

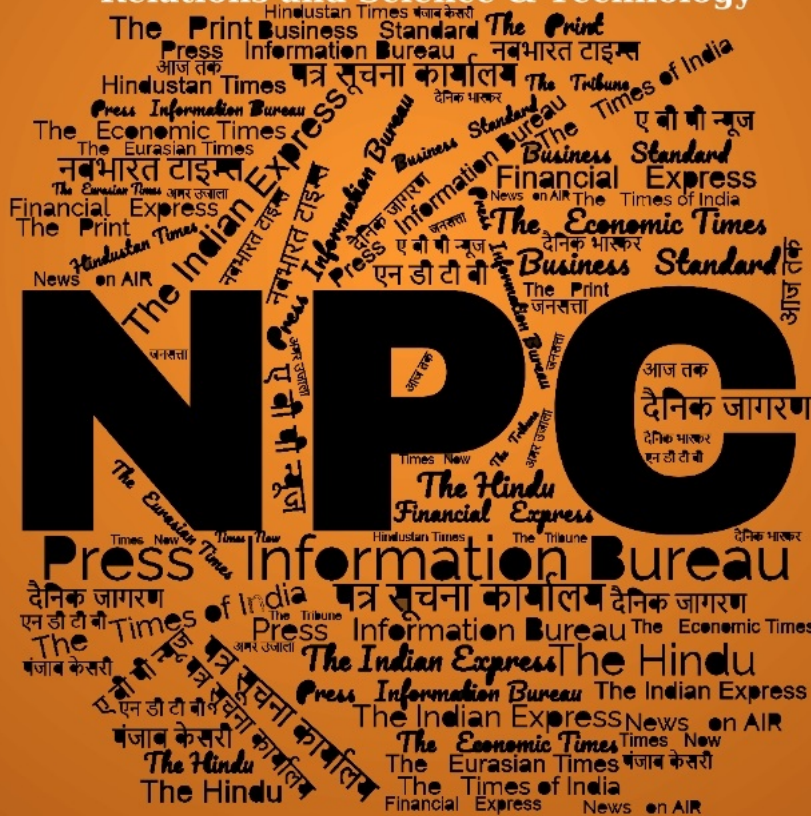
सितम्बर
Sep
2024

खंड/Vol. : 49 अंक/Issue : 173
18 /09/2024

समाचार पत्रों से चयनित अंश Newspapers Clippings

डीआरडीओ समुदाय को डीआरडीओ प्रौद्योगिकियों, रक्षा प्रौद्योगिकियों, रक्षा नीतियों, अंतर्राष्ट्रीय संबंधों और विज्ञान एवं प्रौद्योगिकी की नूतन जानकारी से अवगत कराने हेतु दैनिक सेवा

A Daily service to keep DRDO Fraternity abreast with DRDO Technologies, Defence Technologies, Defence Policies, International Relations and Science & Technology



रक्षा विज्ञान पुस्तकालय
Defence Science Library
रक्षा वैज्ञानिक सूचना एवं प्रलेखन केंद्र
Defence Scientific Information & Documentation Centre
मेटकॉफ हाउस, दिल्ली - 110 054
Metcalf House, Delhi - 110 054

CONTENTS

S. No.	TITLE		Page No.
	Defence News		1-10
	Defence Strategic: National/International		
1	Chief of Integrated Defence Staff Lt Gen JP Mathew to attend Indo-Pacific Chiefs of Defence conference in Hawaii, USA	<i>Press Information Bureau</i>	1
2	India, US hold 2+2 Intersessional, discuss strategic and defence priorities	<i>The Economic Times</i>	1
3	Army starts two-day 'drone-a-thon' in Ladakh	<i>The Economic Times</i>	2
4	Plentiful, mobile, deadly: US strategy for anti-ship weapons aims to counter China's naval power	<i>The Economic Times</i>	3
5	North Korea test-fired ballistic missiles in latest military display, neighbors say	<i>The Economic Times</i>	5
6	USS New Jersey: Pioneering Gender Integration in the US Navy's Submarine Fleet	<i>Financial Express</i>	6
7	Steps taken to improve self-reliance in defence sector, says Rajnath	<i>The Hindu</i>	7
8	Uttarkashi: वायुसेना का अभ्यास शुरू, चिन्यालीसौड़ हवाई पट्टी के ऊपर गरजा AN-32 विमान, दो बार लगाए चक्कर	<i>Amar Ujala</i>	8
9	Nigeria Set To Become The First Export Customer Of Four Prachand Light Combat Helicopters: Report	<i>Swarajya</i>	8
10	Indian Air Force set to receive Tejas Mk 1A Combat Aircraft next month after delays in engine delivery	<i>The Economic Times</i>	9
	Science & Technology News		11-16
11	How quantum computing can make large language models even better	<i>The Hindu</i>	11
12	Superfast lasers open a shortcut to hard drives of the future	<i>The Hindu</i>	13



Press Information Bureau
Government of India

Ministry of Defence

Tue, 17 Sep 2024

Chief of Integrated Defence Staff Lt Gen JP Mathew to attend Indo-Pacific Chiefs of Defence conference in Hawaii, USA

Chief of Integrated Defence Staff (CISC) Lt Gen JP Mathew will attend the Indo-Pacific Chiefs of Defence (IP-CHOD) conference in Hawaii from 18-20 September 2024. The gathering will bring together top military leaders from the Indo-Pacific region to discuss shared security challenges, enhance mutual understanding and foster military-to-military cooperation.

