jet formed from the PG-7VM warhead obtained by numerical simulation was consistent with the experimental results and equaled 278 mm and 280 mm, respectively. The difference between the experimental and numerical value was smaller than 1%, which confirms that the developed methodology of modeling allows users to properly reproduce the PG-7VM shaped charge jet formation and target penetration processes. A verified numerical model of the shaped charge jet penetration into a steel target was used to determine depth of penetration in function of stand-off distance for the PG-7VM warhead. A maximum depth of penetration of about 317 mm was obtained for	https://www.webofscience.com/wos/woscc/full-record/WOS:000660994900001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			the stand-off distance of 360 mm, which may indicate the potential direction of modernization of warheads.	
2	Експериментальне та числове дослідження ауксетичних сендвіч-панелей при вибуховому навантаженні ПЕ4 вагою 160 грамів	Experimental and numerical study of auxetic sandwich panels on 160 grams of PE4 blast loading. Arifurrahman, F.; Critchley, R.; Horsfall, I. JOURNAL OF SANDWICH STRUCTURES & MATERIALS. 2021. Volume 23. Issue 8. Page 3902-3931.	Mines, specifically as Anti-Tank (AT) mines are a significant threat for defence vehicles. While approaches such as v-shaped hulls are currently used to deflect the blast products from such threats, such a solution is not always usable when hull standoff is limited. As such the development of a low profile, energy absorbing solution is desirable. One approach that has potential to achieve these requirements are sandwich panels. While sandwich panel cores can be constructed from various materials, one material of particular interest are auxetics. Auxetic are materials that exhibit a negative Poisson's ratio. This material has potential to be an efficient an impact energy absorber by increasing stiffness at local deformation by gathering mass at the impact location. This study investigates the effectiveness of novel auxetic core infills alongside three other panel types (monolithic, air gap, polymer foam sandwich) against buried charges. 160 grams of PE4 were buried in 100 mm depth and 500 mm stand off the target. Laser and High Speed Video (HSV) system were used to capture the deflection-time profile and load cell sensors were used to record the loading profile received by the panels. Experimental works were compared with numerical model. Explicit model were generated in LSDYNA software as 'initial impulse mine' keyword. The result found that the auxetic and foam core panels were effective in reducing peak structural loading and impulse by up to 33% and 34% respectively. Air-filled panels were the most effective to reduce the deflection of the rear of the plate, however variation between capture methods (HSV and Laser system) were reported, while numerical modelling provided comparable plate deflections responses. When normalised against panel weight, the air filled panels were experimentally the most efficient per unit mass system with the auxetics being the least effective.	https://www.webofscience.com/wos/woscc/full-record/WOS:000583694500001
3	Підготовка та дослідження теплових властивостей високоенергетичної полімерної вибухової речовини на основі HNIW/FOX-7 з низькою вразливістю до теплових подразників	Preparation and thermal properties study of HNIW/FOX-7 based high energy polymer bonded explosive (PBX) with low vulnerability to thermal stimulations. Lan, GC; Jin, SH; Chen, ML; Li, J.; Du, LXS; Wang, JF; Chen, K.; Li, LJ. JOURNAL OF ENERGETIC MATERIALS.	For modern munitions, high energy explosives are expected to reduce vulnerability and improve safety. In this study, based on the formulation of PAX-11 (94 wt% HNIW, 2.4 wt% CAB, 3.6 wt% BDNPA/F), FOX-7 is used as a portion replacement for HNIW to decrease vulnerability. To further decrease mechanical sensitivities and prevent static electricity, 0.5 wt% graphite is added to the surface of PBXs. A series of HNIW/FOX-7 based polymer bonded explosives (PBXs) with different formulations are prepared and mechanical sensitivities, thermal stabilities, detonation velocities, and slow cook-offs are studied to evaluate the energy and hazard of these PBXs.	https://www.webofscience.com/wos/woscc/full-record/WOS:000485446100001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		2020. Volume 38. Issue 1. Page 83-97.	Additionally, finite element numerical simulations are utilized to study the transient temperature distributions, ignition time and ignition locations of the PBX cylinders during slow cook-off. Based on the results of this study, we obtain a high energetic low vulnerable PBX formulation (54 wt% HNIW, 40 wt% FOX-7, 2.4 wt% CAB, 3.6 wt% BDNPA/F, 0.5 wt% additional graphite) that balances energy and vulnerability. This formulation passes the slow cook-off test and detonation velocity reaches 8776 m center dot s(-1), which can be used in the warhead of the high explosive anti-tank cartridge.	
