



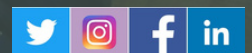
CENTRE FOR
JOINT WARFARE
STUDIES

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SEMINAR REPORT ON SURVEILLANCE & ELECTRO OPTICS INDIA 2024

ORGANISED BY CENJOWS & IMR INDIA
22ND MARCH 2024

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The Centre for Joint Warfare Studies (CENJOWS), in collaboration with Indian Military Review (IMR), hosted a conference on "SURVEILLANCE & ELECTRO OPTICS INDIA 2024 " on March 22, 2024. The event was conducted in New Delhi's Manekshaw Centre. Prominent panellists in the conference comprised senior serving members from the tri-services, representatives from DRDO, and industry representatives. The seminar offered an environment for the industry to interact with the armed forces to understand their SURVEILLANCE & ELECTRO OPTICS requirement and obtain information about their standards so that they model their expertise while developing such products. The session also informed the audience about technical advancements achieved by the industry and DRDO, and the design bureaus under the respective service wings in the field of SURVEILLANCE & ELECTRO OPTICS in addition to the functional challenges. The seminar was conducted in four sessions.

SESSION 1: INAUGURAL SESSION

Maj Gen (Dr) Ashok Kumar, VSM (Retd), Director General CENJOWS, felicitated the speakers, panellists, attendees, serving and former military members in his welcoming comments. He expanded on the seminar's subject and remarked that the deliverables are not fully visible in the services as far as Surveillance & Electro Optics are concerned. Much more needs to be done. He further enumerated that the Svl & EO systems consists of one of the four components essential for warfighting and these are as under:

- Sensors -They are the eyes and ears that sense the situation in the air, land, and sea domain.
- Data and communication links through which sensor outputs are transmitted to the systems where it will be stored, analysed, and acted upon.
- Command and Control Centre/ Data Fusion Centre, where the data will be processed and decisions are taken to respond.
- Shooter - is the final component which will react to the emerging situation.

The sensor is the most critical element of the loop, so surveillance using electro-optical sensors is the most important part of the chain. We need to investigate the spectrum and bandwidth the systems need to work upon efficiently. The systems must have the capacity to connect and work together with the three services, and the compatibility with the existing systems will improve their capabilities.



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Lt Gen D S Rana, AVSM, YSM, SM, DG DIA delivered the inaugural address stating that, Electro-optical sensors harvest the capabilities of optics and electronics to analyse high-resolution visual images in real time. The current conflicts in Ukraine, the Red Sea situation, the South China Sea, the nuclear ambitions of Iran and firings by North Korea are driving the world into an unstable situation. In our neighbourhood, Pakistan is facing an economic crisis, and China, too, is increasing its footprints not only on land but in the sea. The need for high-grade sensors onboard drones and space-based assets is proliferating. The role of commercial intelligence data by Maxar has helped Ukraine analyse the movement of Russian troops and counter the threat in time before the attack began. Ukraine has access to NATO-based intelligence, and Russia and Ukraine are continuously attacking the targets in depth using PNT. China has increased its Space-based capabilities with EO imaging revisit of about fifteen minutes, two hours in SAR, near-continuous coverage of ELINT in the Indian region. It has ISR capabilities in geosynchronous orbit for round-the-clock coverage in the Pacific and Indian Oceans. China is developing a ground-based system in Pakistan that will enhance BeiDou accuracy to 15cm based on PNT to enhance its regional precision strike capabilities. The unmanned drones can conduct ISRs and are equipped with high-definition IR and SAR sensors. Pakistan is building up its capabilities for coverage of its land borders along Iran, India and Afghanistan using high-definition EO sensors fitted drones. HAPS are solar-powered drones that fly above 20 km for persistent capabilities for many months with a resolution of 15 cm. Ground-based sensors can sense the movement of troops using acoustic sensors, and China has operationalised an EO grid along the Line of Actual Control for all weather coverage. The maritime role relies on various sensors, such as long-range patrol aircraft and acoustic sensors fitted on undersea autonomous vehicles. All these developments in the sensors onboard space, air and sea-based platforms have resulted in a paradigm shift in how intelligence is gathered. There is no shortage of data, and the use of data analytics and machine learning algorithms using AI will only help in analysing the spatial data from a variety of sensors. The use of GIS for the fusion and visualisation of spatial data is a growing field many intelligence agencies have adopted. The growth of MASINT (measurement and signature intelligence) is where data from multiple sensors capable of sensing data like electromagnetic, electro-optical, acoustic, and chemical composition are fused. Only the US and Israelis have this technology and our efforts to shore up this technology is the need of the hour. The next challenge is to fuse the data and generate the information using network nodes. These data can be shared in a secure grid to seamlessly counter emerging threats in various domains. He concluded by mentioning that the current global conflicts and geopolitical situations are driving the need for high-grade sensors onboard drones and space-based assets. Both China & Pakistan are developing space-based capabilities, including imaging and coverage in the Indian region. Further