The discussions will be centered around regional security, counter-terrorism, maritime domain awareness and cooperation, and commitment to joint training and exercises.

The United States Indo-Pacific Command hosts virtual IP-CHOD meetings quarterly to provide a forum for open dialogue between military leaders and discuss the regional security environment. The in-person meeting is held on an annual basis.

The representation of the Indian Armed Forces in the event demonstrates our nation's commitment to regional stability and security.

<https://pib.gov.in/PressReleasePage.aspx?PRID=2055761>

THE ECONOMIC TIMES

Tue, 17 Sep 2024

India, US hold 2+2 Intersessional, discuss strategic and defence priorities

India and the US held the 2+2 Intersessional on Monday and the discussions covered bilateral strategic and defence priorities as well as regional and global issues. The officials of the Ministry of External Affairs and Defence and the US State and Defence Departments attended the 2+2 Intersessional.

In a post on X, Ministry of External Affairs (MEA) official spokesperson Randhir Jaiswal stated, "India and the US held the 2+2 Intersessional today with officials from India's Ministry of External Affairs and Defence, and the U.S. State and Defense Departments. Key discussions covered bilateral strategic and defense priorities, alongside regional and global issues."

Earlier on September 13, Union Finance Minister Nirmala Sitharaman held a meeting with a delegation from the US International Development Finance Corporation (DFC) here in the national capital. The delegation was headed by Deputy Chief Executive Officer Nisha Biswal. The delegation included US Ambassador to India Eric Garcetti and Assistant US Trade Representative for South and Central Asia Brendan Lynch.

According to the Ministry of Finance, discussions were centred on strengthening economic cooperation between India and the US, with a particular focus on investment opportunities in India. "Union Finance Minister Smt.@nsitharaman interacted with a delegation from the U.S. International Development Finance Corporation @DFCgov with Deputy Chief Executive Officer, Ms.@NishaBiswal; US DFC @DFCgov shared that India offers good opportunities and is one of their key geographies for #investment," Ministry of Finance said in a post on X.

During the interaction, representatives from DFC acknowledged India's significant potential as a key geography for investment. They highlighted the favourable opportunities in various sectors and expressed their commitment to further expanding their investment footprint in the country.

Finance Minister Sitharaman also emphasised the broad-based and multisectoral cooperation between India and the US, noting that recent reforms and the country's evolving investment climate have created a conducive environment for growth. She highlighted India's potential for increased economic cooperation, particularly in sectors crucial to sustainable development and innovation.

<https://economictimes.indiatimes.com/news/defence/india-us-hold-22-intersessional-discuss-strategic-and-defence-priorities/articleshow/113409112.cms>

THE ECONOMIC TIMES

Tue, 17 Sep 2024

Army starts two-day 'drone-a-thon' in Ladakh

The Indian Army on Tuesday started a two-day 'drone-a-thon' to revolutionise the operations and provide tactical superiority in difficult terrains.

"In a bold stride towards redefining military capabilities in highaltitude environments, the Indian Army, in collaboration with the Federation of Indian Chambers of Commerce and Industry (FICCI), conducted the highly anticipated HIMDRONE-A-THON 2," officials said. They said this "pioneering initiative" the power of cutting-edge indigenous technology, focusing on enhancing operational efficiency and tactical superiority in some of the most challenging terrain on the planet through the use of drones within the ambit of 'Atmanirbhar Bharat'.

"Drones are increasingly playing a significant role in modern warfare as seen in recent conflicts in Ukraine and Israel. The roles are expanding across various domains to include surveillance, logistics, precision strikes, communication etc. Their growing role reflects their versatility, effectiveness and potential to transform military operations," the officials said.

The drone-a-thon is being conducted in Ladakh at altitudes exceeding 15,000 feet, and offers an exclusive platform for over 20 drone manufacturers to showcase a spectrum of drone solutions

designed for high-altitude. "All participants were felicitated for their innovations and participation. Special recognition was given to the winners in the logistics and FPV categories.

These products spanned across domains of surveillance, logistics, swarm and FPV (first-person view) operations," they added.

The drone-a-thon is being conducted in Ladakh at altitudes exceeding 15,000 feet, and offers an exclusive platform for over 20 drone manufacturers to showcase a spectrum of drone solutions designed for high-altitude.

"All participants were felicitated for their innovations and participation. Special recognition was given to the winners in the logistics and FPV categories. These products spanned across domains of surveillance, logistics, swarm and FPV (first-person view) operations," they added.

<https://economictimes.indiatimes.com/news/defence/army-starts-two-day-drone-a-thon-in-ladakh/articleshow/113430070.cms>

THE ECONOMIC TIMES

Tue, 17 Sep 2024

Plentiful, mobile, deadly: US strategy for anti-ship weapons aims to counter China's naval power

The United States is amassing an arsenal of abundant and easily made anti-ship weapons as part of American efforts to deter China in the IndoPacific region and gear up U.S. forces there. Russia's invasion of Ukraine has pushed U.S. thinking toward a new philosophy - "affordable mass," as one missile industry CEO put it, speaking on condition of anonymity, referring to having plenty of relatively cheap weapons at the ready.

"It's a natural counter to what China has been doing," said Euan Graham, a senior analyst with the Australian Strategic Policy Institute think tank, referring to the Chinese arsenal of ships and conventional ballistic missiles including those designed to attack vessels.

The Pentagon and China's Ministry of Defence did not immediately respond to requests for comment. The United States has ramped up testing of its QUICKSINK weapon, an inexpensive and potentially plentiful bomb equipped with a low-cost GPS guidance kit and a seeker that can track moving objects.