4	Поглинання ударів протитанкової оборони за допомогою конструкції із залізобетонної плити	Anti-tank impact absorption with a reinforced concrete plate design. Polat, BY.; Savas, S.; Polat, A. ADVANCES IN CONCRETE CONSTRUCTION. 2023. Volume 15. Issue 4. Page 229-239.	Anti-tank weapons are among the infantry weapons used by the armies of many countries. Anti-tank rockets and explosives such as TNT, generally used for armour piercing, are also frequently used in terrorist attacks. These attacks damage the protection facilities built from reinforced concrete. Rockets or similar explosives' rapid speed and burst temperatures pierce reinforced concrete during strikes, resulting in casualties and damage to crucial strategic structures. This study aimed to devise an economic and applicable reinforced concrete plate that could absorb the impact of anti-tank rockets and Trinitrotoluene (TNT) type explosives. Therefore, 5 different samples, produced from C50 reinforced concrete and 150x150 cm in size, were formed by combining plates of different numbers and thicknesses. Also, a sample, which was a single thick plate, was prepared. In destructive testing, Rocket Propelled Grenade (RPG-7) was used as the anti-tank rocket launcher. As a result of this study, the impact damage was reduced with hollow concrete plate geometries, and recommendations were developed for complete prevention.	https://www.webofscience.com/wos/woscc/full-record/WOS:001001090700002
5	Вплив невибухового заповнення конічної порожнини кумулятивного заряду на його пробивну здатність	Influence of a non-Explosive Filling Included in the Conical Liner Cavity of a Shaped Charge on its Penetrative Capability. Warchol, R.; Zochowski, P.; Bagrowski, J.; Gedziorowski, M.; Salacinski, T. CENTRAL EUROPEAN JOURNAL OF ENERGETIC MATERIALS. 2023. Volume 20. Issue 4. Page 400-416.	Based on literature, it can be concluded that the results obtained for partially or fully filled inert (non-explosive) material of the free space inside the cone created by the liner inside a shaped charge (SC), have not been deeply examined. Preliminary results in this work were obtained for SCs taken from the warhead of an anti-tank rocket-propelled grenade, PG-7WM (also known as PG-7VM). The warhead was modified by perpendicular intersection and by inserting an inert, i.e. made from non-explosive, cone. Each of the inert fillers was prepared from one of the three materials: copper (type M1E), steel S355, aluminium (type 2024) or a polymer (polyoxymethylene, POM-C). The densities of these materials were 8.9, 7.86, 2.7 and 1.41 g/cm3, respectively. Each inert cone was tightly placed inside the inner area of the cumulative liner cone of the warhead. For each filler, there were three types of cones. The differentiating feature between the fillers under test was the difference in their height, i.e. 1/3, 2/3 and the full	https://www.webofscience.com/wos/woscc/full-record/WOS:001425370900001

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			height of the SC cone. In all tests the effect of the impact of the cumulative jet (SCJ) was observed in an arrangement comprised of three adjacent armoured steel plates (ARMSTAL 30PM), with a total target thickness of 25 mm. It was shown that the application of the inert cones caused significant changes in the dimensions and shapes of the holes through the plates of ARMSTAL 30PM armour steel. The relationship between the densities of tested fillers and the height of the cones made with these fillers versus the effects observed in the armour plate were also taken under account. The filling, obtained from non-explosive material, allows a cut off of the relevant section of the front of the SCJ. It was noted that the tested modifications of the anti-tank rocket-propelled grenade, PG-7WM could find some applications in engineering and sapper work, especially in destroying unexploded munitions.	