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the use of data analytics, machine learning algorithms, and GIS for spatial data fusion and visualization is becoming increasingly important. The growth of MASINT technology, which combines data from multiple sensors, is a priority for many intelligence agencies. The next challenge is to effectively fuse and share data to counter emerging threats.

The keynote address was delivered by **Air Marshal Surat Singh, AVSM, VM, VSM, Director General Air Ops, Air HQ**. He defined the emerging warfighting using the sensors in the following roles:

- Superior Battlefield transparency.
- Networking of all sensors.
- Shortening of OODA loop using automated data support loop.
- Swift response using agile weapons.

They are being done at the HQ level to enable the standardised operation of data formats, protocols, and interfaces. The aerospace domain requires the exploitation of space, air and surface-based sensors. The commercialisation of space and dual-use technology must be used optimally. In addition, identifying threats in space, air surface and maritime has to be done almost on a real-time basis using private and public assets. The requirements for space-based solutions that the Air Force has met, are, Stratospheric and persistent platforms assets, Low-cost and fast deployable and expendable assets, Interface with the existing networks like the IACCS system. It enhances the space segment and sensors' networking to provide sufficient early warning and intercept opportunities. He concluded by discussing the use of sensors in emerging warfighting strategies. These must be implemented for achieving superior battlefield transparency, shortening the OODA loop, integrating all sensors, through automated data support. The air and space domain requires the optimal use of space, air, and surface-based sensors, commercialization of space and dual-use technology. Real-time threat identification in various domains is crucial and can be achieved using both private and public assets. He concluded that the Air Force has successfully met the requirements for space-based solutions, including stratospheric and persistent platforms, low-cost and fast deployable assets, and interface with existing networks.

The special Address was delivered by **Dr BK Das, DS & DG Electronics and Communication (ECS), DRDO**, He highlighted that DRDO is working on a comprehensive approach to monitoring warfare trends including both in the outer space and undersea domains. It will be a non-contact war with autonomous weapons with robotics and cyber playing an important role. The next engagement is characterised as zero physical touch, as it will involve use of autonomous weaponry, AI based robots and cyber warfare. Tech wars would require careful re-alignment



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between country's tech capabilities, weapon manufacturing, and industrial infrastructure to sustain them. Prioritizing development and maintenance of technological edge is crucial to come out of reliance on the other countries. DRDO is deliberating various options for services, to include SAR and LIDAR technology, advanced radar technologies, and the concept of a "Digital Soldier as a System." The Services will utilize AI-based electro-optic soldier, autonomous decision-making abilities, robotics capabilities, and its ability to network. Cognitive Warfare is using advanced technologies to disrupt or manipulate adversary's cognitive processes, while first-person drones will be resistant to EI & RF Interference. He further spoke about how Quantum computing will be used for surveillance in multi-domain battlefields which will facilitate object detection and identification through data gathering, fusion, and analysis. In conclusion, he re-iterated that the DRDO is working towards a comprehensive approach to monitoring warfare, incorporating technologies like artificial intelligence, space warfare capabilities, nanotechnology, big data, and additive manufacturing.