The U.S. Air Force used a B-2 stealth bomber during a test last month in the Gulf of Mexico to strike a target ship with QUICKSINK.

China will still have a large advantage in sheer numbers of anti-ship missiles, according to experts, and can base them on its home territory. But increasing U.S. production of QUICKSINK would narrow that gap by putting China's 370 or so warships at more risk during any future conflict than they have faced since before Beijing leaned into modernizing its military in the 1990s.

QUICKSINK, still in development, is made by Boeing, with a seeker from BAE Systems.

QUICKSINK can be used with the hundreds of thousands of JointDirect Attack Munition tail kits - systems that can be dropped from U.S. or allied warplanes and cheaply turn "dumb" 2,000-pound (900-kg) bombs into guided weapons. The U.S. military's Indo-Pacific Command wants thousands of the QUICKSINK weapons - and has for years - according to an industry executive, who declined

to reveal the precise figure because it is classified. With enough "affordable mass" weapons aimed at them, Chinese ship defences would be overwhelmed, according to this executive, speaking on condition of anonymity.

In such a scenario, the U.S. military would use Long Range Anti-Ship Missiles (LRASM) or SM-6 missiles to damage a Chinese warship and its radars, then bombard the vessel with lower-cost weapons such as QUICKSINK.

A Variety Of Weapons

The United States has been amassing a variety of anti-ship weapons in Asia. In April, the U.S. Army deployed its new Typhon mobile missile batteries, which were developed cheaply from existing components and can fire SM-6 and Tomahawk missiles against sea targets, to the Philippines during an exercise.

Such weapons are relatively easy to produce - drawing on large stockpiles and designs that have been around for a decade or more - and could help the United States and its allies catch up quickly in an Indo-Pacific missile race in which China has a big lead.

Although the U.S. military has declined to say how many will be deployed in the Indo-Pacific region, more than 800 SM-6 missiles are due to be bought in the next five years, according to government documents outlining military purchases. Several thousand Tomahawks and hundreds of thousands of JDAMs are already in U.S. inventories, the documents showed.

"China's game is to restrict the movement of U.S. Navy assets in the Western Pacific and First Island Chain," Graham said, referring to the closest major archipelagos from the coast of East Asia.

"This is a sort of like-minded response to make life difficult for the PLAN."

PLAN is short for the People's Liberation Army Navy, China's maritime service branch. Placing anti-ship weapons in locations such as the Philippines would put them within reach of much of the South China Sea.

China claims 90% of the South China Sea as its sovereign territory, but is opposed by five Southeast Asian states and Taiwan. Collin Koh, a scholar at the S. Rajaratnam School of International Studies in Singapore, said, "In a way it is like levelling the playing field."

Koh cited the example of Iran-aligned Houthi forces using low-tech anti-ship weapons against civilian traffic in the Red Sea, which forced the United States and others to deploy costly weapons to defend against them.

"If you look at the case of the Red Sea, clearly the cost equation (of anti-ship missiles) doesn't fall on the side of the defender," Koh said. "Even if you have a smaller arsenal of such offensive missile systems, you can still project some deterrence."

<https://economictimes.indiatimes.com/news/defence/plentiful-mobile-deadly-us-strategy-for-anti-ship-weapons-aims-to-counter-chinas-naval-power/articleshow/113413317.cms>

North Korea test-fired ballistic missiles in latest military display, neighbors say

North Korea on Wednesday test-fired multiple ballistic missiles toward its eastern seas, the South Korean and Japanese militaries said, adding to its military demonstrations as tensions with Washington and neighbors escalate.

The launches come days after North Korea offered a rare view into a secretive facility built to enrich uranium for nuclear bombs as leader Kim Jong Un called for a rapid expansion of his nuclear weapons program. South Korea's Joint Chiefs of Staff said it detected North Korea firing multiple short-range ballistic missiles from north of its capital, Pyongyang, and said they traveled about 400 kilometers (244 miles) while flying toward the northeast.

The joint chiefs said it was closely communicating with the United States and Japan while analyzing the launches but didn't immediately provide further flight details. Japan's defense ministry said it detected at least two launches but didn't immediately say what types of missiles they were and how far they flew.

Japan's coast guard said the missiles were believed to have already fallen into waters between the Korean Peninsula and Japan and urged vessels to watch out for falling objects. Japan's NHK television said the missiles were believed to have landed outside of Japan's exclusive economic zone.

The South Korean joint chiefs condemned the launches as a provocation that "seriously threatens peace and stability on the Korean Peninsula."

It said in a statement that South Korean and U.S. militaries were closely monitoring North Korean activities while maintaining a combined defense posture "to respond overwhelmingly to any provocation."

North Korea didn't immediately confirm the launches. They followed a previous round of ballistic tests last week as Kim vowed to have his nuclear force fully ready for battle with its rivals. The North said the launches on Sept. 12 involved its "super-large" 600mm multiple rocket launchers, which it describes as capable of delivering tactical nuclear warheads.

Experts say North Korea's large-sized artillery rockets blur the boundary between artillery systems and ballistic missiles because they can create their own thrust and are guided during delivery.

Since 2022, North Korea has ramped up its weapons testing activities to expand and modernize its arsenal of nuclear missiles targeting the U.S. and South Korea. The allies have expanded their combined military exercises and are updating their nuclear deterrence strategies based on U.S. assets to counter the North's growing threat.

