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# समाचार पत्रों से चयित अंश Newspapers Clippings

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

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Wed, 16 Feb 2022

## 'Like a diamond in the sky': Enthralling display by Tejas light combat aircraft at Singapore air show

*A 44-member contingent of the IAF is participating in the air show which is being held from February 15 to 18.*

New Delhi: India on Tuesday displayed its indigenously developed Tejas light combat aircraft (LCA) at the four-day Singapore Air Show.

The IAF shared some highlights from the “enthralling display” by the aircraft at the air show.

“‘Like a Diamond in the Sky’. Some highlights from the enthralling display today by #IAF LCA Tejas at the #SingaporeAirShow2022,” the IAF tweeted along with multiple pictures from the air show.

A 44-member contingent of the IAF is participating in the air show which is being held from February 15 to 18.

The Tejas aircraft is manufactured by state-run aerospace behemoth Hindustan Aeronautics Ltd. The fighter jet is potent platform for air combat and offensive air support missions while reconnaissance and anti-ship operations are its secondary roles.

Singapore Air Show is a biennial event that gives a platform for the global aviation industry to showcase its products.

The ministry said the IAF will be pitching the indigenous Tejas MK-I aircraft alongside participants from across the world.

"The Tejas aircraft will be enthralling the audience with its display of low-level aerobatics displaying its superior handling characteristics and manoeuvrability," it said in a statement.

"The participation of Indian Air Force in the air show provides India with the opportunity to showcase the Tejas aircraft and to interact with counterparts from Royal Singapore Air Force and other participating contingents," it said.

In the past, the IAF participated in similar air shows like LIMA-2019 in Malaysia and Dubai air show last year to exhibit indigenous aircraft and formation aerobatic teams.

<https://www.timesnownews.com/india/article/like-a-diamond-in-the-sky-enthralling-display-by-tejas-light-combat-aircraft-at-singapore-air-show/858976>



Tejas light combat aircraft | Photo Credit: Twitter

## Tejas at Singapore Airshow 2022: Sale calls for full court diplomacy

*While industry watchers rate the Tejas Mark 1A highly, there is concern over haste with which Indian team was despatched to Singapore; and a feeling that New Delhi is participating without clear aims*

*By Ajai Shukla*

New Delhi: An Indian Air Force (IAF) detachment of Tejas Mark 1 fighters, supported by a 44-person team, is performing aerobatic displays over Changi International Airport in Singapore from Tuesday to Friday. This is one of the keenly watched attractions of the Singapore Airshow 2022.

The IAF team is there at Singapore's invitation as a prospective vendor in "Capability 55" — the code name for the Royal Malaysian Air Force's (RMAF's) plan to buy 18 light fighters in the coming year and another 18 starting 2025. Malaysia will choose from a bouquet of light fighters on offer. Besides the Tejas Mark 1A, it has been offered the South Korean FA-50 Golden Eagle, the Russian MiG-35 and the Chinese-Pakistani JF-17 Thunder, which already equips the Pakistan Air Force (PAF). Also competing are two smaller jet trainers: Leonardo's M-346FA and the Russian Yakovlev-130.

While industry watchers rate the Tejas Mark 1A highly, there is concern over the haste with which the Indian team was despatched to Singapore; and a feeling that New Delhi is participating without clear aims and objectives.

In the Tejas' first international outings — including the Bahrain International Airshow in 2016, the Langkawi International Maritime Aerospace Expo (LIMA) in 2019 and the Dubai Airshow 2021 last November — the emphasis was on demonstrating flying performance. But while the IAF and Hindustan Aeronautics Ltd (HAL) had put together attractive flying displays, there was no clear understanding of what they were intending to achieve.

"We did not adequately examine crucial questions. Our short-term customers (Malaysia, Sri Lanka, UAE) were evident, but who were our medium-to-long-term customers? What was our aim in participating in those air shows? In what aspects did we need to impress potential buyers?" said a former test-pilot with extensive experience in flying the Tejas.

Given New Delhi's Atmanirbhar Bharat (self-reliant India) policy, a key aim of participating in international air shows was for India to establish itself as a vendor, rather than a buyer, of military aircraft. This would focus attention on the Tejas at a time when buyer countries were sending out Requests for Information (RFIs) and Requests for Proposals (RFPs). It was felt that the Tejas' reputation would be burnished by flying faultless aerobatics in the presence of a chosen audience.

"In fact, the way to sell fighters is not to have them repeat aerobatics, day-after-day. It might be better for the vendor to play and replay simulated combat missions, which directly address the national security needs of the buyer," says an IAF pilot.

A defence industry executive likens the opportunity presented by an air show to dealing with a rich buyer walking into an exclusive store after having made an appointment. In both cases, it must be pre-decided who would be the designated salesperson, who would support him, and what arguments and materials he would use to convince the buyer.

Seriousness is further conveyed by preparing a composite team in advance for briefing and conducting the buyer. The team must include representatives from the platform developer (in this case, the DRDO), the production agency (HAL) and the user (the IAF).

Major defence sellers usually have a dedicated department to address buyers' concerns. The Pentagon has an Office of Defense Cooperation (ODC) to oversee the sale of weaponry. In Russia, defence exports are handled through Rosoboronexport.

India has no such dedicated agency; only responsibilities distributed between departments. To boost defence exports, a “munitions list” has been promulgated; a standard operating procedure (SOP) has been put in place for the export of those items; an end-to-end online portal has been developed for receiving and processing authorisation permission; along with several other export promotion measures.

However, other than a small cell in the Department of Defence Promotion, no agency is specifically charged with all export-related functions.

Such a department would provide institutional expertise in dealing with issues such as end-user certification and the complex permissions needed to sell an aircraft (like the Tejas) that has systems and subsystems from various countries. Permissions would be needed to transfer an airborne radar from Israel, an ejection seat from the UK and a glass cockpit from France.

Discussing and resolving such issues is the real business of an air show, where government-to-government and government-to-business meetings are set up well in advance.

For an emerging exporter such as India, presenting a new fighter in a high-profile air show would require clear lines of authority and control. In an event like the Singapore Airshow, a locally based official, such as India’s military advisor in the embassy in Singapore should have been given ownership of the exercise.

For flying the Indian flag, an Indian Navy destroyer should have been deployed to Singapore well before time. While displaying New Delhi’s presence prominently, this would have also provided a suitable venue for pull-aside discussions with the RMAF.

True, the Ministry of Defence (MoD) will have rented a chalet for delicate discussions outside the limelight. But, a higher degree of government participation is signalled by hosting a meeting on a warship. And the helicopter deck of a destroyer provides an unmatched venue for hosting a cocktail party, serenaded by a navy band.

The MoD and the IAF did not respond to a request for comments.

[https://www.business-standard.com/article/economy-policy/tejas-at-singapore-airshow-2022-sale-calls-for-full-court-diplomacy-122021501594\\_1.html](https://www.business-standard.com/article/economy-policy/tejas-at-singapore-airshow-2022-sale-calls-for-full-court-diplomacy-122021501594_1.html)

## DRDO on Twitter





ANI  
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Some highlights from the enthralling display today by IAF LCA Tejas at the Singapore Air Show 2022: Indian Air Force (IAF)



2:45 PM · Feb 15, 2022 · Twitter Web App



Prasar Bharati News Services पी.बी.एन.एस.  
@PBNS\_India

In Pictures: Highlights from the enthralling display today by IAF LCA Tejas at the Singapore Air Show 2022.

@IAF\_MCC



4:35 PM · Feb 15, 2022 · TweetDeck

Wed, 16 Feb 2022

### IAF LCA Tejas at the Singapore Air Show 2022

Singapore's biennial air show opened Tuesday on a smaller scale than before the pandemic, even as the aviation sector gears up for a recovery two years after coronavirus outbreaks nearly paralysed air travel.

The three-day air show began Tuesday. Members of the general public are not allowed, but about 600 exhibitors are showing their products and services. That's down from 930 during the last show in February 2020, when coronavirus cases were just beginning to rise.

Experts say the aviation market is poised for recovery, with defense spending on the rise and commercial aviation picking up despite the latest wave of omicron-driven infections.

Those attending the show must observe stringent coronavirus rules including regular COVID-19 testing and potential isolation for those found infected with the coronavirus.

The air show began in 2008. It typically attracts senior corporate executives of aviation companies and delegations from countries around the world. About 13,000 people are expected to attend this year's show, less than half the 30,000 who visited in 2020.