The last speaker of the inaugural session was **Col K V Kuber, Dir Def & Aerospace, Ernst & Young**. He began by advocating that interoperability is the key, for a functional surveillance system with impunity. Indian industries must collaborate with global vendors to get competitive. To reduce Indian dependence on foreign countries, we have to pep up our industrial base and ecosystem. Investment in the indigenous industry is essential to reduce India's reliance on resources of the other countries. Strategic partnerships are the key. AI will be applied in almost all domains for crucial inputs on data. Sensors in all domains will be used to boost situational awareness and manage information overload. He concluded by re-iterating that data is crucial for intuitive design and industry must develop advance technology in sensors globally. We must ensure that India should be fully prepared indigenously for potential confrontations and early use of weapon systems based on sensors in all domains.

SESSION 2: TERRESTRIAL SURVEILLANCE

The session **Chairperson, Brig Anurag Asthana, Brig Ops, Artillery Directorate, Army HQ**, introduced the session by drawing inferences from present global scenarios and how countries are striving for military development. He referred to the October 7, 2023 attack launched by Hamas on Israel as an example of growing conventional and asymmetric warfare equipped with lethal weapons. Touching down upon the session's agenda on 'Terrestrial Surveillance', Brig Anurag Asthana reiterated the significance of multi-sensors and how the Indian Army is continuously working to upgrade surveillance facilities. Brig Asthana also opined about future battlefields being driven by miniaturized Unmanned Autonomous Systems (UAS) and Artificial Intelligence (AI).



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He highlighted how AI is being used for reading huge data and additionally has opened “new vistas.” As the Chairperson’s concluding remarks, Brig Anurag Asthana flagged the requirement of surveillance through deployment of sensors that would allow sufficient time to process data. Passive surveillance would remain beneficial than active surveillance and that the surveillance grid needs to have full proof communication systems.

The *1st speaker Shri Madhukar (OPS) BSF FHQ, BSF* covered the challenges being faced by the Border Security Forces (BSF). His presentation showcased an overview of the responsibilities of the BSF, present facilities related to surveillance and future challenges that requires to be addressed. Stressing on the dynamic terrain and climate of the Indian subcontinent, the speaker elucidated on the peace time and wartime responsibilities undertaken by the BSF for each of the geographical commands. The Western Sector revolves around the increased use of UAVs, tunnelling across international borders, low visibility during winters, poorly lit areas and non-effectiveness of Surveillance equipment during winters. Similarly, the challenges in the Eastern Sector are specific to altitude and temperature. The BSF has incubated several responses that include Hot Interception Team, Naka cum Ambush, Foot patrolling, Anti-drone operations and even Boat Naka. He further highlighted several projects undertaken by the BSF and comprise of ‘Comprehensive Integrated Border Management Systems’ (CIBMS), ‘Electronic Surveillance of vulnerable patches’ (ESVP) and OCTS project. In the concluding remarks he reiterated continued collaborative measures between BSF with DRDO, IITs and agencies like NTRO for technical solutions with integrated security system at borders. Additionally, the introduction of smart fences will be a game changer with high tech surveillance devices such as sensors, ground-based radar systems, etc to provide a holistic surveillance mechanism.

The *2ND speaker was Col Sameer Babu, Colonel (C&R), Army AD Directorate, Army HQ*, who emphasised that Army AD is the largest user of radars amongst the three services. The introduction was largely based around an overview of threats emanating from various altitudes and speeds which calls for the requirement of a dynamic surveillance system in addition to the existing ones. He also highlighted evolving air threat and the growing impact of air power with the need for an effective air defence capability for land operations. Advancements in Radar technology was flagged by the speaker. Development of passive radar technology will remain to be a game changer for it is highly cost effective and compliments existing radar systems. Multiple Inputs, Multiple Output (MIMO) radar technology that has evolved from communications systems provide an edge by simultaneously radiating uncorrelated signals, improving coverage and signal quality. He also flagged the use of ‘Digital Beam’ technology that can be deployed to achieve higher angular resolution wide coverage without



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mechanical moving parts. The usage of 'Active Electronically Steered Array Radar' and 'Radar Digital Signal Processing' were also discussed. The concluding remarks by the speaker showcased a comparative analysis of active and passive surveillance systems.