Analysts say Kim's long-term goal is to force the United States to accept the idea of the North as a nuclear power and negotiate economic and security concessions from a position of strength. While disclosing the uranium enrichment facility last week, Kim called for stronger efforts to "exponentially" increase its number of nuclear weapons in the face of what he described as U.S. threats.

State media published photos that showed Kim talking with military officials and scientists between long lone lines of centrifuges used to produce weapons-grade uranium, but the reports didn't say where the facility was located or when Kim made the visit.

Analysts say North Korea could conduct a nuclear test explosion or longrange missile test ahead of the U.S. presidential election in November with the intent of influencing the outcome and increasing its leverage in future dealings with the new U.S. administration.

<https://economictimes.indiatimes.com/news/defence/north-korea-test-fired-ballistic-missiles-in-latest-military-display-neighbors-say/articleshow/113440497.cms>



Tue, 17 Sep 2024

USS New Jersey: Pioneering Gender Integration in the US Navy's Submarine Fleet

The US Navy has entered a new chapter in its history of gender inclusion with the commissioning of the USS `New Jersey`, a Virginia-class fast-attack submarine that has been designed from its inception to fully integrate male and female sailors. The commissioning ceremony took place at Naval Weapons Station Earle in Middletown, New Jersey, marking the vessel's entry into service as a key component of the Navy's modern submarine fleet.

At 377 feet in length and with a 34-foot beam, the USS `New Jersey` is the third Navy ship to carry the state's name, following the famous battleship BB-62, which saw action in World War II, the Korean War, and the Vietnam War. However, the new USS `New Jersey` represents more than just a tribute to New Jersey's naval history. This submarine symbolizes the Navy's commitment to integrating gender diversity in its operations and tackling long-standing challenges in the submarine service.

Cmdr. Steve Halle, commanding officer of the USS `New Jersey`, lauded the crew during the ceremony, acknowledging the complexity of their mission and the historic significance of the vessel. "You operate the most complex platform on the planet and you continuously strive for excellence," Halle said. "Our superior professionalism is enhanced by our crew integration and our diversity." This message speaks directly to the Navy's new direction, where gender inclusivity is not just an obligation but an enhancement of operational effectiveness.

The USS `New Jersey` is the first submarine in the Virginia class to be built specifically to accommodate both male and female sailors from the outset. This design move follows the Navy's decision in 2010 to lift its ban on women serving on submarines, a policy shift that posed logistical challenges due to the confined nature of submarine environments. As a result, previous submarines had to be retrofitted to allow for gender integration. However, the USS `New Jersey` represents a forward-thinking approach to designing submarines that are inherently inclusive.

The submarine's modifications include increased privacy in sleeping quarters and washrooms, designed to address concerns about living conditions for mixed-gender crews. In addition, equipment such as overhead valves and bunks were redesigned to account for differences in height, reach, and strength, ensuring that all crew members, regardless of gender, can perform their duties comfortably. Vice Admiral Robert Gaucher, commander of Submarine Forces Atlantic, highlighted

these innovations, stating, “The USS `New Jersey’ was designed for two genders from the beginning, ensuring seamless integration and operational readiness.”

Beyond its practical advancements, the USS `New Jersey’ also honours its home state. The submarine’s interior features memorabilia reflecting New Jersey’s culture, including a guitar signed by rock legend Jon Bon Jovi, a native of the state. The submarine has even earned the nickname “Jersey Girl” among some of its crew members, unofficially connecting it to its cultural roots.

The commissioning of the USS `New Jersey’ marks a significant step in the Navy’s efforts to expand opportunities for women in submarine service. As of 2023, there were over 600 female sailors serving on operational submarines, mostly on retrofitted Ohio-class vessels. The Navy plans to further increase the number of gender-integrated submarines, with future nuclear-powered attack submarines and Columbia-class ballistic missile submarines designed to be gender-neutral from the keel up.

The addition of the USS `New Jersey’ to the fleet is a testament to the Navy’s broader goals of fostering diversity and inclusion while maintaining operational excellence. The Navy’s evolving approach to integrating women into its submarine force not only strengthens the military but also sets a precedent for future generations of sailors.

<https://www.financialexpress.com/business/defence-uss-new-jersey-pioneering-gender-integration-in-the-us-navys-submarine-fleet-3613098/>



Tue, 17 Sep 2024

Steps taken to improve self-reliance in defence sector, says Rajnath

Defence Minister Rajnath Singh on Tuesday (September 17, 2024) said that, in the first 100 days of its third term under the leadership of Prime Minister Narendra Modi, the NDA government had started a series of infrastructure development and welfare programmes.

Mr. Singh told reporters that the Central government was taking all possible steps to achieve the objective of making India a developed nation. He said in these three months, the Defence Acquisition Council had decided to procure items costing over ₹1.5 lakh crore.

In the effort to make India self-reliant in the defence sector, he said 346 more items had been included in the list of strategically important products to be manufactured in India and by Indians. The public sector undertakings were also being encouraged to develop and manufacture defence related products.

“We were confident of coming back to power for the third time and, therefore, under the leadership of Prime Minister Narendra Modi, all the Ministries had already prepared a plan of action for the first 100 days of the third term. After the Cabinet was formed, many key decisions were taken and they are now being implemented,” he said.