Many Southeast Asian countries have kept their borders closed or imposed strict limits and quarantine and testing requirements to try to curb outbreaks that have ravaged most countries. Some are now slowly relaxing those precautions.

"The air show comes at an interesting time, because the market in Southeast Asia is finally starting to recover after almost two years of decimated impact on air travel, particularly in the international market," said Brendan Sobie, an independent aviation and aerospace analyst based in Singapore.

Many Chinese companies are staying away from this year's show, likely because of Beijing's "zero-COVID" policies that involve lengthy quarantines.

Major exhibitors at this year's show include Boeing, Airbus and Lockheed Martin. Boeing's newest widebody jet, the 777X, made its Asian debut at this year's show, demonstrating aerial maneuvers during a daily flight display.

The 777X is about 20% more fuel efficient than the aircraft it replaces, according to Darren Hulst, the vice president of marketing for Boeing's commercial airplanes. Singapore Airlines is among Boeing customers planning to include the new jet in their fleets.

"The number one trend we're seeing is how resilient the demand for aviation is and how important it is for people to connect," Hulst said in an interview Tuesday. He noted that short-haul flights have recovered quickly in regions like the U.S., where high gas prices are discouraging people from traveling by car.



Twitter IAF/ANI

"As we see the industry recover more, as more and more restrictions are lifted on long haul travel, we'll see the market continue to recover and we think the industry will be back to where it was in 2019 somewhere by the end of 2023 or early 2024," Hulst said.

Boeing rival Airbus said Monday that it had confirmed 48 orders for new aircraft - 28 A320neos for Kuwait's Jazeera Airways, and 20 Airbus A220s for U.S.-based aircraft leasing firm Aviation Capital Group.

China's absence at the show leaves a big gap, said Sobie. Chinese tourists usually are the world's biggest spenders, having splashed out \$254.6 billion on overseas travel in 2019, according to the UN's World Tourism Organization.

"It's not about them not participating in the show necessarily. It's about them not participating in the recovery of the international aviation industry," he said.

"China is a very important market for Asia and in particular, Southeast Asia relies very heavily on China," he said. "So it's an extremely important market that has to recover in order for the market overall to fully recover." While civil aviation has been decimated by the pandemic, experts said defense innovation and spending were less affected, apart from disruptions to supply chains that have troubled many industries worldwide.

Israel Aerospace Industries (IAI) showcased its new Blue Spear missile system at the show in Singapore, while Rafael Advanced Defense Systems, also from Israel, displayed its Spyder air defense system, which is designed to guard against enemy aircraft and unmanned aerial vehicles.

Strategic competition and geopolitical tensions are fueling increased military spending for many countries in the region, including in Southeast Asia, said Michael Raska, coordinator of the military transformation program at the Institute of Defense and Strategic Studies.

"The show might be smaller, and the pandemic may have mitigated the number of exhibitors, but it doesn't mean that defense procurement has been slowing down," Raska said.

He noted that such shows are an important platform for companies and customers to build trust and connect in person, especially when it comes to defense procurement and procurement.

"That's more important than anything else on the show," Raska said. "Forging these relationships or finding new relationships in the industry, that's something you cannot do on Zoom."

<https://www.freepressjournal.in/india/iaf-lca-tejas-at-the-singapore-air-show-2022-see-pics>



Wed, 16 Feb 2022

## **MHA calls high-level meet on using space tech to enhance security of borders with China, Pakistan**

*The Amit Shah-led ministry will seek Isro's help in monitoring India's borders with China, Pakistan, and Bangladesh.*

*By Jitendra Bahadur Singh, Kamaljit Kaur Sandhu*

New Delhi: A day after the Indian Space & Research Organisation (Isro) successfully launched the Earth Observation Satellite-04 onboard its Polar Satellite Launch Vehicle (PSLV), the Ministry of Home Affairs called a high-level meeting to discuss space technology for strengthening border security.

The meeting will be led by the Joint Secretary Border Management division and will be attended by the chief of the Intelligence Bureau along with officials from the paramilitary forces. The meeting will see officials from CRPF, BSF, ITBP, SSB discuss the details with Isro's project head S Arunan.



The meeting comes in the backdrop of a satellite being launched by the MHA to enhance national security. Sources told India Today that the Amit Shah-led ministry will seek Isro's help in monitoring India's borders with China, Pakistan, and Bangladesh. The meeting will see discussions around the satellite that will be launched by Isro for the purpose of enhanced monitoring of regions around these borders.

Sources said that the satellite will help equip forces guarding these borders with real-time information directly to their headquarters. With the borders between India and China seeing increased activity over the last few years, enhanced surveillance will help the country devise better strategies in the future to combat any unforeseen situation.

The meeting comes amid Isro's plans for a renewed pace of space-based missions as it plans to conduct 19 launches this year. During the year, Isro will lift off 08 launch vehicle missions, 07 spacecraft missions, and 04 technology demonstrator missions.

With Monday's successful PSLV launch, the space agency is working towards the launch of the PSLV-C53 mission that will be lifted off in March this year and carry OCEANSAT-3 and INS 2B ANAND into Low Earth Orbit. Isro is yet to release details of the launch window for the mission. The agency had said that it will lift off five missions in three months, kickstarting an eventful year.

<https://www.indiatoday.in/science/story/isro-home-ministry-border-security-surveillance-eos-04-s-somnath-paramilitary-china-pakistan-1913248-2022-02-15>



The meeting comes amid Isro's plans for a renewed pace of space-based missions. (Photo: Isro)

Wed, 16 Feb 2022

## Indian Army's Sikh soldiers to get 'Veer' helmet from the house of MKU; Check features

*MKU is perhaps one of the very few companies from India which has been providing advanced optronic and ballistic protection solutions.*

*By Huma Siddiqui*

For the first time in India, a Combat Helmet has been designed for and dedicated to the Sikh soldiers. This newly designed helmet by Global Defense and Homeland Security Company MKU, based in Kanpur, will be easy for a Sikh soldier to wear without difficulty and comfortably over their under-turban cloth, if they wish to do so.

According to the company, this helmet is capable of providing all-round ballistic protection against bullets and also fragments of up to Level IIIA.

### More about the new helmet — 'Veer'

According to MKU Ltd, like all other Kavro ballistic helmets of the company, 'Veer' helmet is compatible with MACS (Modular Accessory Connector System). MACS is a first of its kind multi-accessory mounting system that enables the head-mounted sensors and modern combat equipment like night vision goggles, cameras on helmets, and communication systems.

This helmet is not only lightweight; it is anti-fungal, and anti-allergic.

With excellent shock absorption, this helmet is flame resistant, chemical safe and all weatherproof.



This helmet is not only lightweight; it is anti-fungal, and anti-allergic. (MKU)

The company has dedicated this newly designed helmet (Model: KAVRO SCH 111 T), to the spirit of valor that Sikh soldiers have embodied for generations – only in India but overseas too.

*Financial Express Online* has reported earlier that the Kanpur based company has executed one of the largest helmet contracts, for 1.59 Lakh ballistic helmets, for India's Ministry of Defence.

Sikh youth have traditionally chosen to serve in the armed forces and central police and paramilitary forces in huge numbers. And based on the information available in the public domain, the largest number of Sikh personnel in uniform serves in the Indian Army.

**Are there special helmets for the Sikhs in the armed forces in India and across the globe?**

So far no. This means that a Sikh soldier was unable to wear a helmet which could be worn over the under-turban cloth comfortably. And this exposed them to injuries, often leading to death in some instances.

**So how will the new designed helmet help?**

According to the MKU's Managing Director Neeraj Gupta, "The turban for a Sikh is his pride. The 'Veer' helmet, from our company offers heroic Sikh soldiers the option of safeguarding their body and life while continuing to wear their under-turban cloth."

The company has been able to create this one-of-its-kind ballistic helmet tailor made for the Sikh soldiers.

**In line with MKU's main motto 'Empowering Heroes' — What did the company's Chairman say?**

MKU's Chairman Manoj Gupta, says, "We observed a need for better head protection for our Sikh troops. The heroes we empower safeguard our freedom, our security and our way of life. And who better to exemplify this spirit of heroism than our Sikh soldiers!"

**MKU Ltd – major exporter**

As has been reported earlier, MKU is perhaps one of the very few companies from India which has been providing advanced optronic and ballistic protection solutions for soldiers and platforms for military, paramilitary, homeland security, police and Special Forces to over 100 countries.

They have operations in India and Germany and till date have provided protection to over 3 million soldiers and 3000+ platforms, across 230 forces. The Indian government recognizes their R&D House and they hold almost 10 patents in India and abroad.

