major way towards victory. Imagery intelligence is a significant source to obtain information about the adversary from a remote platform. Today, with sub-metric resolution, any military feature or otherwise can be easily detected.

All conventional military missions are progressively migrating to outer space on a much faster pace and, thereby, strengthening the theory that space systems affect every degree of military operations to include effective integration of the battlefield. By allowing everyone to comprehend requisite details about the enemy and terrain in the required time and space, the commander's visualisation of the battlefield is enhanced.[1]

Imagery intelligence is one of the advanced and progressing forms of intelligence gathering, the aspects of which are significant and considerable including being able to function at a distance, detached from physical boundaries, and proficient in providing daily revisits on any point on Earth. An image from a space platform could provide much more information of earth's surfaces on a large scale and in a relatively short time. Imagery intelligence derived out of satellite images has been widely used for resource management, planning, monitoring, predicting, and operational, and research purpose in various fields.[2]

Historical Perspective

The use of imagery for intelligence applications has a long and rich history. Before the invention of photography, scouts would deliver tales of their observations to military commanders. They would perhaps draw pictures and maps in the dirt to illustrate what they had observed. They would use word pictures to convey information but the military commander had to always create a mental picture of the scout's descriptions. With the invention of photography in 1830s, this procedure started to migrate towards pictorial depiction.

Manned balloons were used during the Civil War to observe enemy positions, activities, and photographs obtained from a balloon vantage point were used to support military operations. The need for relatively long exposure time to take 1860s vintage photographs caused blurring because of balloon motion and limited the utility of these early intelligence products. The primary use of aerial photography in World War I was to support front-line tactical

operations. As the sophistication of both aircraft and photography increased, it became possible to expand the utility of aerial photography. Longer array aircraft, aircraft for photographic tasks, high resolutions cameras and proficient photo interpreters collectively augmented the scope of aerial photography in its application. Thus, it became possible to accumulate evidences that assisted in detailed analysis of the adversary's future plan.

During World Wars, it was factually proven that nothing in the intelligence arsenal was as effective as a photo reconnaissance mission for determining enemy force deployment, target locations, bombing mission effectiveness and essential map making. Photo reconnaissance missions were flown for area coverage, point targets, enemy movements and to carry damage assessment, interpretation of these was an art that necessitated finesse in assessing photographs and infer facts from images.[3]

Evolution of Imagery Intelligence

Imagery intelligence is an intelligence-gathering discipline wherein imagery is analysed through various components to identify information of intelligence value. It also encompasses technical and geographic information derived through the interpretation or analysis of imagery and collating the same with existing knowledge. It is the science of converting information, extracted from imagery, into intelligence with respect to areas of interest.[4]

Outer space has emerged as a new medium and has highlighted the urgent need to augment awareness regarding specific space issues. Military applications of space and technological advances with increasing integration of outer space capabilities in war fighting doctrines have changed the nature of warfare. Imagery intelligence is among the most important technological achievements of the intelligence community maintaining the capability to support military operations in avoiding collateral damages. Intelligence derived from imagery has become an essential element of military operations and has matured as an increasingly powerful tool for mapping and visualising the world.[5]

For military perspectives, analysis and derivation of imagery intelligence is produced by conversion of raw information into intelligence and includes the integration, evaluation and analysis of all available data which draws separate pieces of information

together to identify patterns and draw conclusions/assessments. Progressive technology now affords the competence to use geospatial data in different ways to generate interactive and customised visual products. It allows the analyst to make more complex connections quickly between different types of data and information than otherwise possible.

Geospatial Intelligence (GEOINT)

GEOINT is a specialised field of practice within the broader profession of intelligence that encompasses all activities involved in planning, collection, processing, analysis, exploitation and dissemination of spatial information to gain intelligence about the operational environment, visually depict the inputs and fuse the acquired inputs with other information through analysis and visualisation processes for better assimilation, thus, aiding in faster decision-making process.

Imagery intelligence is a highly progressive discipline of intelligence, which goes beyond stating as to what is happening, where is it happening and when is it happening, it also reveals how is it happening, why is it relevant and facilitates in carrying out predictive analysis. As an intelligence gathering discipline, the production of imagery intelligence depends heavily upon a robust imagery collection mechanism, which includes satellites and other on ground apparatus, and professional image analysts. The exploitation and analysis of imagery and geospatial information to describe assess and visually depict physical features and geographically referenced activities on the Earth act as the fulcrum for varied military operations. GEOINT consists of geospatial information and imagery intelligence that collectively provide innovative, versatile solutions fulfilling intelligence requirements and predicting tomorrow's threat environment.[6]

Imagery Analysis

Imagery analysis is the process by which meaningful intelligence is derived from pixels or a collection of pixels. The data recorded in the pixel will dictate the quality of the image and its capability for being analysed further for deriving intelligence from it. The body of pixels is holistically interpreted and creatively combined in light of other collateral open-source information to synergistically derive new value-added information from the annotated imagery.