<https://www.thehindu.com/news/national/steps-taken-to-improve-self-reliance-in-defence-sector-says-rajnath/article68652539.ece>

Uttarkashi: वायुसेना का अभ्यास शुरू, चिन्यालीसौड़ हवाई पट्टी के ऊपर गरजा AN-32 विमान, दो बार लगाए चक्कर

चिन्यालीसौड़ हवाई पट्टी पर भारतीय वायुसेना का एक सप्ताह का अभ्यास शुरू हो गया है। मंगलवार को पहले दिन आगरा एयरबेस से पहुंचे वायुसेना के मल्टीपर्पज एएन 32 विमान ने दो बार हवाई अड्डे के ऊपर उड़ान भरी। इस दौरान पूरा क्षेत्र इस विमान की तेज गर्जना से गूँज उठा।

मंगलवार को वायुसेना ने चिन्यालीसौड़ हवाई अड्डे पर अभ्यास शुरू कर दिया। इस अभ्यास के लिए जहां सोमवार को ही गोरखपुर से मौसम विशेषज्ञ यहां पहुंच गए थे। वहीं, मंगलवार सुबह बिहार से वायुसेना की दो सदस्यीय टेक्निकल टीम यहां पहुंची, जिसके पहुंचने के बाद सुबह 11:15 बजे वायुसेना का मल्टीपर्पज विमान एएन 32 आगरा एयरबेस से हवाई अड्डे के ऊपर गर्जना करते हुए पहुंचा।

दो बार हवाई अड्डे के ऊपर चक्कर लगाते हुए विमान करीब 12 बजे वापस आगरा एयरबेस लौट गया। सैन्य सूत्रों के अनुसार, बुधवार से वायुसेना यहां अपने एएन 32 विमान से रनवे पर लैंडिंग और टेकऑफ का अभ्यास करेगी। चिन्यालीसौड़ हवाई अड्डा वायुसेना के लिए सामरिक दृष्टि से खासा महत्वपूर्ण है।

इसी के चलते सेना इसे अपना एडवांस लैंडिंग ग्राउंड बनाना चाहती है, जिसके लिए वायुसेना की ओर से हवाई अड्डे के विस्तारीकरण की भी मांग की गई है। हालांकि, हवाई अड्डे के विस्तारीकरण के प्रस्ताव, जिसमें रनवे की लंबाई भी बढ़नी है, को अभी स्वीकृति नहीं मिल पाई है। स्वीकृति मिलने के बाद ही इस दिशा में कुछ होने की उम्मीद है।

<https://www.amarujala.com/dehradun/uttarkashi-news-indian-air-force-exercise-begins-an-32-aircraft-roars-over-chinyalisaur-airstrip-2024-09-17?pageId=1>

#SWARAJYA

Nigeria Set To Become The First Export Customer Of Four Prachand Light Combat Helicopters: Report

Nigeria is set to become the first export customer of the Hindustan Aeronautics Limited (HAL) built Prachand Light Combat Helicopter (LCH).

According to a report by Financial Express, discussions regarding the export of the LCH between HAL and Nigerian officials are coming to an end, with an agreement expected to be signed shortly.

The report, quoting several defence officials, stated, "The discussions between HAL and Nigerian officials are nearing completion, with an agreement expected to be finalised shortly."

HAL has previously trained several Nigerian officials on Dhruv helicopters at its Rotary Wing Academy. This training has prepared them for operating the LCH.

The LCH Prachand is based on the Dhruv helicopter, with the Dhruv primarily designed for utility tasks, while the LCH focuses on anti-tank and anti-personnel attack missions.

Functioning primarily as a close air support (CAS) aircraft in high-altitude terrain, it excels in roles such as conducting destruction of enemy air defence (DEAD) missions, destroying enemy tanks,

executing high-altitude bunker-busting operations, and intercepting slow-moving remotely piloted aircraft (RPAs).

LCH is the only helicopter in the world with the capability to operate at altitudes above 5,000 to 6,000 meters while carrying a substantial offensive payload.

Moreover, it holds the distinction of executing successful landings at forward camps situated at Siachen, an altitude of 4,700 metres above sea level, while carrying a 500 kg payload.

It comes armed with a 20-millimetre (mm) cannon mounted below its nose, capable of piercing light armour with a fire rate of one thousand bullets per minute, apart from carrying two 70-mm rockets on pods on either side. Additionally, LCH Prachand will be armed with advanced Dhruvastra air-to-ground missiles, designed to target hardened enemy shelters in high-altitude and diverse terrains.

Nigeria currently operates six Turkish-Italian jointly developed T-129 attack helicopters, along with AgustaWestland AW-109 and Russian Mi-24/35 attack helicopters.

Furthermore, Nigeria has signed a deal with American company Bell to supply 12 AH-1Z Viper attack helicopters.

It also operates Chinese-made JF-17 Thunder multi-role jets.

The Nigerian armed forces intend to use this diverse fleet of armed helicopters and jets against Islamic terror organisations like Boko Haram and other jihadist groups in its northwest and central regions.

<https://swarajyamag.com/defence/nigeria-set-to-become-the-first-export-customer-of-four-prachand-light-combat-helicopters-report>

THE ECONOMIC TIMES

Wed, 18 Sep 2024

Indian Air Force set to receive Tejas Mk 1A Combat Aircraft next month after delays in engine delivery

The Indian Air Force (IAF) is set to receive the long-awaited Light Combat Aircraft (LCA) Tejas Mk 1A from the state starting next month, reported The Financial Express. The Tejas Mk 1A, an upgraded version of the LCA, promises enhanced capabilities with modernised features and improved performance.

This marks a significant step in replenishing the IAF's declining fighter jet inventory. The defence and security establishment, necessary modifications to the Israeli software integrated into the Tejas have been completed, and the aircraft is currently undergoing final trials, noted The Financial Express report.