<https://www.financialexpress.com/defence/indian-armys-sikh-soldiers-to-get-veer-helmet-from-the-house-of-mku-check-features/2434950/>



**Press Information Bureau  
Government of India**

**Ministry of Defence**

*Tue, 15 Feb 2022 5:21PM*

## **Historic visit of Lieutenant General Fahd Bin Abdullah Mohammed Al-Mutair, Commander Royal Saudi Land Forces to India**

In a historic and landmark visit, the Commander of the Royal Saudi Land Forces, Lieutenant General Fahd Bin Abdullah Mohammed Al-Mutair, arrived in India on 14 February 2022. This is the first ever visit by a serving Royal Saudi Land Forces Commander to India and marks a deepening bilateral defence cooperation between the two countries. General MM Naravane had visited Saudi Arabia in December 2020 in a historic visit which marked the first time that an Indian Army Chief had visited Saudi Arabia. The aim of the visit is to bolster bilateral defence cooperation between the two countries.

Lieutenant General Fahd Bin Abdullah Mohammed Al-Mutair was received by General MM Naravane, Chief of the Army Staff of Indian Army on 15 February 2022 at South Block where he was accorded a Ceremonial Guard of Honour. He met the COAS for significant bilateral discussions and was briefed on security aspects.

The relationship between India and Saudi Arabia has grown owing to common interests in economic prosperity, eliminating the scourge of terrorism and mitigating the effects of climate change. Defence diplomacy forms one of the major tenets of the overall relationship.

Lieutenant General Fahd Bin Abdullah Mohammed Al-Mutair will depart for Saudi Arabia on 16 February 2022.



<https://pib.gov.in/PressReleasePage.aspx?PRID=1798511>



पत्र सूचना कार्यालय  
भारत सरकार

रक्षा मंत्रालय

Tue, 15 Feb 2022 5:21PM

## रॉयल सऊदी सशस्त्र बलों के कमांडर लेफ्टिनेंट जनरल फहद बिन अब्दुल्ला मोहम्मद अल-मुतायर की ऐतिहासिक भारत यात्रा

रॉयल सऊदी सशस्त्र बलों के कमांडर लेफ्टिनेंट जनरल फहद बिन अब्दुल्ला मोहम्मद अल-मुतायर एक ऐतिहासिक और युगांतरकारी यात्रा के तहत 14 फरवरी 2022 को भारत पहुंचे। यह किसी सेवारत शाही सऊदी सशस्त्र बलों के कमांडर की पहली भारत यात्रा है और दोनों देशों के बीच गहन द्विपक्षीय रक्षा सहयोग का प्रतीक है। इससे पहले भारतीय सेना प्रमुख जनरल एम एम नरवणे ने दिसंबर 2020 में एक ऐतिहासिक यात्रा के तहत सऊदी अरब का दौरा किया था और यह किसी भारतीय सेना प्रमुख द्वारा सऊदी अरब की पहली यात्रा थी। इस यात्रा का उद्देश्य दोनों देशों के बीच द्विपक्षीय रक्षा सहयोग को और मजबूत करना है।

भारतीय सेना के थल सेनाध्यक्ष जनरल एम एम नरवणे ने 15 फरवरी 2022 को साउथ ब्लॉक में लेफ्टिनेंट जनरल फहद बिन अब्दुल्ला मोहम्मद अल-मुतायर का स्वागत किया, जहां उन्हें सेरेमोनियल गार्ड ऑफ ऑनर दिया गया। उन्होंने महत्वपूर्ण द्विपक्षीय चर्चा के लिए सेनाध्यक्ष से मुलाकात की और उन्हें सुरक्षा पहलुओं पर जानकारी दी गई।

भारत और सऊदी अरब के बीच आपसी संबंध आर्थिक समृद्धि में साझा हितों, आतंकवाद के संकट को समाप्त करने तथा जलवायु परिवर्तन के प्रभावों को कम करने के कारण बढ़े हैं। रक्षा कूटनीति समग्र संबंधों के प्रमुख सिद्धांतों में से एक है।

लेफ्टिनेंट जनरल फहद बिन अब्दुल्ला मोहम्मद अल-मुतायर 16 फरवरी 2022 को सऊदी अरब के लिए प्रस्थान करेंगे।



<https://pib.gov.in/PressReleasePage.aspx?PRID=1798587>

THE HINDU

Wed, 16 Feb 2022

## Vizag getting ready for Presidential Fleet Review on February 21

*About 50 ships and an equal number of aircraft to participate in the event*

*By Sumit Bhattacharjee*

Visakhapatnam: About 50 floating assets, including a couple of submarines, and close to 50 aircraft will be participating in the Presidential Fleet Review (PRF) scheduled to be organised on February 21 in Visakhapatnam.

President Ram Nath Kovind, who is the Supreme Commander of the Armed Forces, will be reaching the city on February 20. He will review the fleet at the anchorage on February 21 from 9.30 a.m. onwards.

Though the Presidential Yatch is yet to be named, it is learnt that one of the Naval Advanced Offshore Patrol Vessel in the Saryu Class such as Sunayna, Sumedha, or Sumitra is being refurbished to host the President.

A convoy of three vessels, all in the Saryu Class, will steam-past the columns that will be lined by at least 48 ships from all the naval commands such as the Eastern, Western, Southern and the Andaman.

A couple of ships from the National Institute of Oceanography (NIO), the Shipping Corporation of India and the Indian Coast Guard (ICG) will also be participating.

### **Anchorage**

The ships will be lined up in about four columns at the anchorage point, which is about 8 km to 10 km from the coast. Though all the ships may not be visible, the first line of ships from the coast will be seen, a naval officer has said.



Marine commandos rehearsing for the Naval exercise, in Visakhapatnam on Tuesday. | Photo Credit: K.R. DEEPAK

The presidential convoy of three ships, comprising the Presidential Yatch, the ship carrying media personnel, and a standby Presidential Yatch, will steam past between the columns, and the sailors and officers in each ship will line up on the deck and give the President a salute and raise the slogan, 'Rashtrapati ki Jai'.

The ships will be dressed up ceremonially and the ritual is called 'Dressing Overall'. As per the ritual, all ships will have flags tied from the masts from the bow to the stern. The men will be dressed in their ceremonial attire and the ceremony that follows when the President's Yatch steams past is called 'Man and cheer ship'.

Though the Eastern Naval Command (ENC) is yet to release a list of participating ships, it is learnt that all lead ship in their class, across all commands will be there at the anchorage.

Notably among them could be INS Vikramaditya (aircraft carrier) and INS Visakhapatnam, the Visakhapatnam-Class stealth guided-missile destroyer.

### **Flypast event**

Apart from the steam-past, there will be a flypast by about 50 aircraft. All aircraft in operation under the aviation wing of the Indian Navy will participate in the flypast, which include the latest acquisition such as Mikoyan MiG-29K, Boeing P-8I Neptune and the HAL Dhruv MKIII.

After the flypast, the Marine Commandos (Marcos) will give a demonstration on anti-terrorist operation, a search-and-rescue drill, and a steam-past by a few submarines.

After the exercise, the President will address the nation, which will mark the end of the review.

Later, the President will release a special cover and a postal stamp at the Naval Base to mark the occasion.

<https://www.thehindu.com/news/cities/Visakhapatnam/vizag-getting-ready-for-presidential-fleet-review-on-february-21/article65052364.ece>



Wed, 16 Feb 2022

## **In a first, all-women Indian Army team undertakes offshore sailing expedition off India's east coast**

*By Sidharth MP*

### **Story highlights**

***Organised by Army Southern Wing Sailing Command Node and EME Sailing Association, Secunderabad, this maiden expedition by the crew that comprises officers of the rank major and captain, will demonstrate the strength and vigour of women officers in the Indian Army***

Aimed at motivating young women to take up sailing as an adventure sport, an Indian Army team of nine women officers has set sail on a Chennai-Visakhapatnam-Chennai expedition.

Heading out to sea from the Chennai port, the team of women sailors are led by Major Mukta S Gautam and will be covering a distance of nearly 900 nautical miles or 1700 kilometres.

Organised by Army Southern Wing Sailing Command Node and EME Sailing Association, Secunderabad, this maiden expedition by the crew that comprises officers of the rank major and captain, will demonstrate the strength and vigour of women officers in the Indian Army.

The expedition was flagged off from Chennai Port by Dr. TAMILISAI Soundararajan, Governor of Telangana and Lieutenant Governor of Puducherry, in presence of senior Officers of the Indian Army.



