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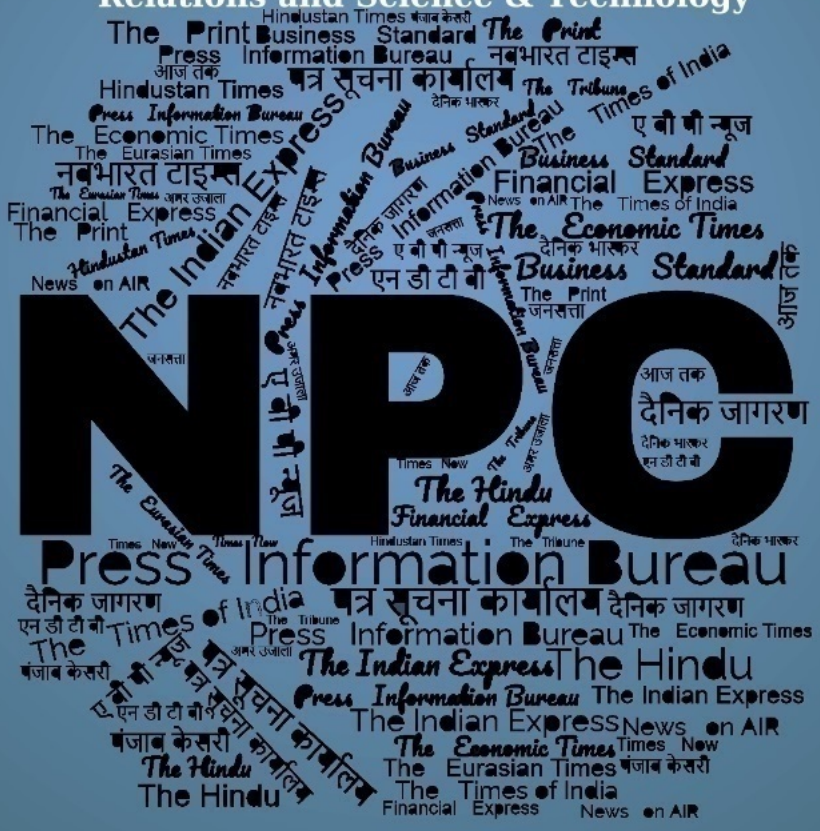
समाचार पत्रों से चयनित अंश
Newspapers Clippings

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



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CONTENTS

DRDO News

DRDO Technology News

TIMES NOW नवभारत

Wed, 26 Jun 2024

नौसेना को **DRDO** ने दे दी सबसे खतरनाक टेक्नोलॉजी! दुश्मन के रडार को चकमा दे **Indian Navy** अब कर सकेगी हमला

डीआरडीओ ने भारतीय नौसेना को अब ऐसी खतरनाक टेक्नोलॉजी दी है, जिससे अब वो दुश्मन के रडार को चकमा देकर हमला कर सकती है। मतलब नौसेना के जहाज से ये खास रॉकेट बिना दुश्मन की नजर में आए उनके ठिकाने पर हमला बोल सकते हैं, उसे तबाह कर सकते हैं। डीआरडीओ इस टेक्नोलॉजी पर काफी समय से काम कर रहा था।

भारतीय नौसेना के लिए मध्यम दूरी के माइक्रोवेव ऑब्स्क्यूरेंट चैफ रॉकेट (एमआर-एमओसीआर) विकसित किए गए हैं। यह रॉकेट बुधवार को नौसेना में शामिल किए गए। यह एक ऐसी तकनीक है, जो दुश्मन के रडार में संकेतों को अस्पष्ट करती है। प्लेटफार्मों और परिसंपत्तियों के चारों ओर माइक्रोवेव शील्ड बनाती है और रडार की पकड़ में आने की आशंका को कम करती है।

कैसे काम करती है ये टेक्नोलॉजी

इस मध्यम दूरी के चैफ रॉकेट में कुछ माइक्रोन के व्यास और अद्वितीय माइक्रोवेव आरोपण गुणों के साथ विशेष प्रकार के फाइबर का इस्तेमाल किया गया है। इस रॉकेट को दागे जाने पर यह पर्याप्त समय के लिए पर्याप्त क्षेत्र में फैले अंतरिक्ष में माइक्रोवेव का बादल बनाता है और इस प्रकार रेडियो फ्रीक्वेंसी पकड़ने वाले शत्रु के रडार के खतरों के विरुद्ध एक प्रभावी सुरक्षा कवच का निर्माण करता है।

रक्षा मंत्री ने की तारीफ

रक्षा मंत्री राजनाथ सिंह ने एमआर-एमओसीआर के सफल विकास पर डीआरडीओ और भारतीय नौसेना की सराहना की है। उन्होंने एमओसी तकनीक को रक्षा क्षेत्र में आत्मनिर्भर बनाने की दिशा में एक और कदम बताया।

https://www.timesnowhindi.com/india/drdo-has-given-the-most-dangerous-technology-to-india-navy-article-111293274

Press Information Bureau
Government of India

Ministry of Defence

Wed, 26 Jun 2024

DRDO hands over Medium Range-Microwave Obscurant Chaff Rocket to Indian Navy

This niche technology creates a microwave shield around platforms & reduces radar detection

Defence Research and Development Organisation (DRDO) handed over the Medium Range-Microwave Obscurant Chaff Rocket (MR-MOCR) to the Indian Navy at a ceremony held in New Delhi on June 26, 2024. Microwave Obscurant Chaff (MOC), a niche technology developed by DRDO's Defence Laboratory, Jodhpur, obscures radar signals and creates a microwave shield around platforms and assets, thus reducing radar detection.

Special type of fibres, with diameter of few microns and unique microwave obscuration properties, have been assembled in the medium range chaff rocket. The rocket, when fired, forms microwave obscurant cloud in space spreading over a sufficient area, with adequate persistence time, thus creating an effective shield against hostile threats having Radio Frequency seekers.

The Phase-I trials of MR-MOCR were successfully conducted from Indian Navy ships, demonstrating the MOC cloud blooming and being persistent in space. In Phase-II trials, the Radar Cross Section (RCS) reduction of an aerial target to the extent of 90 per cent has been demonstrated and cleared by the Indian Navy. The number of MR-MOCR, meeting all the qualification requirements, have been successfully handed over to the Indian Navy.

Raksha Mantri Shri Rajnath Singh has complimented DRDO and the Indian Navy on the successful development of MR-MOCR. He termed the MOC technology as another step towards achieving Aatmanirbharta in defence.