Механіка				
1	Експериментальне та числове дослідження динамічної реакції V-подібного корпусу, що піддавався вибуху міни	Experimental and numerical study on dynamic response of V-shaped hull subjected to mine blast. Erdik, A. MECHANICS BASED DESIGN OF STRUCTURES AND MACHINES. 2022. Volume 50. Issue 2. Page 707-725.	Detonation of an anti-tank (AT) mine or improvised explosive device (IED) yields a shock wave, which can result in a severe damage to a vehicle and its personnel. Blast mitigation techniques play important role in dissipating and reflecting incoming blast waves as well as decreasing damage potential. This study set out to investigate the blast mitigation performance of V-shaped hull design of a military vehicle, both from numerical and experimental viewpoint. LS-DYNA was used in numerical studies. Results show that numerical simulation is in accord with blast experiment and maximum deviation percentage between measured and calculated displacements is 15%. Communicated by Prof. Corina Sandu.	https://www.webofscience.com/wos/woscc/full-record/WOS:000517454500001
2	Модифікований лінійно-квадратичний регулятор, що використовується для керування протитанковою керованою ракетою у вертикальній площині	Modified linear-quadratic regulator used for controlling anti-tank guided missile in vertical plane. Nocon, L.; Koruba, Z. JOURNAL OF THEORETICAL AND APPLIED MECHANICS. 2020. Volume 58. Issue 3. Page 723-732.	The paper concerns the issue of optimum control of the strongly non-linear dynamic system, i.e. Anti-Tank Guided Missile (ATGM). The linear-quadratic regulator (LQR) was used to provide control capabilities. In order to use the classic LQR, the dynamics of the object must be presented in the form of a linear-stationary model. This is not possible in the case of the considered missile, mostly due to mass changing in time (intensive consumption of fuel) and varying aerodynamic conditions depending on the Mach number Ma. Thus, we are dealing with a non-stationary system. Moreover, state variables are frequently involved in complex functions, which do not allow one to separate coefficients related to state variables very easily. In order to linearize such a complex system, the paper uses Jacobian, as the matrix of state, calculated at each time instant. The automatic pilot of the ATGM, using the LQR method, determines the signals controlling the angles of flight control surfaces and the thrust vector using	https://www.webofscience.com/wos/woscc/full-record/WOS:000543456900013

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			continuously calculated Jacobians. The paper presents the algorithm for the ATGM control.	
3	Дослідження застосування магнітометра до протитанкових боєприпасів	Study on the Magnetometer Application to the Anti-vehicle Munition. Son, DS; Son, DR; Jung, IS; Ma, KN; Park, BH. JOURNAL OF THE KOREAN MAGNETICS SOCIETY. 2024. Volume 34. Issue 5. Page 189-195.	Combat mobile vehicle are very important weapon system used for army advance. Apposite point of view, anti-vehicle munition was developed to stop combat mobile vehicles movement. Traditional anti-vehicle munition employed pressure sensor to fuse but life cycle is not finite and require very high cost to remove the anti-vehicle munition after mission finished. To improve this weakness anti- vehicle munition employed electronic sensor to detect combat mobile vehicles was developed and suicide bombing after mission was finished. In this work we studied about magnetometers to employ sensor for anti-vehicle munition because combat mobile vehicles is constructed with steel which has ferromagnetic property. We measured magnetic field distributions of combat mobile vehicles bottom, magnitude and distriution of magnetic field were different from different kinds of combat mobile vehicles even though between the same kine of combat mobile vehicles. The range of magnetic field was between 20 mu T and 70 mu T, and we can find possibility of magnetometer which is applied to anti-vehicle munition. Measuring range of the magnetometer is +/- 120 mu T when we consider Earth magnetic field and measuring frequency is 45 Hz. For recognition of combat mobile vehicles with magnetic field, recommended method is not magnitude but change of the magnetic field.	https://www.webofscience.com/wos/woscc/full-record/WOS:001389059900006
4	Керування ракетою з великим кутом атаки для гнучкого розвороту на основі навчання з підкріпленням	High Angle of Attack Missile Control for Agile Turn Based on Reinforcement Learning. Lee, Y.; Park, J.; Kim, Y. AIAA SCITECH 2024 FORUM. 2024.	This study proposes a reinforcement learning-based method to design missile controllers to accurately track high angle-of-attack commands while guaranteeing robustness with respect to the uncertainties in aerodynamic parameters and rapidly changing internal parameters. The structure of the proportional-integral-derivative controller is utilized to form a policy, an angle-of-attack tracking controller in this study, of the reinforcement learning framework. The gains of the controller are trained in an environment where a longitudinal missile system simulates the actual environment including aerodynamic and internal uncertainties. Comparative numerical simulations are performed to demonstrate the performance of the proposed controller.	https://www.webofscience.com/wos/woscc/full-record/WOS:001375987907011
5	Корекція швидкості INS з використанням даних стабілізованого шукача	INS Velocity Correction Using Stabilized Seeker Data Büyükkoçak, S.; Akgül, M.; Ata, EH. AIAA SCITECH 2024 FORUM, 2024.	One of the most important features that affect the performance, range and accuracy of a tactical missile system is the navigation capability of the missile system. Today, navigation systems use inertial measurement units as basic sensors. In this paper, seeker stabilized LOS calculations are used to correct the velocity components of the navigation solution through a Kalman filter to improve navigation accuracy using a control grade IMU in the presence of an electronic	https://www.webofscience.com/wos/woscc/full-record/WOS:001375901807039

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			warfare environment. This work presents a new method that aims to improve the accuracy of INS speed results without relying on GPS signals. The filter works great even when the exact location of the reference point is unknown. The effect of IMU biases, false target data, and flight path on the performance and observability of the filter is extensively investigated through extensive simulation studies using a 6-degree-of-freedom model assuming a flat earth scenario. The findings of this study highlight the potential of the proposed method to effectively integrate seeker measurements into missile applications, thereby increasing the accuracy of INS velocity results. The ability to bypass the need for GPS signals offers a significant advantage in scenarios where GPS signals are unavailable or unreliable.	