**Indian Army officers with Dr. TAMILISAI Soundararajan, Governor of Telangana and Lieutenant Governor of Puducherry in Chennai Photograph:( Twitter )**

The Governor emphasised that Indian women are shattering all possible glass ceilings and making their own mark, setting new benchmarks. She said that this expedition would not

Only give an impetus to sailing as a sport, but also inspire and motivate young girls to join the Indian Army, don Olive green uniforms and serve the nation.

Lt Gen TSA Narayanan, Commandant MCEME (Military College of Electronics and Mechanical Engineering), congratulated the women officers for having completed their gruelling training and being selected for the expedition. He said that the event was another step towards women empowerment and enhancing the role of women officers in the Army.

The Sailing Association at MCEME has been taking efforts to promote sailing and has groomed sailors of national and international repute. They have also undertaken numerous expeditions in recent decades. These include sea routes such as Mumbai-Kochi, Mumbai-Goa-Mumbai and the Around the Indian Peninsula Offshore sailing expedition, among others.

<https://www.wionews.com/india-news/in-a-first-all-women-indian-army-team-undertakes-offshore-sailing-expedition-off-indias-east-coast-453500>



Wed, 16 Feb 2022

## India, Philippines reaffirm strong commitment to multifaceted partnership

*Jaishankar's three-day visit to the Philippines comes over 2 weeks after the key Southeast Asian country signed a USD 375 million deal with India to buy three batteries of the BrahMos cruise missile*

Manila: India and the Philippines have reaffirmed their strong commitment to a multifaceted partnership that would facilitate the developmental aspirations and shared priorities of the two democracies in the Indo-Pacific region, as External Affairs Minister S Jaishankar on Tuesday concluded his first visit to the key Southeast Asian country.

Jaishankar's three-day visit to the Philippines comes over two weeks after the key Southeast Asian country signed a USD 375 million deal with India to buy three batteries of the BrahMos cruise missile.

During the visit, the minister held a bilateral meeting with his counterpart Teodoro L Locsin Jr and the two ministers reviewed developments in bilateral relations since the meeting of the Joint Commission on Bilateral Cooperation that they co-chaired in virtual format in November 2020.



External Affairs Minister (EAM) S Jaishankar. (Photo | Twitter)

"Both ministers agreed to coordinate closely at multilateral fora and reaffirmed their strong commitment to a multifaceted partnership that would facilitate the developmental aspirations and shared priorities of the two democracies in the Indo-Pacific region," the External Affairs Ministry said in a press release.

They discussed the future trajectory of the wide-ranging engagement between the two countries and also had an in-depth exchange of views on regional and international issues of mutual interest.

The ministers welcomed recent trends in bilateral ties that have contributed to deepening of mutually beneficial cooperation and the expansion to newer areas based on shared interests in line with the vision of the leadership of both countries, the release said.

They agreed to further work towards strengthening engagement in counter-terrorism and defence and maritime security, covering defence capabilities as well as military training and capacity building, it added.

The two sides agreed to make efforts to further expand economic cooperation as well as trade and investment links in a range of areas such as agriculture, infrastructure, health and pharmaceuticals, tourism, ICT, and science & technology.

They expressed satisfaction in recent initiatives to step up cooperation in emerging areas such as fintech, blue economy, renewable energy, space, cyber security and traditional medicine.

To expand business, tourism and student exchange between the two countries, both sides agreed on the need for a simplified visa regime between India and the Philippines.

Jaishankar also pressed for early return of Indian medical students to the Philippines.

He met defence minister Delfin Lorenzana, finance minister Carlos Dominguez III, and Agriculture minister William Dar and discussed issues strengthening cooperation in Defence, Finance and Agriculture sectors respectively.

He also interacted with the Indian diaspora in Manila and appreciated their role in promoting friendship and amity between the people of two countries.

On his part, Locsin said he had "productive and insightful discussions" with Jaishankar.

"At the heart of our relationship are the historical, cultural, and personal ties between our peoples," he said.

"India has been our partner in promoting peace and security in the region, as well as in advocating the rule of law in the face of armed ambition and the anarchy that follows it," he said.

As maritime countries, the Philippines and India, both at the crossroads of the busiest sea lanes in the world, know the critical role of the rule of law in maintaining stability on the water — that most unstable element yet so vital to the life and thriving of nations, the minister added.

"We have so much more to do in maritime cooperation; as much bilaterally as regionally in the context of ASEAN; more broadly still throughout the Indo-Pacific," he said.

He also invoked Mahatma Gandhi, saying India's father of nation is as much a hero here as among his mighty people.

We honoured him by repeating his achievements in reverse: in 1986 by a funeral that American pundits flung in the assassins' faces by calling the two-million strong funeral of Ninoy Aquino 'the greatest since Gandhi's'.

<https://www.newindianexpress.com/world/2022/feb/15/india-philippines-reaffirm-strong-commitment-to-multifaceted-partnership-2419810.html>



Wed, 16 Feb 2022

## **Russia eyes 'Big-Ticket' Sukhoi Fighter deal with Indian Air Force after massive setback from Indonesia, Egypt — Experts**

*By Ashish Dangwal*

The Indian Air Force (IAF) is in the process of acquiring 114 multi-role jets, a project that is likely to cost around Rs 1.3 trillion and take at least a decade to complete before the first fighter jet is supplied.

While the French-made Rafale seems to be in the lead, as revealed by a widely-circulated survey by The EurAsian Times, India's old friend Russia is also hoping to secure this contract. This is especially significant in light of the cancellation of the Su-35's orders by Indonesia and Egypt, seen as a major setback for Russia's defense industry.

Moscow is reportedly offering two fighter different aircraft, MiG-35 and Sukhoi-35, to the IAF. But the service appears to have been unimpressed by the MiG-35.

Last year, it was reported that Russia is proposing its Checkmate, a next-generation fighter jet, to India, but given that the jet is still in development, India is unlikely to consider it for ongoing procurement. Hence, the Su-35 stands a chance for this contract.

A '4 ++ generation' air supremacy fighter, the Su-35 'Flanker' is the only heavy platform among the contenders for the IAF contract apart from F-15EX jets.

## India's Experience with Russian Weapons

India has long been a major customer of Russian weapons. IAF operates fighter jets such as the Mig-21 and Su-30MKI.

In recent years, India has attempted to lessen its reliance on other countries for weapons to boost local manufacturing. However, Russia continues to play an important role in enhancing the capability of India's military. The recent delivery of the S-400 air defense systems is a case in point.

An evaluation by the US Congressional Research Service (CRS) revealed last year that while India's reliance on Russian weapons and equipment has decreased significantly, the Indian military cannot operate effectively without Moscow-supplied military hardware and will continue to depend on it in the near and medium-term.

Miguel Miranda, an international defense analyst had said – 'The 21st Century Asian Arms Race', said, "In reality, for the sake of convenience, the IAF should just fall back on the Russians for a tandem deal involving the Su-35 multirole fighter and the Su-34 supersonic bomber. This is very reasonable since the IAF has decades of experience operating the Su-30MKI. Adopting more Sukhoi is a boon for the air force and local industry and represents a huge leap for the aerospace sector."

Given the exorbitant cost of the Rafale fighter, some analysts predict that Russian fighter jets are the best alternative for India.

At roughly Rs 430 crore per jet, the Su-30 is less than half of the Rs 1,000 crore that the Indian government paid for each Rafale. This too was an estimated price arrived at by experts and media houses, with the government previously refusing to share the cost of the procurement in Parliament.

Squadron Leader Vijinder K Thakur (Retd), a military analyst and former IAF Jaguar pilot, also endorses this view: "The most cost-effective choice for the IAF would be the Su-35. It features all the sensors and capability enhancements that would eventually go into the Su-30 Upgrade." He said that India would not be in a position to afford more Rafales from France, especially in the numbers desired by the IAF.

### Advantages of Russian Aircraft

Russia, like other aircraft manufacturing nations, is aggressively pushing its fighter jets to India. In 2019, the Russian Federal Service for Military-Technical Cooperation announced that it will choose the state-run Hindustan Aeronautics Limited (HAL) as its strategic partner for the MiG-35 and Su-35.

"We believe in HAL and have a long-standing partnership with it," said Anatoly G. Punchuk, the deputy director of the agency, during a conversation with select journalists at Aero India.

Thakur also noted, "with the local manufacturers, the risk of being overly dependent on Russia would be greatly mitigated. As the largest operator of the Su-30 in the world, it is time for India to treat the aircraft as an Indian manufactured fighter."