The MR-MOCR has been handed over by Secretary, Department of Defence R&D and Chairman DRDO Dr Samir V Kamat to Director General of Naval Armament Inspection, Indian Navy Rear Admiral Brijesh Vashistha. The DRDO Chairman congratulated the Defence Laboratory, Jodhpur team for this significant achievement. The Director General of Naval Armament Inspection, Indian Navy also applauded the efforts of DRDO for indigenously developing this strategically-important technology in a short span of time.

https://pib.gov.in/PressReleasePage.aspx?PRID=2028794

Defence News

Defence Strategic: National/International

Press Information Bureau
Government of India

Ministry of Defence

Wed, 26 Jun 2024

Royal Saudi Naval Forces (RSNF) Trainees Join First Training Squadron (1TS) For Afloat Attachment

76 trainees of King Fahad Naval Academy of the Royal Saudi Naval Forces (RSNF) joined the First Training Squadron, 1TS of the Indian Navy at Southern Naval Command, Kochi on 24 Jun 24. This is the second batch of trainees who would be undergoing training with 1TS, the first batch having undergone similar training in May – Jun 2023.

The trainees were extended a warm welcome by Senior Officer 1TS, Capt Anshul Kishore during the inaugural address outlining the four weeks long training programme. The training curriculum ranges from basic seamanship activities to simulator based training during the harbour phase, whereas the sea phase focuses on practical exposure to nuances of life at sea.

The trainees would also be familiarised with sail training onboard sail training ship of 1TS.

The afloat attachment of RSNF trainees is being conducted alongside Indian Naval trainees of 107 Integrated Officers Training Course (IOTC) fostering camaraderie and mutual understanding between the trainees of both maritime nations.

It may be recalled that Adm Fahad Abdullah S Al-Ghofaily, Chief of Staff, RSNF had visited Southern Naval Command in Jan 24 during his official visit to India. The bilateral training cooperation between the two Navies is a testimony to longstanding friendship and shared commitment between India and Saudi Arabia.

https://pib.gov.in/PressReleasePage.aspx?PRID=2028748

Press Information Bureau
Government of India

Ministry of Defence

Wed, 26 Jun 2024

Uniqueness of India’s nuclear trajectory premised on the principle of ‘No First Use & Massive Retaliation’: CDS Gen Anil Chauhan

Chief of Defence Staff General Anil Chauhan has reiterated that the uniqueness of India’s nuclear trajectory is premised on the principle of ‘No First Use & Massive Retaliation’. Gen Anil Chauhan was delivering the keynote address on ‘Nuclear Strategy : Contemporary Developments and Future Possibilities’ in a seminar organised by Centre for Air Power Studies – IISS Seminar in New Delhi on June 26, 2024.

In his address, Gen Anil Chauhan highlighted the changing nature & characteristics of conventional warfare. He impressed that the threat from nuclear weapons has once again occupied centre-stage in the geopolitical landscape.

The CDS stressed the need for a deeper thought, development of new doctrines, reimagning deterrence and safeguarding nuclear C4I2SR (Command, Control, Communications, Computers, Intelligence, Information, Surveillance and Reconnaissance) infrastructure.

Gen Anil Chauhan also released the Asian Defence Review 2024 ‘Emerging Technologies and Changing Dimensions of Threats to India’ at the CAPS – IISS Seminar.

https://pib.gov.in/PressReleasePage.aspx?PRID=2028825

THE ECONOMIC TIMES

Wed, 26 Jun 2024

US has 'some concerns' over India-Russia military engagement: Kurt Campbell

The US has "some concerns" over India's engagement with Russia in military and technology domains but at the same time Washington has confidence and trust in New Delhi to advance partnership in key areas, US Deputy Secretary of State Kurt Campbell said on Wednesday.

The senior Biden administration official made the remarks at a virtual media briefing that was focused on his and US National Security Advisor Jake Sullivan's visit to India last week. "We have a full and frank dialogue between the US and India and we do discuss our mutual relationships with key countries and those include India's relationship with Russia," he said.

Campbell said the US is seeking to develop a much deeper and stronger technological relationship with India.

"We have been clear which areas are affected by the continuing relationship between India and Russia, militarily and technologically," he said. "I think we will take what steps we can to mitigate some of those engagements and we have expressed some concerns. But at the same time, we have confidence and trust in India and we're seeking to advance our partnership in technology in the context of those different ties," he said.

The senior American official was responding to a question on whether there are concerns in Washington over sharing sensitive technologies to India in view of New Delhi's close military and technology cooperation with Russia. "I do want to underscore that the US and India are both great powers. We have many areas of alignment, but it is not surprising that there would be areas where we had perhaps different perspectives, views, historical ties," he said. "In the context of our strategic partnership, I think what's been important is our ability to share views on areas where we occasionally have disagreements, do those respectfully and seek where possible to narrow those areas where there are differences," he said.

Following wide-ranging talks between NSA Ajit Doval and Sullivan, India and the US last week unveiled a raft of transformative initiatives to deepen cooperation in areas of semiconductor, artificial intelligence, critical minerals and defence space. A fact-sheet released after the talks noted that both sides resolved to prevent the leakage of sensitive and dual-use technologies to "countries of concern". Both sides also reviewed New Delhi's planned acquisition of 31 MQ-9B Predator drones, the proposed joint manufacturing of Stryker infantry combat vehicles and negotiations between GE Aerospace and Hindustan Aeronautics Ltd for co-production of GE F414 engines to power India's future fighter jets. On the MQ-9B drone deal, Campbell said a letter of offer and acceptance for the drones was sent to India in March. "I think we're awaiting signature (of the letter) to move forward.

General Atomics is negotiating details of the sale with the Indian ministry of defence and we are prepared obviously to work with them in addressing any outstanding questions," he said.

https://economictimes.indiatimes.com/news/defence/us-has-some-concerns-over-india-russia-military-engagement-kurt-campbell/articleshow/111293842.cms

ThePrint

Thu, 27 Jun 2024

Base price of Rafale agreed upon, fighters for Navy to have India-specific enhancements

India and France have agreed upon the base price of the 26 Rafale M fighters, which will come with several specific enhancements sought by the Navy to enable them to operate from both indigenous and Russian-origin aircraft carriers.

Sources in the defence and security establishment told ThePrint that the first round of cost negotiations has taken place and further rounds will be held with the aim to sew up a contract by this year's end. They also added that the Rafale Marine, or Rafale M, will come with several specific enhancements as sought by the Indian Navy.

These will include some of the enhancements carried out for the IAF's Rafales, including helmet mounted display, low band frequency jammers, better radio altimeter than the one integrated by the French and very high frequency range decoys, among others. Asked about what specific changes the Navy wants, sources said that it was related to software changes for air to sea mode, changes to electromagnetic interference (EMI) and electromagnetic compatibility (EMC) and certain software upgrades needed to enable the aircraft to land on an Indian carrier.