Системи автоматизованого управління				
1	Аналіз керування протитанковою ракетою з модифікованим методом лінійно-квадратичного регулятора з векторизацією тяги ракетного двигуна	Control Analysis with Modified LQR Method of Anti-Tank Missile with Vectorization of the Rocket Engine Thrust. Nocon, L.; Grzyb, M.; Szmidt, P.; Koruba, Z.; Nowakowski, L. ENERGIES. 2022. Volume 15. Issue 1, 356.	This article approaches the issue of the optimal control of a hypothetical anti-tank guided missile (ATGM) with an innovative rocket engine thrust vectorization system. This is a highly non-linear dynamic system; therefore, the linearization of such a mathematical model requires numerous simplifications. For this reason, the application of a classic linear-quadratic regulator (LQR) for controlling such a flying object introduces significant errors, and such a model would diverge significantly from the actual object. This research paper proposes a modified linear-quadratic regulator, which analyzes state and control matrices in flight. The state matrix is replaced by a Jacobian determinant. The ATGM autopilot, through the LQR method, determines the signals that control the control surface deflection angles and the thrust vector via calculated Jacobians. This article supplements and develops the topics addressed in the authors' previous work. Its added value includes the introduction of control in the flight direction channel and the decimation of the integration step, aimed at speeding up the computational processes of the second control loop, which is the LQR based on a linearized model.	https://www.webofscience.com/wos/woscc/full-record/WOS:000756726700001
2	Оптимізація траєкторії високошвидкісної протитанкової ракети з кінетичною енергією та імпульсною корекцією	Trajectory optimization of high-speed kinetic energy anti-tank missile with pulse correction. Ma, J.; Miao, HC; Li, HQ; Zhang, YJ. PROCEEDINGS OF THE 40TH CHINESE CONTROL CONFERENCE (CCC), 2021. Page 1581-1585.	High speed kinetic energy antitank missile is an important development direction of antitank weapons in the future. Aiming at the high-speed kinetic energy antitank missile system with pulse correction engine as actuator and three-point guidance scheme, a trajectory optimization method in the lead-in phase is designed, which can be applied in engineering. Firstly, the principle and mathematical model of the pulse correction high-speed kinetic energy antitank missile system are described in detail. Then, the trajectory optimization scheme of the pulse correction high-speed kinetic energy missile in the lead-in phase is described, and the trajectory optimization model is established.	https://www.webofscience.com/wos/woscc/full-record/WOS:000931046701121

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			Then, taking a certain type of high-speed kinetic energy missile as an example, the trajectory optimization scheme of the lead-in phase is verified and analyzed by mathematical simulation. The real results show that the designed trajectory optimization algorithm can effectively reduce the pulse energy consumption in the lead-in phase.	