Initial delivery with Category B engines

The first aircraft will be delivered with Category B engines, which are either previously used or sourced from earlier agreements with General Electric (GE) for the Tejas series. New General Electric F404-IN20 engines, essential for optimal aircraft performance, are expected to arrive in November. From November, HAL is expected to receive two GE-F404 engines per month, according to the latest commitment from General Electric.

The first jet was originally expected to be ready by February-March 2024, but is now likely to be ready by November. The delay in engine delivery was addressed by Defence Minister Rajnath Singh during his recent visit to Washington, resulting in a revised schedule from GE.

Hindustan Aeronautics Limited (HAL), the state-run aerospace manufacturer responsible for the Tejas, had initially aimed to start deliveries in March after signing a contract in February 2021. However, the first flight of the Tejas Mk 1A took place only in March this year, leading to additional trials and a postponement of at least four months due to software changes requested by the IAF.

A history of delays

In response to ongoing delays and to meet future demands, the IAF has proposed a public-private partnership (PPP) model to establish additional production lines for the Tejas. Air Chief Marshal VR Chaudhary has emphasised the need to expand production capabilities to fulfil the IAF's requirements, with plans to diversify production lines and explore joint ventures with private sector partners to support the induction of nearly 300 Tejas variants over the next fifteen years.

This strategic initiative aims to strengthen the IAF's fighter fleet while fostering collaboration between public and private sectors in India's aerospace industry, noted The Financial Express. The Tejas program has encountered numerous setbacks since its inception in 1983.

Originally expected to debut in 1994, the first prototype flew in 2001, with initial operational clearance achieved in December 2013. The IAF accepted its first operational aircraft in 2019, and out of the initial order of 40 Tejas aircraft, four remain pending delivery. Introduced following a 2015 agreement with the IAF under then-Defence Minister Manohar Parrikar, the Tejas Mk 1A features significant upgrades, including an advanced electronic radar, enhanced communication systems, Beyond Visual Range Missile capabilities, and improved maintenance features.

The IAF has expressed interest in acquiring an additional 97 Mk 1A aircraft. So far, the IAF has received 35-36 of the first 40 Tejas Mark-1 fighters from contracts signed in March 2006 and December 2010. Moreover, India and the US are in negotiations to co-produce GE-F414 jet engines for the Tejas Mark-2 fighters.

Multiple countries want Tejas supply

Nigeria, the Philippines, Argentina, and Egypt have expressed interest in acquiring the indigenously-developed Tejas Light Combat Aircraft, CB Ananthakrishnan, Chairman and Managing Director of HAL told PTI in December last year.

Earlier, the US, Australia and Indonesia had also interest in the aircraft while Malaysia shortlisted the jet under its acquisition programme. The Tejas is a lightweight, high-agility supersonic multi-role fighter aircraft.

The Tejas Mk1A has an Uttam AESA radar that can scan the skies and track multiple targets simultaneously. The radar has a detection range of more than 200 kilometres. The aircraft can also engage enemy targets from a distance and is designed to evade enemy radar detection.

<https://economictimes.indiatimes.com/news/defence/indian-air-force-set-to-receive-tejas-mk-1a-combat-aircraft-next-month-after-delays-in-engine-delivery/articleshow/113446592.cms?from=mdr>

How quantum computing can make large language models even better

In recent years, the landscape of artificial intelligence (AI), particularly within the realm of natural language processing (NLP), has undergone a remarkable transformation. We have witnessed the rise of powerful large language models (LLMs) made by OpenAI, Google, and Microsoft, among others, and generative AI (Gen-AI), characterised by its unparalleled ability to generate data based on user inputs.

These sophisticated models have revolutionised human-computer interactions, bestowing upon users experiences akin to human understanding. The advent of these cutting-edge technologies and their wide availability has compelled the people at large, industry stakeholders, and governmental bodies to pay attention to their implications.

Problems with current LLMs

LLMs are a cornerstone in AI and mirror the complexities of human language processing. They can classify text, answer questions, and translate between languages. But they also consume a lot of energy to be trained and when put in use. For example, as models go, LLMs are much larger than other AI applications such as computer vision.

The energy consumption of a large language model (LLM) is determined mostly by the number of parameters it has. Larger models demand more computational power for both training and inference. For example, GPT-3 has 175 billion parameters and required around 1,287 MWh of electricity to train.

This is around what an average American household consumes in 120 years. LLMs also surpass non-AI applications in this regard. Training an LLM with 1.75 billion parameters can emit up to 284 tonnes of carbon dioxide, which represents more energy than that required to run a data centre with 5,000 servers for a year. It's important that we lower LLMs' carbon footprint to ensure they are sustainable and cost-effective. Achieving these goals will give LLMs more room to become more sophisticated as well.

Another shortcoming of LLMs pertains to their pre-trained nature, which restricts the level of control users have over their functioning. These models are trained on large datasets with which they develop awareness of word-use patterns in diverse linguistic contexts. But such training often also results in "hallucinations".

Essentially, LLMs may generate text that is contextually coherent but factually incorrect or semantically nonsensical. This arises from limitations inherent to the training, when the model's understanding may diverge from reality.

A third limitation revolves around the abilities of current LLMs to understand syntactics. Syntax refers to the structural arrangement of words and phrases in a sentence. LLMs excel at processing the semantic (meaning-related) aspects of natural language but struggle with syntax. For example,

they may overlook or misinterpret syntactic cues and impede their ability to generate contextually appropriate text.

In sum, we need to develop sustainable, energy-efficient approaches that yield more accurate language models.