Russia is believed to have offered a variety of Su-35 technology under the contract that can be utilized to upgrade India's Su-30 fleet, greatly improving their flight performance. Furthermore, a large number of the systems will be manufactured in India.

The prospective contract states that the radar and other equipment installed on the Su-35 will be integrated into the Indian Su-30, making the two aircraft generally identical and, thus, compatible. It can also contribute to less onerous maintenance and a reduction in the net operational expenditures needed to maintain the fleet of heavyweight fighters.

Highlighting the significance of nuclear delivery aircraft, military analysts have previously told The EurAsian Times that barring, France and Russia, no country will allow their supplied or co-



File Image: Russian Su-35



produced platforms to be used by India for nuclear weapons delivery due to their respective domestic laws.

### **A Good Option to Integrate Future Weapons?**

Since 2004, India has purchased Su-30s in batches from Russia, with 222 being assembled at HAL's Nasik plant under a technology transfer agreement. Forty of the 272 fighters are being upgraded to deploy the air-launched variant of the supersonic cruise missile BrahMos.

“Instead of upgrading older fighters, with a shorter residual lifespan, it would be better to build three more squadrons of Sukhois with the capability to carry BrahMos missiles,” then HAL Chairman T. Suvarna Raju had stated.

In November 2017, the BrahMos missile, developed by the Indo-Russian joint venture BrahMos Aerospace, was successfully test-fired for the first time from a Su-30. As a result, India became one of the few countries in the world capable of launching a supersonic cruise missile from a jet.

This provides a massive strike capability, jeopardizing critical enemy strategic locations, as well as greater operational flexibility in undertaking military actions.

Considering the situation, acquiring a Russian fighter would be a viable solution for India. Additionally, due to its massive bulk, the Su-35 outperforms all other bidders on several parameters: payload, range and altitude, and equipment power.

Since its proportions allowed for the installation of an engine with a regulated thrust vector, it has greater maneuverability and speed (like the MiG-35). Moreover, Su-35 is the only aircraft in the race that can carry hypersonic air-to-air missiles.

Additionally, New Delhi is collaborating with Moscow on the development of a hypersonic missile. Integrating these missiles into Russian-made jets will ensure greater compatibility, and the Su-35 could be a good option for that.

<https://eurasianimes.com/russia-eyes-big-ticket-sukhoi-fighter-deal-with-indian-air-force-after-massive-setback-from-indonesia-egypt-experts/>



Wed, 16 Feb 2022

## **A Matter of speed? Understanding Hypersonic Missile Systems – Analysis**

*By Kolja Brockmann and Dr Markus Schiller*

Over the past weeks and months, ‘hypersonic missiles’ have again made headlines in global defence news. On 5 and 11 January, North Korea performed test flights of what it claims is a ‘hypersonic missile’. The announcement, the released pictures and the flight path suggest North

Korea tested a rotational symmetric glide vehicle atop a rocket booster that performed pull-up and cross-range manoeuvres during its flights. However, many analysts have argued that in this case, the label of manoeuvrable re-entry vehicle would be more appropriate. In September 2020, North Korea tested what it called its first ‘hypersonic missile’, a ballistic missile booster with a wedge-shaped hypersonic glide vehicle. Another example where the term ‘hypersonic missile’ was used by media outlets was in August 2020, when China was reported to have tested a ‘hypersonic glider’.



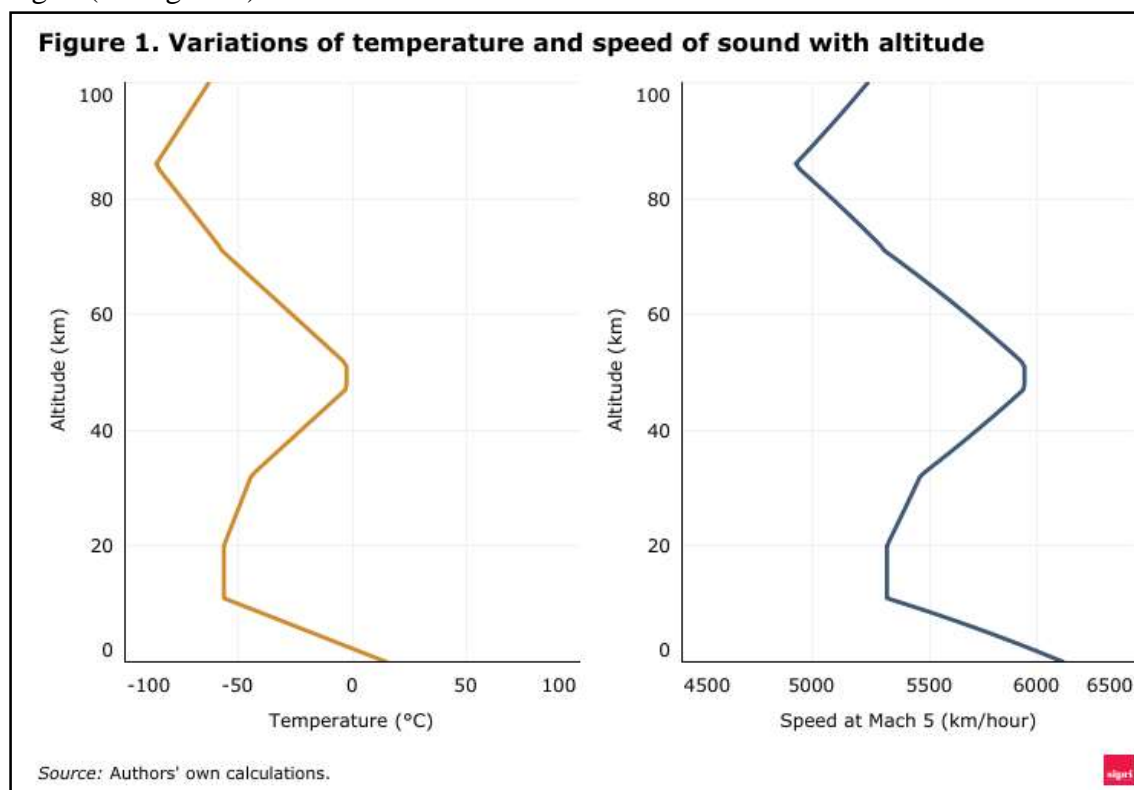
X-51A Waverider, U.S. Air Force graphic, Wikipedia Commons.

These examples demonstrate how confusing—and potentially distorting—the term ‘hypersonic’ is when it is applied to a whole range of missile systems by a range of different actors. Some of the news coverage of these events also indicated a lack of understanding of the different types of ‘hypersonic missiles’, the role of their speed and manoeuvring capabilities, the physics behind them, and their military capabilities and missions. This SIPRI Topical Backgrounder seeks to improve the understanding of hypersonic speed, the nature of hypersonic missile systems, as well as their key subsystems and technologies. Improving the understanding among policymakers and journalists could help inform political and public discourses and identify opportunities for applying targeted non-proliferation and arms control measures to reduce the risks associated with them.

### Understanding hypersonic speed

The term ‘hypersonic speed’ is widely defined as any speed beyond Mach 5, meaning five times faster than the speed of sound. This threshold is used to define a subset of air vehicles because a range of physical effects start becoming a significant engineering challenge at that speed. Specifically, the object endures a massive heat flux when it flies through dense layers of the earth’s atmosphere at hypersonic speeds. This and other physical effects make developing aerial vehicles for hypersonic flight particularly difficult and costly. However, there are also some problems linked to the definition of ‘hypersonic speed’, and with that, part of the definition of ‘hypersonic missiles’.

First, defining hypersonic speed as anything beyond Mach 5 actually results in a variation of the object’s speed, depending on its altitude. The speed of sound, which defines the speed of Mach 1, depends not only on the chemical composition of the gas that the sound is moving through (in this case, the air in the earth’s atmosphere) but also on its temperature. The most common standard model of the earth’s atmosphere, the US Standard Atmosphere, shows a significant change of temperature with altitude. This results in a different measurement of what the speed—in kilometres per hour—of a missile moving with Mach 5 is, simply depending on the altitude that the missile is flying at (see figure 1).