3	Онлайн-ідентифікація замкнутої системи для виконавчого механізму літаючого апарату	Online closed loop system identification for the actuator of a flying vehicle. Ouda, AN. INTERNATIONAL JOURNAL OF AUTOMATION AND CONTROL. 2021. Volume 15. Issue 3. Page 275-317.	The frequent minor wars have brought to the fore guided missiles as the main weapon against all types of military targets. Restoring the single shot kill probability can be achieved by using two methods as follows: first, using large warhead with the large lethal area; second, design a robust guidance system to reduce the miss-distance with high single shot kill probability. The performance of an anti-tank guided missile can be enhanced by select the nominal model to design the guidance computer system. Furthermore, an online closed-loop system identification is required to adaptive autopilot design. This paper is devoted to using system identification in position control robotic benchmark via open and closed loops system identification. Hence, applying the closed-loop methods to identify the actuator and airframe of the intended plant in order to design a self-tuning controller. The online system identification is based on the recursive least square method.	https://www.webofscience.com/wos/woscc/full-record/WOS:000651432600001
4	Розподілений закон спільного наведення для кількох ракет із затримкою входу та перемиканням топології	Distributed cooperative guidance law for multiple missiles with input delay and topology switching. Yu, H.; Dai, K.; Li, HJ; Zou, Y.; Ma, X.; Ma, SJ; Zhang, H. JOURNAL OF THE FRANKLIN INSTITUTE, 2021. Volume 358. Issue 17. Page 9061-9085.	This paper considers the simultaneous attack of a stationary target by multiple missiles. A novel fixed-time distributed guidance law based on the proportional navigation (PN) guidance law is designed by integrating a consistent control technique into the guidance strategy. This guarantees that the time-to-go of the missile becomes consistent. The guidance law adopts a discrete design, and a compensation item driven by normal acceleration is added to tangential acceleration. This eliminates the potential singularity problem when the heading angle is zero before the consistency is obtained, and thus the multiple missile system still converges in fixed time. In addition, the proposed guidance law can be applied to both undirected and directed graphs. Furthermore, two improved guidance laws are proposed to improve the robustness of the system against adverse effects caused by input delays and topology switching failures and to provide a theoretical proof. Finally, a simulation is used to verify the performance of the distributed guidance law and its robustness against the above failures.	https://www.webofscience.com/wos/woscc/full-record/WOS:000739703900012
5	Розподілений закон спільного наведення з фіксованим часом для одночасної атаки з обмеженням кута удару	Distributed Fixed-Time Cooperative Guidance Law for Simultaneous Attack With Impact Angle Constraint	Multi-missile cooperative guidance is an important way to improve the strike effect of missiles, and the fast convergence of guidance commands can effectively ensure the stability of multi-missile systems. The cooperative guidance method based on the fixed-time consistency theory has been proved to be suitable for multi-missile coordinated	https://www.webofscience.com/wos/woscc/full-record/WOS:001504135500038

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		Zhang, Y.; Sun, SY. IEEE ACCESS. 2025. Volume 13. Page 95307-95320.	attack, but the non-singularity problem of the controller itself will have a large impact on the striking effect of the multi-missile system, so this paper designs a fixed-time fast non-singular distributed cooperative guidance law to solve the above problem. First, a fixed-time cooperative guidance law with fast convergence is designed in the line-of-sight (LOS) direction and an auxiliary function is designed to solve the singularity problem; after that, a cooperative guidance law in the LOS normal direction is designed to ensure that each missile attacks the target simultaneously at the desired attack angle. Finally, the effectiveness, superiority and robustness of the designed guidance law are demonstrated by numerical simulations.	
Телекомунікації				
1	Розробка повітряного георадара для виявлення наземних мін та саморобних вибухових пристроїв: аналіз антен та взаємне порівняння	Development of an Airborne-Based GPR System for Landmine and IED Detection: Antenna Analysis and Intercomparison. Fernández, MG; Narciandi, GA; Arboleya, A.; Antuña, CV; Andrés, FLH; López, YA. IEEE ACCESS. 2021. Volume 9. Page 127382-127396.	Airborne-based Ground Penetrating Radar (GPR) systems have proved to be an efficient solution for safe and accurate detection of buried threats such as Improvised Explosive Devices (IEDs) and anti-personnel and anti-tank landmines. The design of these prototypes is influenced by several parameters such as the working frequency band or the maximum weight and size of the payload to be placed on board the Unmanned Aerial Vehicle (UAV). In this sense, one of the main bottlenecks found in the design of these systems is the proper selection of the GPR antenna. This contribution focuses on the analysis of different Ultra Wideband (UWB) Vivaldi antennas and their performance in the context of an airborne-based GPR system. First, the Vivaldi antennas are characterized in terms of S-11, radiation pattern, directivity, and phase center. Next, they are placed on board the implemented airborne-based GPR prototype to assess their impact on the detection capabilities of the system. In addition, other criteria such as the weight and size of the antennas are considered to make the final selection. Finally, the selected UWB Vivaldi antennas are tested in a realistic scenario.	https://www.webofscience.com/wos/woscc/full-record/WOS:000697810900001