Quantum computing

Quantum computing is a highly promising way to address these challenges. It harnesses the remarkable properties of quantum physics like superposition and entanglement for computational needs. In particular, quantum natural language processing (QNLP) has emerged as an active and burgeoning field of research with potentially profound implications for language modelling.

QNLP incurs lower energy costs than conventional LLMs by leveraging quantum phenomena.

QNLP models also require far fewer parameters than their classical counterparts in order to achieve the same outcomes (on paper), thus promising to enhance efficiency without compromising performance. This processing paradigm takes advantage of quantum correlations, an approach in which the system focuses on grammar (syntax) and meaning (semantics) together, rather than separately as conventional systems do.

QNLP achieves this using a better ‘mapping’ between the rules of grammar and quantum physical phenomena like entanglement and superposition. The result is a deeper, more complete understanding of language.

The approach is also expected to mitigate the “hallucinations” that plague many existing LLMs, as the resulting QNLP models are better equipped to distinguish the contexts of various pieces of information and produce more accurate outputs. With the help of QNLP, researchers also hope to uncover the mental processes that allow us to understand and create sentences, yielding new insights into how language works in the mind.

Time-series forecasting

From the basic details of quantum mechanics, we learn that a quantum system (like an atom or a group of particles) can be described by a quantum state — a mathematical representation that keeps evolving with time. By studying this representation, we can determine the expected outcomes of an experiment involving that system.

Based on the same idea, researchers have proposed a quantum generative model to work with timeseries data.

A generative model is a mathematical model that generates data, if required with a user’s inputs. A general model designed to run on a quantum computer is a quantum generative model (QGen). Here, the techniques of quantum computing can be used to create or analyse sophisticated time-series data that conventional computers struggle with.

Time-series data is data of something that has been recorded at fixed intervals. This new data can then be used to teach quantum algorithms to identify patterns in the data more efficiently, to solve complex problems related to forecasting (e.g. stock market trends), and/or to detect anomalies.

On May 20, 2024, researchers in Japan reported that a QGen AI model they built could successfully work with both stationary and nonstationary data. Stationary data refers to information that doesn’t change much over time. It stays fairly constant or fluctuates around a stable average.

For example, the current price of a commodity like gold or the world’s population can be considered stationary: the data doesn’t show big changes in trends over a short period and the values move within a predictable range. On the other hand, nonstationary data keep changing, such

as ambient temperature, stock prices, and the GDP. Classical methods struggle to analyse such data accurately. In the new study, the researchers built a time-series QGen AI model and evaluated its performance by applying it to solve plausible financial problems.

They wrote in their preprint paper: “Future data for two correlated time series were generated and compared with classical methods such as long short-term memory and vector autoregression. Furthermore, numerical experiments were performed to complete missing values. Based on the results, we evaluated the practical applications of the time-series quantum generation model. It was observed that fewer parameter values were required compared with the classical method. In addition, the quantum time-series generation model was feasible for both stationary and nonstationary data.”

That fewer parameters were required means the model based on the quantum computer could solve the same problems as a classical computer but while requiring less computational resources. In sum, quantum computing holds considerable potential to revolutionise AI applications, particularly in addressing the challenges posed by current LLMs.

By embracing QNLP and QGen-AI, together with advancements in time-series forecasting, we can pave the way for sustainable, efficient, and performant AI systems.

<https://www.thehindu.com/sci-tech/science/how-quantum-computing-can-make-large-language-models-even-better/article68647764.ece>



Tue, 17 Sep 2024

Superfast lasers open a shortcut to hard drives of the future

You're watching Chennai Super Kings play Mumbai Indians at the Wankhede. The stands are packed and the atmosphere is electric. In the excitement, a bunch of people in one of the stands starts a Mexican wave. Everyone is eager to participate. At just the right moment, hundreds of people stand up and sit down in unison, giving the wave a full and fervent expression.

The Mexican wave is a type of wave that appears to propagate through a medium when the medium's constituents are sequentially displaced from and restored to their original positions.

In the same way, let's imagine a spin current.

A flow of spin

Every electron particle has an intrinsic property called quantum spin, or just spin for short. It represents some angular momentum carried by the particle. At any given moment it can be measured to have one of two values, colloquially called up and down. A spin current flows through a medium when electrons transmit a spin state — say, up — in quick succession before reverting to their original state (in this case down).

That is, when a spin current moves through a material, it implies a Mexican wave of a particular spin state moving through the material. The electrons themselves aren't displaced, however. Scientists are interested in spin currents because the electrons' up and down spin states can represent 0s and 1s, to store and retrieve data in a computer's hard drive.

Spintronic drives of the future are expected to be able to store more data than existing drives, manipulate the data faster, and consume less energy. In a study published in the journal Physical

Review Letters on September 6, an international team of researchers reported an important advance on this front.

‘Crucial figure of merit’

Spintronics is a branch of physics dealing with the study and manipulation of electrons’ magnetic properties. Magnetic hard drives in computers already take advantage of spintronics. Each drive consists of a very thin magnetic disk that uses an effect called giant magnetoresistance to quickly store and read data encoded in the ups and downs of its electrons.

These spin states are modified by applying a magnetic field over small parts of the disc. The stronger the field, the faster the states change, and the faster the drive’s read/write speed. The field strength increased through the 1990s and 2000s as computers became a common sight in daily life. Today, drive speeds have been maxed out: new products improve the read/write speed only marginally.