As per its plan, the Indian Navy will be acquiring 22 single seater fighters and another four twin seaters.Regarding the base price of the aircraft, the sources said it is the same as that of the IAF Rafales but taken with the escalation in mind. While all eyes are on how much the deal will eventually cost, ThePrint has learnt that it is likely to be close to Euro 4 billion, which comes to be a little less than Rs 40,000 crore. This will include the vanilla cost (bare cost) of the aircraft, besides missiles and maintenance contracts.

The sources said that the cost negotiations for the Indian side is being led by a joint secretary-rank IAS officer while a Commodore-rank officer from the Indian Navy is also part of the team. Pointing out to ThePrint's report earlier that the Indian Navy could learn from the French when it comes to operations and maintenance of the same fighters across the navy and the air force, the sources said that a Navy team had already visited Ambala air station.

The IAF has kept one squadron of Rafales in Ambala. The sources said that the Navy team looked at the IAF facilities and that both sides have already discussed the common approach that can be done.

https://theprint.in/defence/base-price-of-rafale-agreed-upon-fighters-for-navy-to-have-india-specific-enhancements/2148834/

NDTV

Wed, 26 Jun 2024

"Key Milestone": Adani Defence, Thales Tie Up To Make Rockets In India

Adani Group's defence arm - Adani Defence & Aerospace - has signed an agreement with the Thales Group to manufacture rockets in India, in a major push for government's flagship "Make in India" programme.

"Not only is this partnership significant for our commitment to India, but it also allows us to strengthen our partner network worldwide," the Thales Group said in a post on X - earlier known as Twitter.

"We congratulate the Adani Group on this partnership. Together, we seek to contribute to the further growth and success of India's defence sector," the Thales Group said.

Earlier this month, Adani Defence and Aerospace signed a landmark agreement with EDGE Group - one of the world's leading advanced technology and defence groups in the UAE.

The agreement aims to establish a global platform leveraging the defence and aerospace capabilities of both companies to bring together their respective product portfolios and cater to the requirements of global and local customers.

The agreement will explore the establishment of R&D facilities in India and the UAE and the setting up of development, production, and maintenance facilities of defence and aerospace solutions to not just serve the two captive markets, but also Southeast Asian and wider global markets.

Adani Defence & Aerospace, part of the Adani Group, is a pioneer in the design, development, and manufacturing of state-of-the-art defence products.

https://www.ndtv.com/business-news/adani-group-gautam-adani-key-milestone-adani-defence-thales-tie-up-to-make-rockets-in-india-5972689

THE ECONOMIC TIMES

Wed, 26 Jun 2024

Manta Ray: US Navy's secret undersea drone spotted, then disappeared from Google Maps

A prototype US Navy submarine, dubbed the "Manta Ray," was recently spotted by Google Maps users at the Port Hueneme naval base in California. The sighting went viral online, sparking widespread curiosity. Shortly after the image leaked, the submarine disappeared and was replaced by boats. This development has drawn significant attention due to its advanced technology and strategic implications.

Whatis Manta Ray?

Manta Ray is an underwater drone developed by Northrop Grumman for the US Navy. Named after the cartilaginous fish with a distinctive broad, diamond-shaped body, the Manta Ray submarine boasts a sleek design, enabling it to operate in low-power mode deep underwater. It can hibernate on the seafloor for extended periods without refueling.

Key Features and Development

Dr. Kyle Woerner, Manta Ray program manager at the Defense Advanced Research Projects Agency (DARPA), stated: "It [Manta Ray] uses efficient, buoyancy-driven gliding to move through the water ... our successful, full-scale Manta Ray testing validates the vehicle’s readiness to advance toward realworld operations."

The submarine's modular design allows it to be disassembled and transported in ordinary shipping containers, eliminating the need for dedicated port facilities. This feature makes deployment and logistics more flexible and cost-effective.

The Manta Ray is part of a US Navy project aimed at developing long-range underwater weapons. According to DARPA, the vessel is a multi-phase effort that includes at-sea demonstrations of critical technologies. "The program is using a disciplined systems engineering approach to define demonstration system objectives and identify enabling technologies needed for future systems," DARPA noted.

Strategic Testing and Implications

The US Navy spent over three months testing the Manta Ray off the coast of Southern California. Defense analysts believe this technology aims to strategically counter submarine operations by Russia and China.

Amid its ongoing conflict with Ukraine, Russia is also developing underwater drones and plans to acquire nearly three dozen vessels. Russian drones reportedly have a range of 6,200 miles, can be armed with nuclear weapons, and can reach speeds of up to 100 knots (115 mph).

Background and Public Reactions

The Manta Ray caught public attention not only for its advanced technology but also for its resemblance to a Star Wars spaceship. The vessel's sleek design and ability to anchor itself deep underwater have drawn comparisons to the Hollywood franchise.

This autonomous vessel has been named after the sea creature due to its distinctive design and operational capabilities.

https://economictimes.indiatimes.com/news/defence/secret-us-navy-under-sea-drone-manta-ray-spotted-later-disappears-from-google-maps/articleshow/111277801.cms

THE ECONOMIC TIMES

Thu, 27 Jun 2024

North Korea says it tested a multiwarhead missile. Kim Jong Un covets the weapon to overwhelm US defenses

North Korea said Thursday it had successfully tested a multiwarhead missile, a sophisticated weapon coveted by leader Kim Jong Un to overwhelm missile defenses in the continental United States. The statement contradicted South Korea's assessment of a failed launch Wednesday of a different type of weapon.

The launch tested the separation and guidance control of individual mobile warheads to ensure the capability of the Multiple Independent Reentry Vehicle, the North's official Korean Central News

Agency said. The separated mobile warheads "were guided correctly to the three coordinate targets" and a decoy that separated from the missile was verified by radar, it said.

It was North Korea's first known launch event related to the development of a multiwarhead missile, though outside experts believe it was a preliminary test.

KCNA, citing the country's Missile Administration, said it was significant to bolstering North Korea's missile forces and developing missile technologies that testing of the weapon had entered a full-scale stage.

A multiwarhead missile was among the high-tech weapons systems Kim cited on his wish list during a ruling party meeting in early 2021, along with spy satellites, solid-fuel intercontinental ballistic missiles, hypersonic weapons and submarine-launched nuclear missiles. North Korea has since performed a series of tests to develop such weapons systems.

"I had been anticipating a MIRV test for some time now, as this was one of the last remaining items on Kim Jong Un's modernization wish list from the 8th Party Congress back in January 2021," said Ankit Panda, a senior analyst at the Carnegie Endowment for International Peace. Panda said Wednesday's test appeared to be an initial evaluation of some of the key subsystems to develop a workable MIRV.