2	Реалізація USRP георадара з використанням комбінації принципів ступінчастої зміни частоти та ортогональне частотне мультиплексування	USRP Implementation of a Ground Penetrating Radar Using a Combination of Stepped Frequency and OFDM Principles. Kafedziski, V.; Pecov, S.; Tanevski, D. IEEE. INTERNATIONAL CONFERENCE ON BROADBAND	We present a Software Defined Radio (SDR) implementation of a Ground Penetrating Radar which uses much larger bandwidth than the SDR instantaneous RF bandwidth in order to increase radar resolution. It is based on the Stepped Frequency principle, where the baseband signal is an Orthogonal Frequency Division Multiplexing (OFDM) signal, transmitted in different subbands by modulating the RF stepped frequencies. Using OFDM in each subband provides faster signal transmission and simpler detection. The receive signal-to-noise ratio (SNR) is improved by repeating a number of times the transmit baseband signal before modulating each RF frequency. The random	https://www.webofscience.com/wos/woscc/full-record/WOS:000621671100002

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		COMMUNICATIONS FOR NEXT GENERATION NETWORKS AND MULTIMEDIA APPLICATIONS (COBCOM), 2020.	phase discontinuities between the adjacent subbands that appear when the RF frequency is changed, are removed by postprocessing the received signal. Singular value decomposition is used to remove the effects of the direct and the ground reflected waves. We perform field experiments with anti-tank mines buried in the ground. The resulting B-scans provide excellent detection and localization of the buried objects.	
3	Робастне H∞ проектування фільтрів нелінійних стохастичних сигнальних систем на основі глибоких нейронних мереж	Robust H∞ Deep Neural Network-Based Filter Design of Nonlinear Stochastic Signal Systems. Chen, BS; Wu, PH; Lee, MY. IEEE ACCESS. 2021. Volume 9. Page 165103-165119.	Recently, deep neural network (DNN) schemes based on big data-driven methods have been successfully applied to image classification, communication, translation of language, speech recognition, etc. However, more efforts are still needed to apply them to complex robust nonlinear filter design in signal processing, especially for the robust nonlinear H-infinity filter design for robust state estimation of nonlinear stochastic signal system under uncertain external disturbance and output measurement noise. In general, the design problem of robust nonlinear H-infinity filter needs to solve a complex Hamilton-Jacobi-Isaacs equation (HJIE), which is not easily solved analytically or numerically. Further, the robust nonlinear H-infinity filter is not easily designed by training DNN directly via conventional big data schemes. In this paper, a novel robust H-infinity HJIE-embedded DNN-based filter design is proposed as a co-design of H-infinity filtering algorithm and DNN learning algorithm for the robust state estimation of nonlinear stochastic signal systems with external disturbance and output measurement noise. In the proposed robust H-infinity DNN-based filter design, we have proven that when the approximation error of HJIE by the trained DNN through Adam learning algorithm approaches to 0, the HJIE-embedded DNN-based filter will approach the robust nonlinear H-infinity filter of nonlinear stochastic signal system with uncertain external disturbance and output measurement noise. Finally, a trajectory estimation problem of 3-D geometry incoming nonlinear stochastic missile system by the proposed robust H-infinity HJIE-embedded DNN-based filter scheme through the measurement by the sensor of radar system with external disturbance and measurement noise is given to illustrate the design procedure and validate its robust H-infinity filtering performance when compared with the extended Kalman filter and particle filter.	https://www.webofscience.com/wos/woscc/full-record/WOS:000734422800001
4	Розподілений закон спільного наведення з фіксованим часом для одночасної атаки з обмеженням кута удару	Distributed Fixed-Time Cooperative Guidance Law for Simultaneous Attack With Impact Angle Constraint	Multi-missile cooperative guidance is an important way to improve the strike effect of missiles, and the fast convergence of guidance commands can effectively ensure the stability of multi-missile systems. The cooperative guidance method based on the fixed-time consistency theory has been proved to be suitable for multi-missile coordinated	https://www.webofscience.com/wos/woscc/full-record/WOS:001504135500038

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
		Zhang, Y.; Sun, SY. IEEE ACCESS. 2025. Volume 13. Page 95307-95320.	attack, but the non-singularity problem of the controller itself will have a large impact on the striking effect of the multi-missile system, so this paper designs a fixed-time fast non-singular distributed cooperative guidance law to solve the above problem. First, a fixed-time cooperative guidance law with fast convergence is designed in the line-of-sight (LOS) direction and an auxiliary function is designed to solve the singularity problem; after that, a cooperative guidance law in the LOS normal direction is designed to ensure that each missile attacks the target simultaneously at the desired attack angle. Finally, the effectiveness, superiority and robustness of the designed guidance law are demonstrated by numerical simulations.	