There is also another factor to add to this variation. Since the Mach number strongly depends on the surrounding gas that the object is moving through, using a Mach number for definitions becomes more and more difficult once the surrounding gas gets thinner and thinner—and disappears completely at higher altitudes. While scientists and engineers agree that it still makes

sense to talk about Mach numbers at altitudes around 30 km—which weather balloons and special aeroplanes can reach—there certainly is not enough atmosphere at an altitude of 300 km—where satellites are already orbiting the earth. Due to the nature of the earth’s atmosphere, which becomes exponentially thinner with altitude, it is difficult to agree upon a clear altitude limit where Mach numbers should still be used as a measurement of speed, and with that, where hypersonic missiles can sensibly be defined by stating that such missiles travel faster than Mach 5.

### **Distinguishing hypersonic weapon systems**

Hypersonic speed is often pointed to as one of the key factors—if not the key factor—that set ‘hypersonic’ missiles apart from other missiles. However, the speed of ballistic missiles (predating the current hype around hypersonic missiles by almost a century) in many cases far exceeds that of today’s ‘hypersonic missiles’. The ancestor of ballistic missiles, Germany’s A-4 (which later became commonly known as the V-2) was first launched in the 1940s. During ascent, it could reach a speed greater than Mach 5 (although only for a brief period) and could do so again momentarily on its way back down. But, no one would claim that the V-2 was a hypersonic missile. In a similar vein, should one apply this label to modern intercontinental ballistic missiles that reach speeds beyond Mach 20 at ascent and re-entry?

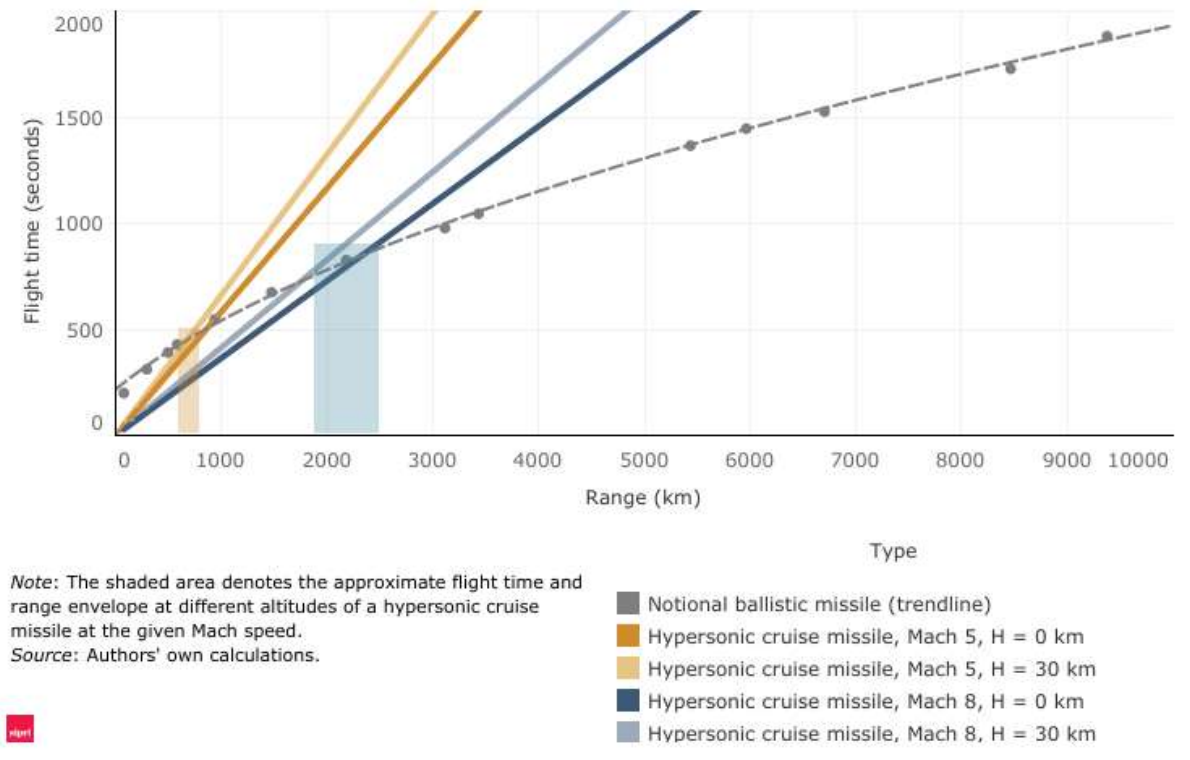
Certainly not, and there are other characteristics commonly cited when defining ‘hypersonic missiles’. However, while a combination of defining characteristics is increasingly adopted among experts, hypersonic missiles are often not well understood within public discussions in politics and the media. Wikipedia, a common starting point for those new to the topic, defines ‘hypersonic flight’ as ‘flight through the atmosphere below about 90 km at speeds ranging between Mach 5–10, a speed where dissociation of air begins to become significant and high heat loads exist.’ However, a V-2 missile would be classified as a hypersonic missile under this definition. The US-based Missile Defense Advocacy Alliance states that ‘hypersonic weapons refer to weapons that travel faster than Mach 5 (~3800mph) and have the capability to maneuver during the entire flight.’ An article published by the Russian International Affairs Council states that ‘there are two major defining characteristics [that] are prerequisite[s] to label a weapon “hypersonic”: Speed exceeding Mach 5 [and the] capability to make maneuvers (both vertical and horizontal) while traveling at this speed inside the atmosphere.’ Many ballistic missiles fall outside of the definition since they do not meet these prerequisites.

Given the speed and manoeuvrability characteristics, hypersonic weapons are further subdivided into two different types of missile systems: hypersonic cruise missiles (HCMs) and hypersonic glide vehicles (HGVs). HCMs keep a constant hypersonic speed (and usually altitude) and are powered over the entire course of their flight. In contrast, HGVs are usually launched on tops of ballistic missiles (often referred to as a boost-glide system) and then glide back through the atmosphere to their target at hypersonic speeds. There are also hybrid cases that do not match either of these categories, but exploring these is beyond the scope of this backgrounder.

It is worth considering the speeds of hypersonic missiles (in this case HCMs) and comparing them with those of ballistic missiles (which may or may not carry an HGV as a re-entry vehicle) to get an idea of how long it takes for both types to reach targets at different distances (see figure 2).

The distance a ballistic missile can fly depends on the speed which it accelerates—the faster it flies, the further it goes, just like throwing a rock. In contrast, HCMs travel at an (almost) constant speed, which is independent of how far away their target is. As illustrated by figure 2, ballistic missiles reach their target quicker than hypersonic missiles at distances beyond roughly 600–800 km for HCMs constantly travelling at Mach 5 (depending on the altitude). Conversely, hypersonic missiles reach their targets faster at ranges of more than roughly 1900–2500 km for HCMs constantly travelling at Mach 8, which is currently seen as the maximum speed they may travel using current technology. This means that HCMs usually take longer than ballistic missiles to reach distant targets. As HGVs are usually carried by ballistic missiles, the time they require to reach a target depends on the trajectory the booster is launched at, the distance covered, and the manoeuvres performed while gliding towards the target.

**Figure 2. Time required by hypersonic cruise missiles and ballistic missiles to reach a target**



Speed, manoeuvrability and the characteristics of each of these types of hypersonic missile systems make them more or less suitable for specific military missions and present challenges for missile defence systems. This also influences their possible impact on strategic stability. However, reaching the desired performance characteristics often implied when talking about HGVs and HCMs requires overcoming a range of significant technical challenges.

### Subsystems and technology challenges for hypersonic glide vehicles

Any HGV, whether it carries a conventional, nuclear, or no weapon payload, is designed so it can independently perform the necessary manoeuvres to fly precisely into a given target. Sensors and computational capabilities are required to enable the vehicle to maintain a certain degree of autonomy. Consequently, an HGV requires many of the same (or at least similar) basic subsystems a ballistic missile requires, with the exception of the propulsion system. Because an HGV is launched on a rocket booster, it is usually intended to glide towards its target and does not need a main engine.