He expect successive tests of the technology to follow, leading up to a launch of an intercontinental ballistic missile on a lofted trajectory. "The presence of decoys is significant. North Korea has made no secret of its intention to stress and overcome U.S. homeland missile defenses," Panda said.

"Decoys will assist in that endeavor and will likely be incorporated onto their single-warhead missiles as well." South Korea's military had no immediate response to the North's statement. But Panda said it appeared that "South Korea misinterpreted the nature of this test initially."

South Korea's Joint Chiefs of Staff had said Wednesday it suspected the weapon launched by North Korea was a solid-fueled hypersonic missile. It said the missile blew up off the North's east coast, scattering fragments in the water.

It said it detected more smoke than normal launches, suggesting a possible combustion issue caused by an engine fault. Wednesday's test was the North's first weapons launch since it fired nuclearcapable multiple rocket launchers to simulate a preemptive attack on South Korea almost a month ago. In recent weeks, North Korea has also floated numerous trash-carrying balloons toward South Korea in what it has described as a tit-for-tat response to South Korean activists sending political leaflets via their own balloons.

In response, South Korea on June 9 briefly conducted propaganda loudspeaker broadcasts at border areas for the first time in years. Worries about North Korea also deepened last week when Kim Jong Un and Russian President Vladimir Putin signed a deal requiring each country to provide aid to the other if it is attacked and vowed to boost other cooperation.

Analysts say the accord represents the strongest connection between the two countries since the end of the Cold War.

https://economictimes.indiatimes.com/news/defence/north-korea-says-it-tested-a-multiwarhead-missile-kim-jong-un-covets-the-weapon-to-overwhelm-us-defenses/articleshow/111299372.cms

Wed, 26 Jun 2024

Artificial Intelligence could be a literal copilot, serving as wingmen for fighter jets

The future of military conflict has to incorporate Artificial Intelligence (AI) as humans defending against adversaries with AI capabilities operating at machine speeds is a recipe for disaster. Most of the work in the domain is focused on creating autonomous fighter aircraft, such as the US Air Force's development of the XQ-58A Valkyrie, an experimental pilotless airborne platform.

Researchers at the Applied Physics Laboratory (APL) at the Johns Hopkins University however are exploring a novel approach of augmenting human decisionmaking with the computational power of AI. Over three years of research and development, the researchers have created an AI copilot called Virtual Intelligent PeerReasoning agent or VIPR. VIPR is a situationally aware peer, a performant wingman and a cognitive support assistant.

The researchers liken VIPR to astromech droids from the Star Wars universe. Such an AI can track blind spots and alert the pilot when needed, and even step up and play the role of the pilot, taking actions to save the life of the human.

Looking inward as well as outward

Tom Urban, one of the researchers associated with the initiative says, "We need to keep human warfighters in control of the future battle, and that means investing in efforts to catalyze human decision-making with the advanced computing power of AI. APL is involved in a number of efforts to do that by providing humans with intelligent virtual assistants."

VIPR can also be thought of as an extremely advanced GPS and navigation assistant. While a driver on a road might primarily have to deal with visual blind spots, for a fighter pilot, the blind spots are cognitive. The focus and 'tunnel vision' necessary to be a fighter pilot can prevent them from responding to critical new information in the heat of combat.

One of the functions of VIPR is to track the cognitive state of the pilot, to understand the intentions of the pilot, know what the pilot knows, and reasons what the pilot understands, so understand when the AI and the pilot are no longer on the same page. The VIPR prototype is capable of doing all of this in realtime, responding to the voice commands of the pilot, and switching roles with the pilot fluidly and seamlessly.

Swarming capabilities

VIPR also has the capabilities of piloting multiple autonomous squad mates, or collaborative combat aircraft. This allows for formation flying to accomplish mission

objectives, such as reconnaissance. The APL team is preparing to evaluate its VIPR prototype more formally with human pilots.

https://www.news9live.com/science/artificial-intelligence-could-be-a-literal-copilot-serving-as-wingmen-for-fighter-jets-2592944

The EurAsian Times

Wed, 26 Jun 2024

China Modernizes AWACS 'Flying Radars' To Counter US Military; Draws Critical Lessons From Ukraine Conflict

In the shadow of the ongoing Russia-Ukraine conflict, a quiet revolution is taking place in China's military aviation. The world's second-largest defense spender is rapidly modernizing its "eyes in the sky" – the crucial Airborne Warning and Control System (AWACS) aircraft that serve as flying command centers in modern warfare. For the past 28 months, the world has been closely observing the Russia-Ukraine war. This conflict has witnessed the deployment of numerous weapons systems, including drones, missiles, and the Airborne Warning and Control System (AWACS).

According to experts, Chinese strategists remain highly interested in the performance of AWACS, in addition to all other weapons systems. In a recent development, the Chinese social media platform 'Weibo' buzzed with sightings of a new variant of the Kongjing-500N long-range radar detection and control aircraft. Spotted among the Northern Fleet of the Chinese People's Liberation Army Navy, this aircraft is rumored to be the Kunjing-700.

Open-source intelligence (OSINT) images reveal that the new Kongjing-500N features a light bulb-shaped addition to the nose and a new radar system on the underside, similar to the one on China's Yungan-9 (Shaanxi Y-9) reconnaissance plane. This revelation follows reports from November 2022 suggesting China is developing next-generation "strategic airborne early warning" aircraft amid escalating tensions with Taiwan, the United States, and regional U.S. allies.

Initially met with skepticism by military experts, these ambitions now seem increasingly plausible. The Kunjing-700 may well be a fruit of these efforts, especially significant given U.S.-imposed obstacles in acquiring foreign radar and AWACS technologies. This latest development highlights China's ongoing modernization of its "eyes in the sky" – the crucial airborne early-warning and control (AEW&C) aircraft. Drawing lessons from the Russian-Ukrainian conflict, where AWACS have proven pivotal in guiding combat aircraft and monitoring airspace, China is clearly intent on bolstering its surveillance and detection capabilities.

Recognizing AWACS as a critical force multiplier in modern aerial warfare, China's focus appears to be on enhancing the aircraft's resilience against enemy threats. The Kunjing-700 is thus positioned as a versatile asset, capable of simultaneous aerial reconnaissance, electronic countermeasures deployment, air and maritime surveillance, and combat aircraft guidance. This

multi-role capability represents a significant leap forward in China's airborne early warning capabilities.