5	Спільний удар кількома ракетами по стаціонарній цілі на основі розподіленої моделі прогнозного керування	Multi-missile Cooperative Strike on Stationary Target Based on Distributed Model Predictive Control Chen, YD; Ning, ZK; Zhang, K.; Li, B. ADVANCES IN GUIDANCE, NAVIGATION AND CONTROL. 2023. Volume 845. Page 2678-2687.	This paper mainly studies multi-missile system cooperative strike on stationary target and designs a controller based on distributed model predictive control (DMPC) to ensure the performance of multi-missile strike system. The contributions of this paper are summarized as: Firstly, the nonlinear continuous model predictive control (MPC) system is linearized into discrete MPC system. Secondly, the distributed model predictive control method is used to get nice control effect and the computational complexity is reasonable. Finally, one consider the time of multiple missiles and the consistency of the distance between the target, the effect of simultaneously strikeing the target can be achieved through information exchange betoneen each missile. The simulation is used to verity the effectiveness of the proposed method.	https://www.webofscience.com/wos/woscc/full-record/WOS:001463221800261
Термодинаміка				
1	Підготовка та характеристика експлуатаційних характеристик високоенергетичної низьковразливої полімерно-зв'язаної вибухової речовини на основі HNIW (гексанітрогексаазаізовюрцитан) / NTO (3-nitro-1,2,4-triazole-5-one)	Preparation and performances characterization of HNIW/NTO-based high-energetic low vulnerable polymer-bonded explosive. Lan, GC; Jin, SH; Chen, ML; Li, J.; Lu, ZY; Wang, N.; Li, LJ. JOURNAL OF THERMAL ANALYSIS AND CALORIMETRY. 2020. Том 139. Volume 6. Page 3589-3602.	To satisfy the energy and security requirements of the explosives, it is necessary to develop high-energetic low vulnerable explosive. As the representatives of high-energetic explosives and low vulnerable explosives, hexanitrohexaazaisowurtzitane (HNIW) and 3-nitro-1,2,4-triazole-5-one (NTO) are used to research high-energetic low vulnerable polymer-bonded explosive (PBX) in this study. Based on the formulation of PAX-11 (94 mass% HNIW, 2.4 mass% CAB, 3.6 mass% BDNPA/F), some HNIW is replaced by NTO to reduce the vulnerability of the PBX during this work. Solution-water suspension method was used to prepare a series PBXs with different formulations. The explosion probability method, differential scanning calorimeter and accelerating rate calorimeter are used to evaluate the hazards of different PBX molding powders. And the thermal vulnerabilities, mechanical properties and energy levels of PBX columns are assessed by slow cook-off tests, tensile strengthes and detonation velocities, respectively. Moreover, finite element numerical simulations are	https://www.webofscience.com/wos/woscc/full-record/WOS:000519668200021

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
			adopted to study the transient temperature distributions, ignition time and ignition locations of the PBX columns during slow cook-off. The investigated results show that when the mass fraction of HNIW and NTO is 50% and 44%, respectively, the PBX passes the slow cook-off test and the detonation velocity reaches 8685 m s(-1). To balance the energy and vulnerability of the PBXs, we obtain a high-energetic low vulnerable PBX formulation (50 mass% HNIW, 44 mass% NTO, 2.4 mass% CAB, 3.6 mass% BDNPA/F, 0.5 mass% additional graphite) which can be used in the warhead of the high-explosive anti-tank cartridge.	