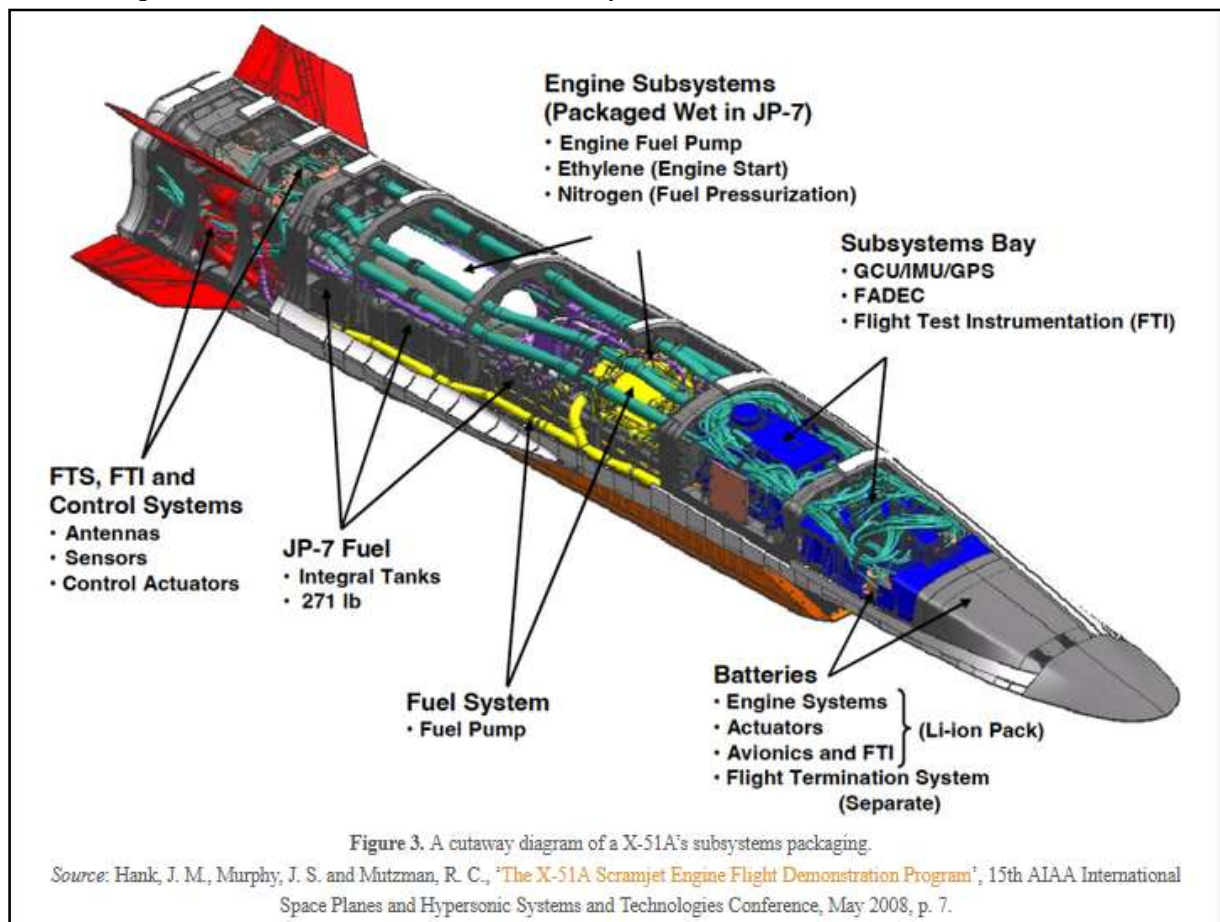
The main subsystems of an HGV are:

- a guidance and control system;
- a lightweight airframe (with sufficient thermal shielding);
- the payload (for some limited missions, an HGV could potentially rely on the kinetic energy of the impact alone).

As with ballistic missile systems, developing and integrating these subsystems is very difficult. For example, the guidance and control system needs a power source, a computer, sensors, and actuators—such as aerodynamic control surfaces or small cold gas thrusters that enable performing manoeuvres. As one adds the cables, bolts, screws, nuts and elements where these components are affixed, the total weight and the required space increase. There also needs to be enough room to carry the actual payload in most cases. As a result, HGVs are usually neither small nor light, which significantly impacts the capabilities of the overall system and the necessary trade-offs between some of its capabilities.

Any HGV is intended to move through thicker layers of the atmosphere at a very high speed, thus creating a huge heat load and ionizing the air around it. This heat load puts a huge strain on

the airframe, which should also be able to withstand any stresses generated by manoeuvres that the HGV is to execute. Also, the plasma cloud generated by the HGV moving at hypersonic speed makes it very hard for any type of sensor to sense anything, let alone to identify and lock onto a target. The HGV, therefore, must know exactly where it is without any help from the outside, thus requiring very precise inertial sensors, among others. The technological challenges of these requirements are comparable to those of a spacecraft designed to re-enter the earth's atmosphere. But they are even more demanding due to the stricter size and weight limits of HGVs as well as additional requirements derived from their military role.



Designing, building and operating a reliable HGV presents many challenges, including access to technology, high development costs and testing requirements.

### Subsystems and technology challenges for hypersonic cruise missiles

The basic requirements for HCMs are similar to those of HGVs, with the exception that the speeds may be lower (even top speeds of Mach 8 have not been convincingly demonstrated yet). In addition, HCMs carry propulsion systems, which have to be highly sophisticated to maintain hypersonic speeds over significant durations. Currently, it seems that only some advanced ramjets and supersonic combustion ramjets (scramjets) are capable of meeting these requirements. Hypersonic propulsion using air-breathing engines over longer distances presents extreme technical challenges. So far, no state has deployed a missile system using a scramjet engine, but research, development and testing continue.

The same basic elements that are required for an HGV (albeit in a very different design) are also relevant for HCMs, with the addition of the propulsion system:

- a guidance and control system;
- a lightweight airframe (with sufficient thermal shielding);
- a highly efficient propulsion system (usually a scramjet);
- the payload.

Adding the propulsion element adds to the problems mentioned for HGVs, as is illustrated by the US X-51A ‘Waverider’ prototype (which would be an HCM). The X-51A was only designed to demonstrate scramjet operations for a few minutes of hypersonic flight without the capacity to carry a weapons payload. At more than 4 metres in length, the X-51A cruiser module was completely packed (see figure 3), with no extra room for a payload. This shows the severe limitations regarding weight and volume for any subsystem elements in HCMs.

As with HGVs, many of the same technology requirements arise for HCMs. Heat loads may be comparable (depending on the mission), and sensors, as well as the guidance system, have to meet comparable requirements. The sophisticated technology required for a workable scramjet propulsion system is currently a major obstacle for HCM development efforts.

The capabilities of different states’ HGVs and HCMs, respectively, can vary significantly depending on the sophistication of the technology, design and engineering choices. Assessing and comparing the real capabilities of any such systems should thus go deeper than a capability to reach speeds greater than Mach 5 and a certain degree of manoeuvrability.

### **Conclusions**

Returning to the reported hypersonic missile tests by North Korea, in both cases, enabling manoeuvrability appears to be one of the main objectives behind the apparent design choices. Therefore, merely describing these systems as ‘hypersonic missiles’ neither provides the necessary understanding of their actual speed, nor their manoeuvrability or the type of hypersonic weapon system they are. These examples are also a reminder that different degrees of manoeuvrability may be achieved using different types of re-entry or glide vehicles and that speed—and even manoeuvrability—are only two of the key characteristics of a missile system. As North Korea continues its intensive testing cycle, it is important to consider characteristics and types of systems and assess them for their capabilities and possible missions—beyond the ‘hypersonic’ label.

The excessive focus on ‘hypersonic missiles’, particularly in some popular media, paired with a lack of understanding of the limitations of this descriptor, has meant that discussions on the risks created and possible responses have sometimes overly focused on the threat of reduced response times, or impact on missile defences and other countermeasures. Questioning why certain actors—be they states or industry—adopt this terminology can help reveal motivations and vested interests in the hype around hypersonic missiles, i.e. to appear threatening or attract funding. More informed discussions have explored, for example, the potential impact of significant manoeuvring capabilities, including target ambiguity and the evasion of radars and other sensors. In the way that it is currently being used, the term ‘hypersonic’ often has little to no meaning and at the same time fuels competitive dynamics and a fear of missing out on the technology. Overcoming this lack of nuance could help put a brake on some of the competitive dynamics and hype-driven military spending. For example, the capabilities of some existing missiles often already provide the desired capabilities. Conversely, the advantages of future hypersonic missiles over other systems are sometimes exaggerated and come with a large price tag. Considering the technical and economic challenges of developing and deploying viable hypersonic weapon systems can help inform arms control and non-proliferation efforts addressing risks posed by hypersonic missiles.

*(About the authors: Kolja Brockmann is a Researcher in the SIPRI Dual-Use and Arms Trade Control programme. Dr Markus Schiller (Germany) is an analyst at Munich-based consulting company ST Analytics.)*

*Source: This article was published by SIPRI*

<https://www.eurasiareview.com/16022022-a-matter-of-speed-understanding-hypersonic-missile-systems-analysis/>

### Key landing test will push reusable vehicle RLV-TD closer to Orbital Re-Entry mission

*By Chethan Kumar*

Bengaluru: ISRO, which has been making quiet progress on the reusable launch vehicle-technology demonstrator (RLV-TD) is looking to carry out a key landing Experiment — RLV-LEX — in the next few months that will push it closer to an orbital re-entry experiment (ORE). The planned landing experiment will be carried out in Challakere in Chitradurga district, some 220km from Bengaluru.