Lessons From Russia-Ukraine War

The ongoing Russia-Ukraine conflict has exposed a critical vulnerability in modern warfare: the susceptibility of high-value airborne early warning and control (AEW&C) aircraft. In a stunning turn of events, Ukraine has managed to strike at the heart of Russia's aerial surveillance capabilities, downing two of its prized A-50 aircraft in rapid succession.

The first blow came in mid-January 2024 when Ukrainian forces claimed to have shot down a Russian A-50 over the Sea of Azov. Lightning struck twice on February 23, with Kyiv reporting the destruction of a second A-50 just weeks later. These successes marked a significant shift in the conflict, demonstrating Ukraine's growing ability to neutralize Russia's most advanced aerial assets.

The fallout from these incidents has been swift and severe. Russia's investigative committee has taken the unprecedented step of targeting individual Ukrainian military personnel for their alleged roles in the attacks. Colonel Mykola Dzyaman, a Ukrainian commander, now finds himself in Moscow's crosshairs, accused of orchestrating the February 23 shootdown.

Russian authorities insist that the downed aircraft were unarmed, non-combatant, and operating strictly within Russian airspace. They claim that Colonel Dzyaman issued an "unlawful order," resulting in the destruction of one such plane and the deaths of its 10 crew members. These events underscore the dual nature of AEW&C aircraft in modern conflict – both invaluable assets and potential vulnerabilities. As military powers worldwide, including China, observe these developments, the race is on to develop more resilient and defensible aerial early warning systems.

Advancing China's AWACS Capabilities

China recognized the importance of developing AWACS after witnessing its pivotal role in the 1991 Gulf War, during which the U.S. Air Force's E-3 Sentry fleet demonstrated its capabilities. In response, China introduced the KJ-2000 and KJ-200 in the 2000s, providing capabilities deemed essential, though not at the forefront, for dedicated AWACS operations.

Among its operational AWACS platforms is the KJ-2000, the largest AEW&C platform. It integrates an indigenous Type 88 radar onto a Russian A-50 Mainstay AWACS modified by the Xi'an Aircraft Corporation (XAC). Additionally, there are ongoing efforts reported on the KJ-3000 project, which aims to enhance capabilities with a modern radar system and advanced electronics mounted on the indigenously developed Y-20A strategic transport aircraft.

Another notable platform is the Shaanxi Aircraft Corporation (SAC) Y-8J, derived from the Y-8 turboprop transport utilized by PLA naval aviation. Initially developed under Project 515 and first observed near Shanghai in 2000, it features a British Skymaster surveillance radar housed in a distinctive bulbous and partially drooped nose radome. Further expanding its tactical AEW&C capabilities, China operates the Y-8W/KJ-200, based on the Y-8 airframe, with modifications including a solid nose and redesigned tail section.

The KJ-500, based on the Y-9 airframe, serves both the PLA Air Force (PLAAF) and PLA Naval Aviation. Recently introduced is the KJ-600, a twin-turboprop carrier-borne AEW&C aircraft

designed to operate from Fujian, equipped with an Electromagnetic Launch System (EMALS) for heavier fixed-wing AWACS operations. While carriers like the Shandong and the Liaoning, configured with ski-jump ramps (STOBAR), deploy rotary-wing helicopter-mounted AWACS platforms, the Fujian represents China's advancement towards more sophisticated carrier operations.

As the People's Liberation Army Navy (PLAN) expands its capabilities with the launch of its third aircraft carrier, the Fujian, designed for "blue water" operations, China continues to enhance its extensive inventory of airborne early warning (AEW) aircraft. This strategic development aligns with China's broader doctrine of "intelligentized warfare."

This evolving arsenal places China in a unique position – potentially the only U.S. adversary with truly advanced AWACS capabilities, surpassing even Russia's aging fleet.

KJ-500: China's Advanced AEW&C Aircraft

The Kongjing-500, introduced into service in 2015, is also known as the Shaanxi KJ-500 airborne early warning and control (AEW&C) aircraft. It is deployed within frontline units of the Chinese People's Liberation Army (PLA). The KJ-500 represents a significant advancement over its predecessors, leveraging improvements in China's Active Electronically Scanned Array (AESA) and data link technologies. It has the capability to simultaneously track up to 100 targets.

Its radar system, developed by the 38th Research Institute of the China Electronics Technology Group Corporation, is housed within a saucer-shaped dome that also accommodates a satellite communications antenna and two passive electronic intelligence arrays. Featuring a fixed dorsal rotodome with three triangular radar arrays, the KJ-500 provides full 360° coverage, distinguishing it from earlier Shaanxi KJ-200 AEW&C aircraft. According to Chinese sources, its operational range extends up to 470km.

By early 2018, an estimated 17 KJ-500s were deployed, making it the most numerous in service at that time. Production efforts escalated in subsequent years, with the fleet expanding to an estimated 28 aircraft by 2022, evenly distributed between the air force and naval aviation units. As AEW&C aircraft significantly enhance combat capabilities across various military services, the KJ-500 has gained prominence, particularly in conjunction with China's Chengdu J-20, its most high-profile fighter aircraft. In the realm of aerial surveillance, the ongoing conflict in Ukraine has underscored the critical importance and vulnerabilities of AWACS aircraft. China, attentive to these lessons, is poised to integrate them into its latest designs. The upcoming Kongjing-700 and its peers are anticipated to feature enhanced defensive systems and electronic countermeasures, bolstering their survivability in contested airspace.

As tensions persist in the South China Sea, China's rapidly advancing AWACS capabilities are poised to assume a pivotal role in potential conflicts. These airborne platforms not only augment China's ability to detect and monitor threats but also function as crucial nodes in its expanding military network. Beyond technological advancement, the Kongjing-700 signifies China's resolve to challenge U.S. air dominance in the Pacific, marking a strategic evolution that could redefine regional dynamics in the years ahead.

https://www.eurasiantimes.com/header-china-modernizing-its-flying-rada/

The EurAsian Times

Wed, 26 Jun 2024

US F-16, Pakistani JF-17 Fighters Participate In Falcon Talon Drills; Comes After Rafale, F-15 Combat

The US Air Force Central Command (AFCENT) and the Pakistan Air Force (PAF) have successfully concluded Falcon Talon 2024, a bilateral exercise held from June 1 to June 11. The annual event, hosted by the Pakistan Air Force, is designed to enhance the critical relationship between the two nations. The US Air Force released details and images of the exercise on June 25, highlighting the focus on tactical-level counter-terrorism, air-to-ground weapons employment, and subject matter expert exchanges.

Airmen from the US Central Command area of responsibility were deployed to Pakistan, supported by the Air Mobility Command's C-17 Globemaster III aircraft, which delivered personnel and cargo. The exercise also involved the US Air Force F-16 Fighting Falcons from Aviano Air Base's 510th Expeditionary Fighter Squadron, known as the Buzzards. Images from US and Pakistani sources showed that the Pakistani Air Force deployed its F-16s and JF-17 Thunder jets during the exercise.