2	Термохімічні та енергетичні характеристики N-(2,2-біс(метокси-NNO-азокси)етил)нітрамінів	Thermochemical and Energy Characteristics of N-(2,2-bis(methoxy-NNO-azoxy)ethyl)nitramines. Zyuzin, IN; Lempert, DB; Nabatova, AV; Kazakov, AI. COMBUSTION EXPLOSION AND SHOCK WAVES. 2020. Volume 56. Issue 4. Page 464-470.	The standard enthalpies of formation of 1,1-bis(methoxy-NNO-azoxy)-3-nitro-3-azabutane and 1,1,8,8-tetrakis (methoxy-NNO-azoxy)-3,6-dinitro-3,6-diazaoctane were experimentally determined to be 87.7 +/- 3.9 and 283.8 +/- 6.2 kJ/mol, respectively. Calculations have shown that solid composite propellants containing these two compounds as gasifying components in metal-free compositions based on an active binder and ammonium perchlorate are inferior in the maximum achievable effective impulse at the third stage of the rocket system I-ef (3) to compositions based on HMX, but in designing special compositions with a limited content of organic explosive (not higher than 30-35%), these two compounds provide 5-10 s higher values of I-ef (3) than when using HMX.	https://www.webofscience.com/wos/woscc/full-3record/WOS:000564989300010
3	Порівняння ефективності блокування хвилею тиску в структурному перегородковому інжекторі та флюїдному перегородковому інжекторі	Comparison of blockage performance of pressure wave in structural baffle injector and fluidic baffle injector. Song, W.; Cha, J.; Yoon, Y.; Koo, J. ACTA ASTRONAUTICA. 2020. Volume 176. Page 666-671.	The role of the structural baffle injectors and blades in the liquid rocket engine is to block the transverse pressure waves that are caused by combustion instability. Although the protection of the liquid rocket system from high-frequency combustion instability is essential, there are side effects such as increased weight of the rocket and thermal effect. In this study, a fluidic baffle injector was applied to the simulant spray system, expecting that it would operate with the same performance as a structural baffle injector.	https://www.webofscience.com/wos/woscc/full-record/WOS:000583679400062
4	Перша ступінь зондування ракети на твердому паливі	A Sounding Rocket Solid Propellant First Stage. Berndl, M.; Eineder, L.; Esterl, R.; Fechler, G.; Hacker, A.; Kuhn, M.; Meyer, T.; Müller, I.; Naumann, KW; Rest, S.; Stadler, L.; Stangl, D.; Steinfeld, H.; Vetter, M.; Weigand, A.; Kirchhartz, R.; Scheuerpflug, F. AIAA PROPULSION AND ENERGY 2021 FORUM, 2021.	The Sounding Rocket Motor named "Red Kite (R)" is a development for the German Aerospace Center (DLR) and its Mobile Rocket Base (MORABA) with a propellant mass of about 1 metric ton. The challenge for the program is a three year period of time for development and qualification. The use of proven materials, methods and components is one applied method to reduce risk. The interfaces fit existing components without any modifications. The development of Bayern-Chemie's biggest solid rocket motor so far paves the way for the development and qualification of further solid rocket motors for micro-launcher stages.	https://www.webofscience.com/wos/woscc/full-record/WOS:001327980305074

	Назва публікації (укр.)	Дані про публікацію	Анотація (англ.)	Посилання
5	Стала система протитанкових перешкод із застосуванням цивільно-військової співпраці у високоурбанізованих районах	Sustainable Anti-Tank Obstacle System Applying Civil-Military Cooperation in Highly Urbanized Areas. Kim, K.; Jeon, Y.; Park, YJ; Park, S. SUSTAINABILITY. 2022. Volume 14. Issue 19, 12715.	Decreasing the use of concrete in construction projects is an important factor in sustainability awareness and green planning. In the past, the military installed and managed concrete block-shaped obstacles called "rock drops" on major roads in order to hinder enemy movement. As the cities surrounding Seoul are developing, traffic volumes are increasing, and traffic networks are expanding, such types of obstacles are becoming obsolete and need to be replaced by a new eco-friendly, urban-friendly alternative. This study proposes a new sustainable anti-tank obstacle and demonstrates its performance through a finite element analysis. In addition, this study analyzes the effect of the proposed obstacle as a civil-military cooperation policy with respect to sustainability by comparing the CO_2 emissions between the original and the proposed ones. Once one rock drop obstacle made of massive concrete blocks is replaced, CO_2 emissions can be reduced by as much as 99.2%. If 100 rock drop obstacles distributed in the surrounding areas of Seoul are replaced, then 347,581 tons of CO_2 emissions would be reduced. This corresponds to total cost savings of USD 17,379,050 based on the Korean carbon transaction price of USD 50/ton-CO_2.	https://www.webofscience.com/wos/woscc/full-record/WOS:000868047600001

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