Isro chairman S Somanath, while confirming that the agency has planned the RLV-LEX this year, said: “...We will be demonstrating one of the critical technologies — the approach and autonomous landing on a runway. This will happen in Challakere. We are preparing for the test and systems are being readied. We will soon make an announcement.”

In the LEX, the vehicle will be carried using a helicopter to an altitude of about 3km to 5 km and released at a distance of approximately 4km to 5km ahead of the runway with a horizontal velocity. As per Isro, after the release, the RLV glides, navigates towards the runway and carries out a conventional autonomous landing with a landing gear.

S Unnikrishnan Nair, director, Vikram Sarabhai Space Centre (VSSC), said: “We are planning for the test in the next three to four months, the hardware is nearly ready. The RLV will be released from the helicopter under controlled conditions. It will have various control systems, including its own navigation and guidance control systems and aerodynamics sensors etc. This experiment will simulate the last 800m to 1km of the actual orbital mission.”

Pointing out how landing is among the most complex activities in any mission, Nair said the RLV-LEX would take the technology demonstration one step closer to the planned ORE. “Once we successfully complete this mission and we have validated the software, landing gear and get data on how the aerodynamics sensors worked to manoeuvre the aircraft and bring it back to the intended spot on the runway and other critical technologies, we will be ready for the orbital re-entry experiment. For this the RLV will be scaled up,” Nair said.

As per Isro, in ORE, a wing body called Orbital Re-entry vehicle (ORV) will be taken to an orbit by an ascent vehicle derived from the existing GSLV and PSLV stages and stay in orbit for a stipulated period, re-enter and land in a runway autonomously with a landing gear. “Before the RLV-LEX we’d done the RLV-TD HEX-01 (hypersonic experiment) mission in which we successfully validated autonomous navigation, guidance & control, reusable thermal protection system and re-entry mission management. Once LEX is done, we’ll need to integrate both for the ORE,” Nair said.

Carried out on May 23, 2016, the RLV-TD HEX was a 770-second suborbital flight and designed to land on sea. The experimental mission saw the HS9 solid rocket booster carrying RLV-TD to a height of about 65km from where the vehicle began its descent followed by atmospheric re-entry at around Mach 5 (five times the speed of sound).



Isro, which has been working on this technology for more than a decade, decided to develop it primarily to address the cost and time issues. “The cost of access to space is the major deterrent in space exploration and space utilisation. A reusable launch vehicle is the unanimous solution to achieve low cost, reliable and on-demand space access,” Isro has said.

However, mastering this technology will provide multiple other benefits, including in development of different types of launch vehicles, space transportation and so on. While the ORE will be a major milestone, the RLV-TD is only a technology demonstrator and the development of an actual re-usable launch vehicle will take more time.

<https://timesofindia.indiatimes.com/home/science/key-landing-test-will-push-reusable-vehicle-rlv-td-closer-to-orbital-re-entry-mission/articleshow/89596282.cms>



Wed, 16 Feb 2022

## New technique for making wearable sensors allows faster and less costly prototyping of designs

By Alan S. Brown

Engineers at UC Berkeley have developed a new technique for making wearable sensors that enables medical researchers to prototype test new designs much faster and at a far lower cost than existing methods.

The new technique replaces photolithography—a multistep process used to make computer chips in clean rooms—with a \$200 vinyl cutter. The novel approach slashes the time to make small batches of sensors by nearly 90% while cutting costs by almost 75%, said Renxiao Xu (Ph.D.'20 ME), who developed the technique while pursuing his Ph.D. in mechanical engineering at Berkeley.

"Most researchers working on medical devices have no background in photolithography," Xu said. "Our method makes it easy and inexpensive for them to change their sensor design on a computer and then send the file to the vinyl cutter to make."

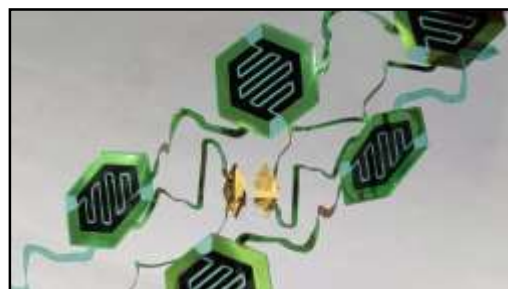
A description of the technique was published Jan. 25 in *ACS Nano*. Xu, who now works at Apple, and Liwei Lin, professor of mechanical engineering and co-director of the Berkeley Sensor and Actuator Center, were the lead researchers.

Wearable sensors are often used by researchers to gather medical data from patients over extended periods of time. They range from adhesive bandages on skin to stretchable implants on organs, and harness sophisticated sensors to monitor health or diagnose illnesses.

These devices consist of flat wires, called interconnects, as well as sensors, power sources and antennas to communicate data to smartphone apps or other receivers. To maintain full functionality, they must stretch, flex and twist with the skin and organs they are mounted on—without generating strains that would compromise their circuitry.

To achieve low-strain flexibility, engineers use an "island-bridge" structure, Xu said. The islands house rigid electronics and sensor components, such as commercial resistors, capacitors and lab-synthesized components like carbon nanotubes. The bridges link the islands to one another. Their spiral and zigzag shapes stretch like springs to accommodate large deformations.

In the past, researchers have built these island-bridge systems using photolithography, a multistep process that uses light to create patterns on semiconductor wafers. Making wearable sensors this way requires a clean room and sophisticated equipment.



A supercapacitor array made using a new fabrication technique that is faster and less expensive than photolithography. Credit: Peisheng He/UC Berkeley



The new technique is simpler, faster and more economical, especially when making the one or two dozen samples that medical researchers typically need for testing.

Making sensors starts by attaching an adhesive sheet of polyethylene terephthalate (PET) to a Mylar (biaxially oriented PET) substrate. Other plastics would also work, Xu said.

A vinyl cutter then shapes them using two types of cuts. The first, the tunnel cut, slices through only the top PET layer but leaves the Mylar substrate untouched. The second type, the through cut, carves through both layers.

This is enough to produce island-bridge sensors. First, tunnel cuts are used in the upper adhesive PET layer to trace the path of the interconnects; then the cut PET segments are peeled off, leaving behind the pattern of interconnects on the exposed Mylar surface.

Next, the entire plastic sheet is coated with gold (another conductive metal could be used as well). The remaining top PET layer is peeled away, leaving a Mylar surface with well-defined interconnects, as well as exposed metal openings and contact pads on the islands.

Sensor elements are then attached to the contact pads. For electronic devices, such as resistors, a conductive paste and a common heat plate are used to secure the bond. Some lab-synthesized components, such as carbon nanotubes, can be applied directly to the pads without any heating.

Once this step is done, the vinyl cutter uses through cuts to carve the sensor's contours, including spirals, zigzags and other features.

To demonstrate the technique, Xu and Lin developed a variety of stretchable elements and sensors. One mounts under the nose and measures human breath based on the tiny changes in temperatures it creates between the front and back of the sensor.

"For a breath sensor, you don't want to something bulky," Lin said. "You want something thin and flexible, almost like a tape beneath your nose, so you can fall asleep while it records a signal over a long period of time."

Another prototype consists of an array of water-resistant supercapacitors, which store electrical power like a battery but release it more rapidly. Supercapacitors could provide power for some types of sensors.

"We could also make more complex sensors by adding capacitors or electrodes to make electrocardiogram measurements, or chip-sized accelerometers and gyroscopes to measure motion," Xu said.

Size is sensor cutting's one key limitation. Its smallest features are 200 to 300 micrometers wide, while photolithography can produce features that are tens of micrometers wide. But most wearable sensors do not require such fine features, Xu noted.

The researchers believe this technique could one day become a standard feature in every lab studying wearable sensors or new diseases. Prototypes could be designed using high-powered computer-aided design (CAD) software or simpler apps made especially for vinyl printers.

**More information:** Renxiao Xu et al, Facile Fabrication of Multilayer Stretchable Electronics via a Two-mode Mechanical Cutting Process, *ACS Nano* (2021). [DOI: 10.1021/acsnano.1c10011](https://doi.org/10.1021/acsnano.1c10011)

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