The session also saw participation by several industry players and start-ups who making strides in surveillance and electro-optics equipment. *Mr Vaibhav Gupta, Director, MKU Ltd, Mr Ram Biron, Director of Marketing, SCD, Israel, Mr Sandeep Shah, Managing Director, Optimized Electrotech, Mr Abhinav Gupta, Managing Director, SES, Mr Vinod Yadav, Tata Advanced Systems Ltd and Mr Ramkrishna Siddam, GM, Optica* were the speakers from the industry for this session. Each representative provided a general overview followed by brief summary of key equipment related to surveillance being developed at their respective companies.

SESSION 3: AERIAL IN SPACE-BASED SURVEILLANCE

The **Chairperson AVM Rajiva Ranjan, VM, ACAS Ops (Space), Air HQ** introduced the session by mentioning that military intelligence is key to war. Space and air are the ultimate frontiers. In 1991, space ISR became prominent. Aerial and SAR systems are very vital assets for military in all domain Operations. Aerial SAR, integrated on aircraft, offers various advantage of fast deployment and flexibility, enabling real-time monitoring and target identification in various terrain and all domains. These systems provide crucial intelligence for mission planning, threat assessment, and battlefield situational awareness. On the other hand, SAR satellites provide persistent surveillance capabilities to monitor vast areas continuously for global coverage. They offer high-resolution capabilities that detect and track moving targets and assess changes in the environment. He concluded with saying that both aerial and space-based SAR systems are integral components of military reconnaissance in providing invaluable support for operations, intelligence and decision-making processes in all domain.

The *1st speaker was Col Jasbir Mann from the Army Aviation Directorate.* He emphasised on the technologies for future warfare which could include three main types of technologies: Foundational, Strategic, and Tactical. Examples include Artificial Intelligence, space tech, and cyberwarfare. There's also a list of other advanced tech like nanotechnology and robotics. He concluded by mentioning about the need of all-weather aircraft and svl systems with capability of contemporary payload with high resolution.



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The 2nd speaker was Wing Cdr Aruna, DIPAC, Def Space Agency. Space Surveillance along with Military operations rely heavily on surveillance and reconnaissance, to perform strategic and tactical imaging over areas of interest with persistent surveillance. Geosynchronous satellites offer wider surveillance over wide areas particularly denied by other SVI devices. The speaker highlighted the significance of gathering intelligence to effectively plan and carry out military operations, making well-informed decisions. She discussed the importance of adjusting military forces in response to shifts in an adversary's order of battle (ORBAT) and making necessary revisions to future actions. Regarding EW satellites, she mentioned that they are designed to specifically detect ballistic missile launches. It was later incorporated into missile defence systems and regulatory control systems for nuclear tests as these satellites have the capability to detect a missile launch right from the start of its trajectory. They utilise infrared sensors to detect missile engines based on the intense heat emitted by their flames. They possess a distinct advantage over radar in their ability to scan a significantly larger area. As on date, three nations-USA, Russia, and China possess constellations of these early warning satellites. Lastly, she emphasised the advantages of the Space-Based Infrared System (SBIRS). This system consists of a network of satellites in geosynchronous Earth orbit and payloads in highly elliptical orbit, all managed by ground processing and control systems. These systems are held by three countries only so far.

The 3rd speaker was Air Cmde Hrushikesh J Page, VM, Air Cmde Int (Ops), Air HQ. He spoke about military tactics and reconnaissance. Having a deep understanding of tactical reconnaissance is crucial for successful military operations. It allows for thorough analysis of the ever-changing dynamics of the battlefield, accurate identification and prioritisation of targets, efficient management of information dissemination, and effective communication. It is of utmost importance in dangerous environments such as nuclear, biological, and chemical. The equipment needs to possess a high level of agility, resilience, efficiency, and seamless integration with systems. Utilising cutting-edge technology, such as face and text recognition, is crucial for precise identification. Security and compatibility are of utmost importance. Having equipment such as ELINT, SAR, and IR is crucial.