Imagery analysis is a process that begins with an initial examination of an image and its constituent features. Various constituent features of an image that will aid in interpretation are size, shape, shadows, shade, surroundings, signatures, texture, time and perspective. Imagery intelligence has proven to be an effective tool for many military applications.

Varied categories of spatial data which provide intense support to military operations are panchromatic imagery, infrared imagery, multispectral imagery, hyperspectral imagery, ultra-spectral imagery, motion imagery sensors like and Remotely Piloted Aircraft (RPA) and Synthetic Aperture Radar (SAR).

Role of an Image Analyst

The skills and experience of an image analyst are critical to any pertinent verification of information extracted from all sources of imagery. Imagery analysis is the cornerstone upon which entire technology to collect imagery data collection, technologies and capabilities to process are built upon.

The discipline of imagery intelligence encompasses more than systems, technology and processes. The discipline comprises of highly skilled and experienced professionals with a wide range of expertise and domain specialisation to include payload planning, imaging architecture, imagery acquisition and analysis, corroboration with available inputs, and creating an Imagery Intelligence Report and data base management for archival imagery. An experienced image analyst possesses a database of knowledge and operating principles developed over many years of experience.[7]

Spatial data is required to be competently interpreted by well trained and experienced imagery analysts, fully cognizant of terrain, its seasonal dynamics, enemy strategies, equipment and operations. For tactical and strategic verifications, spatial data is corroborated with collateral information from other sources and open source information and draw correctly under geospatial intelligence tradecraft.

In future, imagery analysts will face more challenging tasks as they are required to look at and evaluate diverse types of imagery and use more sophisticated tools which are under continuous upgradation due to fast changing technologies and

technological evolution. The demanding timelines required to be met by producing thoroughly analysed and contextually based products. Strategic superiority will be enjoyed by the entity with shortest timelines for collection, exploitation and dissemination.[8]

Imperatives of Imagery Intelligence

Role of imagery intelligence in national defence and security is decisive, making it critically essential and a crucial component of successful military operations. All conventional military missions for land, sea and air are migrating to spatial data, for effective integration of space systems for military operational needs. The uses of imagery intelligence continue to progress extensively with the onset of newer technologies like Artificial Intelligence, Machine Learning and Big Data Analytics affording greater scope for exploitation.[9]

Imagery intelligence provides the ability to integrate precise location and terrain data to create a foundation of information about a specific area. This information is then turned into a picture of area that diverse users and organisations can access simultaneously ensuring they are working with identical data and are referencing the same information. This Common Operational Picture (COP) provides users the ability to quickly orient and visualise their mission space which displays the required information supporting situational awareness and rapid decision making.

Spatial products range from standard geospatial data, satellite imagery, digital raster and vector information, reports, GIS maps, terrain maps and 3D fly-through models that incorporate multiple types of advanced sensors. These products may be used alone or with many layers of additional data such as geographic data and intelligence information. Same can be accessed using hard copies i.e., annotated prints or soft copies i.e., graphics and overlays displayed for displaying a holistic operational picture. The varied products examine the imagery to detect, recognise, identify and locate objects and activities. The products may be developed using sophisticated technology to integrate multiple types of geospatial data as well as data from other intelligence sources.

Integration with Imagery Intelligence

Imagery intelligence has already been proven to be a timely, accurate data source to support and supplement monitoring. The

world has witnessed an era of new capabilities in earth observation that include large constellations of more agile and capable satellites having improved spatial, spectral and temporal resolutions that even include high-definition video.[10]

Spatial source of imagery have global coverage and reach which is now freely available via digital virtual globes. Moreover, imagery can be readily supplemented by multiple platforms, sensors, companies and nations. Despite the initial uncertainty regarding quality, timeliness of acquisition and processing and final delivery, spatial imagery has more than established in its value as a monitoring and intelligence tool. The technology has progressed over a period of time and brought ease of access to sub metric resolution for spatial products. However, the challenges of real time dissemination, correlation, corroboration, rate of data acquisition, increase in signal bandwidth, no loss data transmission and time sensitivity in generating final actionable intelligence requires more advancement and expertise. The emergent need of the present time is to integrate varied sources of intelligence under one nodal appointment for depiction, correlation and corroboration.[11]

Technology-Tactical Fusion

Technology has revolutionised how intelligence is gathered and analysed. Advanced technology facilitates the capability to use and combine geospatial data in different ways to create interactive, dynamic, customised visual products. It facilitates an image analyst to make more complex connections between different types of data and information, than otherwise previously possible, to present predicted analysis.