According to the US Air Force, Falcon Talon 2024 concentrated on three primary areas: tactical execution, logistics support, and planning integration. US Airmen collaborated with their Pakistani counterparts, engaging in hands-on experience and knowledge exchange sessions in various fields, including firefighting, explosive ordnance disposal, medical support, and joint terminal attack control.

Airmen from the 378th Expeditionary Civil Engineer Squadron Fire Department integrated with the Pakistan Air Force Fire Department to conduct aircraft pilot egress drills, fuel, munitions, and aircraft firefighting, policy creation exercises, and effective debrief sessions, including the introduction of the "hot wash" briefing style. The exercise concluded with a friendly firefighter competition to test the new skills learned by both teams, said the USAF. The exercises involved practicing close air support operations and infiltration/exfiltration methods.

"The impact has been immeasurable but positive; some of the small details have received extremely positive attention, and many of our suggestions or methods of doing things have already begun to gain traction," said US Air Force Master Sgt Jonathan Campos, 378th Expeditionary Civil Engineer Squadron Fire Department fire chief. "These exchanges not only help us showcase our expertise but the personal relationships and bonds created and sense of community is palpable after such exercises," added Campos.

The Chief of Operations for Exercise Falcon Talon 2024, Lt. Col. Nicholas Gardner of the U.S. Air Force, said, "The enduring partnership between our nations remains critical for the security of the region as the US continues to stand with Pakistan in tackling the most pressing global and regional challenges, as we have since our mutual defense assistance agreement in 1954." He added that 70 years on, Falcon Talon 2024 continues to strengthen the partnership by promoting peace, security, and stability.

Falcon Talon enhances the airmen's combat effectiveness. He eagerly anticipated working side-by-side to maintain aircraft, safeguard personnel, and forge bonds that would endure for another 70 years. While a US Air Force official highlighted the enduring partnership between Washington and Islamabad as critical for regional security, the United States has deprioritized its relations with Pakistan.

The Trump administration halted military cooperation, and under the Biden administration, relations have further declined, especially after the US withdrawal from Afghanistan. Conversely, the US has strengthened its defense partnership with India to bolster alliances in the Indo-Pacific to counter China's influence and to further isolate Russia due to its invasion of Ukraine. In April 2023, for example, B-1B Lancers from Ellsworth Air Force Base participated in Cope India 2023. That was the first time these bombers took part in the joint exercise.

The Cope India exercise, initiated in 2004, has seen the participation of US Air Force F-15s, F-16s, C-130Hs, C-130Js, and C-17s in subsequent years. In May 2024, the Indian Air Force's Rafale fighter jets and aircrew traveled to Alaska for the US multinational exercise Red Flag 24. The exercise, held from May 30 to June 14, 2024, involved eight Rafale jets, a C-17 Globemaster, and an IL-78 air-refueller.

Additionally, India has emerged as a strategic partner of the US, receiving critical technology, armed drones, and co-producing GE F414 jet engines. Further collaboration is planned in the military space, with Indian officials set to participate in US Space Command's Global Sentinel exercise next year. This is part of the US-India initiative on Critical and Emerging Technology (iCET), launched in January 2023, which aims to enhance cooperative space domain awareness.

https://www.eurasiantimes.com/us-f-16-pakistani-jf-17-fighters-hold-bilateral/

Science & Technology News

Press Information Bureau
Government of India

Ministry of Science & Technology

Wed, 26 Jun 2024

Researchers at IISER Tirupati developed an efficient method of hydrogen generation from methanol and formaldehyde combination developed for moving towards 'Hydrogen economy'

Researchers have developed an innovative synthetic method to produce hydrogen gas from a mixture of methanol and paraformaldehyde under mild conditions. This method has proven particularly effective for the transfer hydrogenation of alkynes to alkenes and the combination could be a promising hydrogen carrier, paving the way for advancements in chemical synthesis and sustainable energy solutions.

The rapid depletion of fossil fuels has spurred the search for alternative energy sources, highlighting the need for sustainable and renewable resources. Hydrogen gas generation is particularly important due to its potential to replace fossil fuels in energy storage, transportation, and various chemical processes. Methanol and paraformaldehyde, both produced on a large scale, have emerged as viable candidates for hydrogen carriers. Their abundance and widespread

manufacture make them valuable for the storage and transportation of hydrogen, offering significant advantages over free hydrogen itself.

The research led by Prof. Ekambaram Balaraman at IISER Tirupati has utilized commercially available nickel catalysts to produce hydrogen from methanol and paraformaldehyde without the need for bases or activators. This efficient catalytic system has demonstrated remarkable efficiency under mild conditions, and the generated hydrogen was successfully employed in chemo- and stereo-selective partial transfer hydrogenation of alkynes. This process enabled access to bioactive molecules with enhanced synthetic value. This research was supported by ANRF (erstwhile SERB, a statutory body of the Department of Science and Technology (DST).

This research, accepted for publication in the journal Catalysis Science & Technology, opens a new avenue for COx-free hydrogen generation, contributing to the advancement of a 'Hydrogen economy.' The ability to harness methanol and paraformaldehyde as hydrogen carriers offers significant potential to address the challenges posed by the increasing global energy demands. This development marks a significant step forward in the quest for sustainable energy solutions.

Publication link: https://pubs.rsc.org/en/content/articlelanding/2024/cy/d3cy01699d

https://pib.gov.in/PressReleasePage.aspx?PRID=2028759

Press Information Bureau
Government of India

Ministry of Science & Technology

Wed, 26 Jun 2024

The Council of Scientific and Industrial Research -National Institute of Science Communication and Policy Research (CSIR-NIScPR) and Narional Chemical Laboratory (NCL) jointly organised OWOT campaign on 'TRL Assessment and Patent Landscaping of Energy Technologies'

The Council of Scientific and Industrial Research (CSIR), under the Department of Science and Technology has organised 'One Week One Theme (OWOT)' campaign from 24 June 2024, across its 37 labs in India.

Union Minister of State (independent Charge) for Science & Technology, Earth Sciences, MoS PMO, Ministry of Personnel public grievances and pensions, department of atomic energy and space Dr. Jitendra Singh inaugurated One Week One Theme (OWOT) Campaign in the presence of DG CSIR Dr. N. Kalaiselvi at India habitat Centre, New Delhi.