SESSION 4: MARITIME SURVEILLANCE, RESEARCH & DEVELOPMENT

The **Chairman of the fourth session, Cmde Ashish Bhargava, Cmde Air Warfare & Flight Safety, Naval HQ**, emphasized on the importance of maritime surveillance in the Indian context owing to the long coastline. He brought in the historical



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perspective highlighting the period of the Chola dynasty post which the importance of maritime security declined and the foreign powers came to take power on the Indian shores. However, it has once again gained importance with the resurgence of maritime activity and maritime domain and the happenings in the Red Sea and the Gulf of Aden. He said that maritime surveillance is an amalgamation of a lot of platforms with sensors with the inherent challenge of transporting the data due to absence of terrestrial network.

First speaker was *Comdt Banshidhar Singh, Jt Dir Communications, Indian Coast Guard, HQ ICG* who spoke on Surveillance against Aerial, Surface and Underwater Threats. The speaker began by highlighting the importance of surveillance in the maritime domain for ensuring an appropriate response to any developing situation relating to maritime safety and security. He defined the objectives of maritime surveillance to holistically understand, anticipate and administer all events and actions related to the maritime domain that could impact the maritime security. He said that it includes and relies on maritime law enforcement, maritime pollution and marine environment control, disaster response, search and rescue, anti-poaching, anti-smuggling, anti-human trafficking and safeguarding countries' trade and economic interests. So, the prime objective is to detect any suspicious or anomalous target that could subvert the national interest in the maritime zones. He acknowledged the need to upgrade capabilities by keeping in tune with the advancements in technologies and put forth some recommendations for the ICG which include adaptation of existing magnetron-based radars to solid-state radars, daylight CCD thermal imager with laser illumination, electro-optic system to HD thermal camera, CCD with short wave infrared technology to see through haze, fog, glass, and better ranges, and inclusion of satellite AIS for better coverage. The speaker concluded by stressing on the importance of an effective maritime surveillance system for India's maritime economic and security interests and the need to modify and upgrade the existing system to stay abreast so that the ever-evolving maritime security challenges can be met effectively.

The 2nd speaker was *Cdr K Varun, Cdr AW, Naval HQ* who spoke on Integrating Assets for Maritime Surveillance. He talked about complexity of maritime surveillance of the IOR because of the amount of maritime traffic that transits this region which is further exacerbated by the thousands of fishing boats and the requirement of keeping an eye on the three domains of surface, sub-surface and air by the Indian Navy. He also mentioned the government's stance on India being the 'First Responder & Preferred Security Partner' and the role being played by the Indian Navy currently in the Gulf of Aden. He spotlighted the importance of Maritime Domain Awareness (MDA) and its centrality to the information, decision and action cycle. He mentioned the various fixed & rotary wing and manned & unmanned platforms and the surveillance sensors in



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service with IN for building the MDA. He also covered the various surface and sub-surface platforms, sensors and weapons utilised by the IN towards the task. He threw some light on how all this data from the IN's sensors and from other agencies including space is aggregated, correlated and disseminated by the Information Management and Analysis Centre (IMAC). The speaker made the audience aware of the various projects that are underway concerning space-based surveillance and under the iDEX initiative that exploit the future technologies of AI, ML and Deep Learning and are going to facilitate automation in surveillance processes. He concluded his talk by calling for collaborative efforts for surveillance of the vast IOR. He said that innovation and adapting to dynamic challenges like the drone challenge will be key in harnessing new technologies like AI-based analytics and satellite imaging.

Maj Gen (Dr) Ashok Kumar, VSM (Retd), Director General CENJOWS, in his closing remarks, alluded to the rise of India as a leading economic power and the need for the defence forces to rise to the challenges towards which the three services are willing to state their needs in an open and upfront manner and there is much visible collaboration between the forces and the industry. He said that the defence forces are ready to hand-hold those who are willing to be partners in the growth of the defence forces and the nation. He also conveyed his thanks to all the speakers who obliged to share their time and thoughts, all the participants of the seminar for their attendance, and the teams of CENJOWS and IMR for successfully organising the event.

Maj Gen Ravi Arora, Chief Editor, Indian Military Review, ended the seminar with a vote of thanks to the Director General CENJOWS for having personally selected the speakers and prepared the program for the event, all the sponsors for their efforts and the delegates present for making the event a success.