Rapid response is becoming increasingly important in military operations with targeting, surveillance, command and control activities that need to make sense out of a large amount of disparate and possibly unreliable information. Subsequent control of acquisition, collation, corroboration and dissemination is passed to an autonomous system that will attempt to select an appropriate target from captured image data set and initiate an appropriate response.[12]

In recent times, Russia-Ukraine conflict has demonstrated that technologies that can perforate cloud cover and work at night are coming to fore as emerging professionals and experienced

spatial intelligence analysts offer near real time assessments of battle ground developments.

The imagery intelligence discipline encompasses all activities involved in the planning, collection, processing, analysis, exploitation and dissemination of spatial information to gain intelligence about the operational environment. Imagery intelligence is combined with a wider variety of data, such as signal intelligence, human intelligence, technical intelligence and open source intelligence through collaborative processes, to provide more accurate, comprehensive and relevant products.[13]

Growth of Imagery Intelligence – The Future

The collection of intelligence was earlier considered about primarily in human terms with covert actions and espionage missions by agents. Reconnaissance satellites have contested counter to this statement and has ultimately undermined the opinion to exclusively obtaining intelligence picture with human intelligence. In the course of active operations, imagery intelligence would provide an atmosphere of legitimacy over espionage that had never existed.[14]

COP of a specific area is established effectively using multiple and advanced sensors, multiple types of data and information including operations, planning and logistics as well as multiple intelligence disciplines to present a comprehensive visual depiction. This capability provides many advantages for the military leaders by precisely locating activities and objects, assessing and discerning the meaning of events and providing context for decision makers.[15]

The intelligent system envisaged will be an automated configuration for dynamic and comprehensive integration of sensors, intelligence inputs, reports, data processors and communication systems. It will enable simultaneous, global measurement and timely analysis of the operational environment in real-time. The varied fields for futuristic progression in the imagery intelligence domain necessitate development and growth in the following arena:

- Nano Satellites.

- Resolution and accuracy.

- Sensor technology.

- Automated extraction and information collation.

- Change detection.

- All weather capabilities.

- Thematic analysis.

- Launch on demand facilities.

- Hybrid constellation.

- Onboard processing.

- Higher bandwidth.

- Artificial Intelligence analysis.

- Automated target recognition system.

GEOINT platform must provide target and situational development information; determine effects on operations, threat assessment, enemy weaknesses and potential high value targets. The systems must be reliable and have self-contained communications to support joint and coalition operations with standard product transmission formats with dissemination down to battalion level.[16]

Detection and identification of target holding military value, from imagery intelligence, is the last stage of expert application, however, the entire scheme of affairs functions at much higher levels. It encompasses training and learning concerning diverse aspects of imagery intelligence comprising payload operations, orbital calendar matrix, operational and imaging capabilities, scene coverage, target acquisition and real time transmission procedures which collectively positions as essential elements for image analysis without which satellite imagery can be difficult to interpret.[17]

Conclusion

The present and future of space based intelligence has added a fourth dimension to modern day warfare to achieve desired operational capabilities by empowering commanders to take decisions in a compressed period. Increased and faster access to high-resolution spatial data will shift power from the former holders of secrets to the newly informed end user.

Imagery intelligence will see a greater transformation in the coming decade as future success will be critically dependent upon the effective utilisation of imagery intelligence and its effective integration in creating a COP. The ability to utilise multiple forms of intelligence and channelise it to an automated common point of reference with minimum human interference will be critical for dominance resulting in victory on the future battlefield and enabling decision makers to arrive at the most viable course of action.[18]

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Concept of Atma Nirbhar Bharat Abhiyaan and its Relevance

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When India speaks of becoming self-reliant, it doesn't advocate a self-centred system. In India's self-reliance; there is a concern for the whole world's happiness, cooperation and peace.

Hon'ble PM Shri Narendra Modi

Abstract

The covid pandemic, despite all its socio-economic disruption, has opened new avenues for India to chart its way towards a self-reliant and sustainable country. India has opted to turn adversity into opportunity, and is, hence, moving towards realisations of Atma Nirbhar Bharat. It has clearly spelt out that Atma Nirbhar Bharat will not be a policy of protectionism and isolationism, but a policy of India working with the world to produce for the world. PM Modi in his clarion call had clearly marked the five pillars on which the policy will stand and India has since then taken many strides towards realisation of the goal.

Introduction

Atma Nirbhar Bharat or self-reliant India is one of the most ambitious visions of the Prime Minister Shri Narendra Modi. In principle, the vision is about understanding India's present, and based on learnings from the past, to create a new tomorrow — a new India. In this context, the article, both descriptive and analytical in nature, aims to understand the concept, campaign, the thrust areas and relevance of it in the overall development of India as a self-reliant and self-sustainable country.

In his address to the nation on 12 May 2020, Indian PM Narendra Modi said that an unprecedented crisis has emerged

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