Dr. Jitendra Singh also unveiled the OWOT logo along with launch of CSIR products, signing of MoUs and 12 Thematic Technology Transfers. OWOT is an initiative aimed at showcasing the wide-ranging thematic research and innovations across its numerous laboratories. This program serves as a platform to highlight CSIR's diverse contributions to scientific and industrial advancements in India and to engage with various societal sectors.

The event series is structured around specific themes, with each week dedicated to a different area of focus. The One Week One Theme (OWOT) Campaign has been initiated on 24 June and it will culminate on 17 December 2024. And during this six months' time, total eight broad themes will be covered by concerned laboratories of CSIR.

The theme Energy and Energy Devices (EED) was identified as the first theme. Inaugural of this theme centric OWOT program organized on June 24, 2024 at CSIR-National Chemical Laboratory, Pune.

As part of the EED theme, CSIR's National Institute of Science Communication and Policy Research (CSIR-NIScPR) collaborates with the CSIR-National Chemical Laboratory (CSIR-NCL) to organize an event titled "TRL Assessment and Patent Landscaping of Energy Technologies: Pathways for Commercialization" on 25 June 2024 at CSIR-NCL, Dr. Homi Bhabha Road, Pune.

Dr. Ashish Lele, Director of CSIR-NCL, Pune, speaking on the occasion delved into the critical aspects of Technology Readiness Level (TRL) Assessment and Patent Landscaping for Energy Technologies, emphasizing their significance in commercialization pathways.

The Chief Guest, Dr. Prof. G.D. Yadav, Former Vice Chancellor of ICT Mumbai, lauded CSIR-NIScPR's commendable work in TRL Assessment and Patent Landscaping. He highlighted the institute's pivotal role in shaping the future of energy technologies.

The event featured two engaging technical sessions, the first session, focused on Technology Readiness Level Assessment, was chaired by Prof. Satishchandra Ogale, Director of the Research Institute for Sustainable Energy at TCG-CREST, Kolkata

The second session, centred on Technology Mapping of Energy Technologies, was led by Prof. Siddharth Jabade, Vice Chancellor of Vishwakarma University.

A Panel Discussion on 'Energy Devices: Pathways for Commercialisation' was organised under chairmanship of Dr. Reji Mathai, Director, Automotive Research Association of India. Around 150 students from various universities, faculty, students, research institutes, start-ups, and industry participated in the event.

https://pib.gov.in/PressReleasePage.aspx?PRID=2028904

THE ECONOMIC TIMES

Wed, 26 Jun 2024

SSLV's first dedicated commercial launch to put Australia-built satellite into orbit in 2026

ISRO's commercial arm NSIL said on Wednesday that its newest rocket the SSLV will have its first dedicated commercial launch when it puts into orbit the Optimus -- a satellite built by Australia-based Space Machines Company.

The announcement was made jointly by NewSpace India Limited (NSIL) and Space Machines Company at the India Space Congress, organised by the Satcom Industry Association-India. This pioneering collaboration sets the stage for the launch of Space Machines Company's second

Optimus spacecraft, weighing 450 kilogrammes, the largest Australian-designed and built spacecraft so far, a statement from NSIL said.

"This will be the first dedicated commercial launch for SSLV (Small Satellite Launch Vehicle). The first commercial launch was Janus, a 10-kilogramme nanosatellite on board the SSLV-D2 mission," NSIL Chairman and Managing Director Radhakrishnan Durairaj told PTI.

The satellite is slated for a dedicated launch in 2026 onboard the SSLV, a mission that will mark a defining moment for India and Australia in the area of space collaboration. This mission, named Space MAITRI (Mission for Australia-India's Technology, Research and Innovation), marks a significant milestone in the strategic partnership between Australia and India in the space domain, fostering closer ties between commercial, institutional and government space organisations from both nations, the NSIL said.

"By combining our innovative spacecraft capabilities with India's proven launch expertise, we are not only strengthening the ties between our nations' space sectors but also demonstrating our shared commitment to sustainable space operations," said Rajat Kulshrestha, CEO and co-founder of Space Machines Company.

By focusing on debris management and sustainability, the mission aligns with the core values and objectives of both countries, promoting responsible space operations and mitigating the growing threat of space debris.

https://economictimes.indiatimes.com/news/science/sslvs-first-dedicated-commercial-launch-to-put-australia-built-satellite-into-orbit-in-2026/articleshow/111290505.cms

ThePrint

Thu, 27 Jun 2024

Quantum security lab launched in Chennai

Professor Ajay Kumar Sood, Principal Scientific Adviser to the Government of India and Dr. Parvinder Maini, Scientific Secretary, today (June 25, 2024) attended the 23rd Foundation Day of the Society for Electronic Transactions and Security (SETS) in Chennai. Prof. Sood also inaugurated the Quantum Security Research Lab on the occasion.

The lab was inaugurated by Prof Sood during the 23rd Foundation Day of SETS in Chennai. The function was jointly performed by the Director General of the Indian Computer Emergency Response Team (MeitY), Dr Sanjay Bahl, and the Principal Scientific Adviser to the Government of India, Prof Ajay Kumar Sood. The research lab will strengthen the country’s cybersecurity and provide impetus to the field of quantum information science in India. The lab is expected to develop innovative solutions to some of the pressing cybersecurity challenges faced by the country today. The focus areas of the lab will include post-quantum cryptography, key distillation engine for quantum key distribution, and the development of a quantum random number generator.

The lab's inauguration is a significant step forward in India's efforts to strengthen its cybersecurity posture. It is expected to create new opportunities for research and innovation in the field of quantum information science and also stimulate economic growth. The development of the lab will also help in improving the security of critical infrastructure and enhancing the overall digital security of the country.

https://theprint.in/science/quantum-security-lab-launched-in-chennai/2148975/

The Indian EXPRESS

Wed, 26 Jun 2024

Chandrayaan-4 parts to be sent in 2 launches, assembled in space: ISRO chief

Chandrayaan-4, which is supposed to bring back samples from the Moon, would not be launched at one go and instead, different parts of the spacecraft would be sent into orbit through two launches, and the spacecraft would be assembled in space before proceeding to the Moon, ISRO Chairman S Somanath said Wednesday.

This would have to be done because Chandrayaan-4 is expected to be beyond the carrying capacity of even the most powerful rocket that ISRO currently has.

The International Space Station and all previous similar facilities were built by assembling different parts in space. However, this would be probably the first time in the world that a spacecraft would be launched in parts and then assembled in space.

"…We have worked out the configuration of Chandrayaan-4… how to bring back samples from Moon to Earth. We propose to do it with multiple launches because our current rocket capability is not (strong) enough to do it at one go," Somanath said on the sidelines of an event in Delhi.