Spin currents are expected to provide a quantum leap on this frontier. If scientists can find a way to create spin currents rapidly, the currents can quickly reorganise electrons’ spin states and form the basis of next-generation drives. The catch is we need to produce spin currents that start-stop on an extremely short timescale. As a review article published in 2020 in the *Journal of Magnetism and Magnetic Materials* put it, “In spintronics, the spin-current generation efficiency is the most critical figure of merit for device applications.”

Beyond 1,000x better

Researchers are currently exploring ways to produce spin currents directly. In one existing scheme, they fire lasers at a material, delivering energy to its electrons and getting them to move around. Then they apply a magnetic field across the material so that some electrons’ spins are parallel to the field and some other electrons’ spins are anti-parallel.

Finally they have the electrons interact with impurities in the material that scatter electrons with up and down spins at different rates, eventually leaving only electrons of one spin state behind. A 2014 study by researchers at Eindhoven University of Technology in the Netherlands introduced another scheme.

They sandwiched three layers of carefully chosen materials together. When they magnetised the uppermost layer and shot an ultrafast laser at the bottommost layer, the magnetisation of the middle layer changed in a way that induced spin currents in the uppermost layer. These and other schemes have produced spin currents in the order of a few hundred femtoseconds (1 fs = 10⁻¹⁵ s).

The lead author of the 2014 study, Sjors Schellekens, said in a press release that this timescale was “a factor 1,000” improvement on other technologies of the day. Schellekens also said the team was able to explain how the spin currents arose in the material, which is important to ensure the technique is reliable and there’s nothing in the data that simply resembles a spin current. Soon, scientists began to anticipate even faster technologies.

For example, in January 2020, *Science Advances* published a paper by researchers from Germany, Sweden, and the U.S. They reported using a Heusler alloy to demonstrate the transfer of spin from one atom to another. Heusler alloys are compounds of some elements and which exhibit many properties of interest in spintronics. They anticipated their findings paved the way “towards spintronic devices that can operate on few-femtosecond or faster time scales.”

‘Petahertz clock rates’

In the September 6 study, researchers were able to use a new concept to produce spin currents in 2 fs. Physicists with the Max Planck Institute for Microstructure Physics, Germany, had described

this concept in a 2018 paper in *Nano Letters* and further fleshed it out in subsequent work. It was based on a mechanism called optical intersite spin transfer (OISTR). Here, light of specific frequencies could rapidly manipulate electrons' angular momentum in a material without relying on indirect effects.

If it seems straightforward, deducing this mechanism wasn't simple. The reason is light itself. In its wave form, it consists of an electric field and a magnetic field oscillating perpendicular to each other. When an electromagnetic wave interacts with matter, the material's electronic properties respond almost immediately to the oscillating electric field.

Translating the energy in the wave to the electrons' spin is more long-winded, however, because it is mediated by intervening processes. For some time, scientists were looking for evidence of a link between changes in the electrons' spin with an incident light wave. In a 2019 study in *Nature*, researchers — including many involved in the 2018 study — found one way.

They proposed using a layered stack of ferromagnetic materials like cobalt and nickel. Here, they wrote, “optical excitations result in the local displacement of charge carriers between different atomic species or across layer interfaces”. The result is OISTR, as a “spatially dislodged electron wave carries its spin away” from its ‘resident’ atom to another atom nearby.

Importantly, they were able to track subatomic changes in the stack using a bespoke “detection scheme” at the level of thousandths of femtoseconds. Their findings, they wrote, “paves the way towards coherent spintronic applications with petahertz clock rates”.

One-two punch

The researchers in the September 6 study engineered a material consisting of 20 alternating layers of cobalt and platinum. Each layer was less than 1 nm thick. They wrote, “This type of structure is ubiquitous in spintronic research, in particular to obtain giant magnetoresistance effects.” For their study, they added, the layered stack offered two advantages: it maximises “magneto-optical effects with normally incident light” and “multiplies the number of Co/Pt interfaces, so that potential injection taking place there becomes more measurable”.

They applied a magnetic field perpendicular to the stack to force the electrons to settle into an ordered arrangement of spins. First the researchers fired a pulse of linearly polarised light only 4 fs long into the material. (When the oscillation of the electric field in the light wave is confined to a fixed plane, the light is linearly polarised.) This shot riled up the electrons and sent their spin states into a tizzy.

Right after, they shot another pulse of circularly polarised light (when the electromagnetic field is rotating around the light's direction of motion). The way this light was absorbed as it passed through the material told the researchers how ‘well’ the electrons' spins were ordered following the first laser shot.

Proof of concept

The absorption of the circularly polarised light indicated to the researchers that in the cobalt layers, the electrons' spins had become around 10% less ordered whereas they'd become slightly more ordered in the platinum layers — both within just 2 fs after the linearly polarised light had passed through.

The team developed a mathematical model to explain these findings using densityfunctional theory, which allows physicists to predict a material's properties based on some fundamental quantum properties. These calculations are computationally intensive. The researchers made some

assumptions to simplify their model, and this version showed that their findings could be explained if a small spin current had passed from the cobalt layers to the platinum layers in that 2-fs interval.

Thus, the team reported a new record for the timescale at which a system could produce spin currents. This is a proof of concept — a feat that says it's possible for ultrafast lasers to directly induce spin currents within a few femtoseconds in a specific material.

The researchers have said that next they plan to test whether femtosecond-laser pulses can produce useful spin currents in a functional spintronic device and whether they can produce spin currents in a few attoseconds, i.e. a thousand-times faster.

<https://www.thehindu.com/sci-tech/science/superfast-lasers-open-a-shortcut-to-hard-drives-of-the-future/article68637177.ece>