"So, we have to have docking capability (joining of different parts of a spacecraft) in space — both in Earth space as well as in Moon space. We are developing that capability. We have a mission called Spadex scheduled later this year to demonstrate this capability," Somanath said.

Docking of spacecraft modules on the return journey from Moon is a fairly routine manoeuvre. A part of the spacecraft detaches from the main spacecraft and makes a landing while the other part remains in the Moon orbit. When the landing part leaves the Moon's surface, it docks and links up with the orbiting part, becoming one unit again.

However, it would be the first instance of docking of modules in Earth orbit for the onward journey to the Moon. "We are not making any claims to be the first one to attempt this, but yes, I am not aware of anyone else having done this so far," Somanath said.

ISRO has so far not had any need to carry out a docking operation in space, and Spadex (Space Docking Experiment) mission would be its first opportunity to demonstrate this capability.

Somanath said that a detailed study, internal review, and cost for the Chandrayaan-4 mission have been worked out which will soon be sent to the government for approval. This is one of the four

project proposals that the space agency plans seek approval for in line with its Vision 2047, which has envisioned India building its own space station by 2035 and sending humans to the Moon by 2040.

India's space station, named Bharatiya Antariksh Station (BAS), would also be set up by carrying different parts of the infrastructure in multiple launches.

"The first segment of the BAS can be launched using (the current) LVM3 rocket because it is the only rocket available today and we have decided that by 2028 we should have the first launch of the BAS. For this, we are preparing another proposal for government approval detailing how we plan to build it, what are the technologies required, the timeline and the cost," Somanath said.

He said details of other modules of the BAS will be worked out in due course. "We have a five module configuration, multiple committees are working on how to develop this," he said.

Somanath said the subsequent modules of BAS would be lifted either by upgraded version of LVM3 or the Next Generation Launch Vehicle (NGLV), a heavy rocket that is currently under development. He said the full design and production plan for NGLV had been prepared.

"The first step is to convert the vision to actionable items – what would be the nature of the space station, what is the way the NGLV should look like. I have today the project report of NGLV in hand — the full design, including its configuration, architecture, production plan, realisation plan, and cost. This will go to the government for approval," he said.

ISRO is also creating a new launch complex for the bigger and heavier NGLV. He said the current launch complex would not be adequate for the 4,000 ton rocket. "It requires a huge facility and processing capability," he said.

https://indianexpress.com/article/technology/science/chandrayaan-4-parts-to-be-sent-in-2-launches-assembled-in-space-isro-chief-9417421/

THE TIMES OF INDIA

Thu, 27 Jun 2024

India must aim to lower cost of access to space: ISRO chief

Isro chairman S Somanath on Wednesday said that India must aim to lower the cost of access to space as it could boost small satellite launches and attract new participants in the space sector.

At the third Annual India Space Congress (ISC) 2024 here, which saw the participation of delegates from over 300 global space organisations and 30 countries, the Isro chief said, "Bringing down the cost of access to space is a global trend, and India must also look at it.

Space can never be solely for business and economy; it must inspire generations to innovate for humanity." he said. "Isro has created significant space capability and talent in the country. It's time for new actors to scale India's space operations," he added.

The Isro chief also said that there is not enough internal demand for the satellite-launch market in India but it can be created through more work on the application of satellite technology. He said big companies are willing to enter the space sector but they are concerned about the timeline. "When I

talk to many of those industries who are willing to come and set up facilities, they are all very ready to do it. But they are asking when they are going to break even and where the orders are so that they can safely invest in this. I think this is a big question. It is the bigger challenge of convincing investors to come in a big way in big state projects," the Isro chief said.

Somanath mentioned that PM Narendra Modi's vision for Amrit Kaal includes extending human space activity beyond the Gaganyaan mission, with the goal of landing on the Moon by 2040. However, he said India's current rockets are not sufficient for round trips to the Moon. Developing rockets with higher payload capacity is essential for both bringing back samples and future human missions, the Isro chairman said.

"Though GSLV MKIII (LVM3) is the biggest rocket that we have, it is not big enough. We need to develop the capability to bring samples back and then send humans to the Moon and bring them back," he said.

https://timesofindia.indiatimes.com/india/india-must-aim-to-lower-cost-of-access-to-space-isro-chief/articleshow/111296895.cms

Wed, 26 Jun 2024

Japanese Scientists Create Robots with Self-Healing Living Skin

Imagine a robot that can smile and frown just like a human. Japanese scientists at Tokyo University have made a significant breakthrough in robotics by attaching living skin to robot faces. This innovative development promises more realistic facial expressions and self-healing skin, bringing us closer to the future of human-like robots.

The Science Behind Living Skin on Robots

The artificial skin developed by the Tokyo University team is made from living cells in a laboratory. This skin is not only soft like human skin but also has the ability to repair itself when damaged. Previous attempts to attach artificial skin to robots faced numerous challenges, primarily due to the difficulty in securing the skin to the robot's structure without causing damage.

How It Works:

Mimicking Human Skin Structure In humans, skin is attached to underlying structures by ligaments, which are flexible ropes made of collagen and elastane. To replicate this, the researchers drilled tiny holes into the robot and applied a collagencontaining gel, followed by a layer of artificial skin. The gel fills the holes and tethers the skin to the robot, mimicking the natural skin-ligament structure.

The Breakthrough Method

Prof. Shoji Takeuchi, the lead researcher, explained to BBC, “By mimicking human skin-ligament structures and by using specially made V-shaped perforations in solid materials, we found a way to bind skin to complex structures. The natural flexibility of the skin and the strong method of adhesion mean the skin can move with the mechanical components of the robot, without tearing or peeling away.”

Potential Applications and Future Challenges

This development, published in the journal Cell Reports Physical Science, paves the way for creating humanoid robots with more lifelike and expressive faces. However, the researchers acknowledge that it will take many years of testing and refinement before this technology becomes an everyday reality.

Applications Beyond Robotics

The potential applications of this technology are not limited to robotics. It could also be useful in research into skin ageing, cosmetics, and surgical procedures, including plastic surgery. By studying the interactions between the artificial skin and robotic components, scientists can gain insights into human skin behavior and improve various medical treatments.

The Road Ahead: Challenges and Future Work

While the attachment of living skin to robots is a significant milestone, there are still many challenges to overcome. One of the major hurdles is creating human-like expressions by integrating sophisticated actuators or muscles inside the robot. These actuators are necessary to simulate the movements and expressions of human facial muscles. As we look forward to the future, the idea of robots with lifelike expressions and self-healing skin is no longer confined to the realm of science fiction. The work done by Prof. Takeuchi and his team brings us one step closer to that reality.

https://www.news9live.com/science/future-of-robotics-living-skin-makes-robots-human-like-2593229