Abstract: Geospatial Intelligence (GEOINT) is the exploitation and analysis of imagery and geospatial information to describe, assess, and visually depict physical features and geographically referenced activities on the Earth. GEOINT provides critical spatial information to a decision making process that is necessary for meaningful actions and decisions, based on the fusion or integration of multiple forms of data collected from satellite and airborne sensors, along with a wide variety of other digital geographic information. The Romanian Training and Operational GEOINT capabilities are concentrated inside GEOINT Training and Research Center (CGINT) from Military Technical Academy, developed in cooperation with Romanian Space Agency (ROSA), and other national security organizations. CGINT concept is based on National Geospatial-Intelligence Agency (NGA) GEOINT doctrine, published in 2004. The paper aims to highlight the important experience was acquired in operational conditions, continuously developed mainly on two directions: training, and research capabilities. CGINT concept, missions, applications, products, research topics, and training capabilities are presented as well.

Keywords: GEOINT, Critical Infrastructure, Security, Training, Research

1. Introduction: GEOINT target

Geospatial Intelligence (GEOINT) provides critical spatial information to a decision making process that is necessary for meaningful actions and decisions, based on the fusion or integration of multiple forms of data collected from satellite and airborne sensors, along with a wide variety of other digital geographic information. GEOINT represents the new National Geospatial-Intelligence Agency (NGA) doctrine, published in 2004. Last years, especially the period post September 11, showed that the intelligence community’s biggest part of raw information extraction and analysis relies on intelligence disciplines. HUMINT (human intelligence) and IMINT (Imagery Intelligence) are based primarily on collection capability while MASINT (measurement and signature intelligence), SIGINT (Signal Intelligence) and OSINT (open source intelligence) are more analytic and data mining oriented. GEOINT provides the spatial foundation essential for the analysis of information from all sources, providing the baseline starting point for all geographically referenced analytic efforts. It brings together cartography, imagery analysis, geospatial analysis, geodesy, aeronautical analysis, maritime analysis and regional analysis thus providing unique intelligence capability.

2. GEOINT concept

GEOINT represent the exploitation and analysis of imagery and geospatial information to describe, assess, and visually depict physical features and geographically referenced activities on the Earth. GEOINT has emerged recently as a powerful new intelligence discipline that is providing a foundation for intelligence analysis and achieving information dominance. It unites
the complementary fields of imagery intelligence (IMINT) and mapping, charting, and geodesy (MC&G) into a single, integrated intelligence discipline. It combines their strengths, incorporating the dynamic, detailed content of IMINT with the precise methods. Figure 1 illustrates the natural convergence of IMINT and MC&G.

The term GEOINT is used in two ways. First, GEOINT is a discipline, a specialized field of practice within the broader profession of intelligence. It is the use of remote sensing, spatial data, and analytical methods to understand the global security situation. Second, GEOINT is a type of intelligence product, the information and knowledge that is produced as a result of the discipline’s activities. GEOINT is the basis from which all intelligence analysis is derived [1].

![Figure 1. GEOINT and its application of the field of remote sensing.](image)

Regardless of the intelligence challenge, all analysis is geospatially and temporally referenced in some fashion, and GEOINT is uniquely capable of providing that reference. As former NGA Director Lt. Gen. James R. Clapper, U.S. Air Force (ret.), actually DNI, has stated "everyone and everything has to be somewhere," and GEOINT provides the information to identify the "where and when."

The etymology of the word “geospatial” connotes the focus of GEOINT on representing natural features and human activities in their place on the planet. “Geo” comes from the Greek for Earth. “Spatial” refers to location.

Accordingly, a simple way to describe GEOINT might be to say it shows what is where on the Earth. As a discipline, however, and as a distinct category of intelligence products, GEOINT goes far beyond answering the question, “Where?” This section describes the nature of GEOINT as a discipline, its sources and its component tradecrafts, and the foundation it provides for analysis. It then discusses the nature of GEOINT as a product or service, and the role of GEOINT in national security.

3. GEOINT applications

Geospatial intelligence provides unique knowledge not available by other means that is critical for informed national security decisions. It provides objective, precisely measurable information about the environment and potential adversaries, especially in remote or inaccessible regions.

The applications of geospatial intelligence include the most important functions of our national government.

Geospatial intelligence supports the development of national policy, the planning and execution of military operations, the protection of homeland security and other civil operations, and the collaborative efforts of analysts throughout the Intelligence Community. It is an essential tool for national security policy and operations, providing the knowledge basis for decision, planning, and action.

3.1. Informing Statecraft

Geospatial intelligence provides knowledge national leaders need to make informed decisions on matters of national security and foreign affairs. It plays a central role in identifying strategic threats, providing warnings of war, predicting humanitarian crises, and verifying international treaty compliance. It enables national decision-makers to monitor crisis situations as they develop and measure or forecast the effects of foreign policy decisions. Geospatial intelligence provides information useful in the negotiation of international agreements and in the protection of U.S. diplomatic facilities overseas. Geospatial intelligence increases confidence in policy decisions by reducing uncertainty, risk, and surprise.
3.2. Supporting Military Operations

Geospatial intelligence provides the vital knowledge foundation for modern joint warfare, serving as the basis for decision superiority, dominant maneuver, and precision engagement for the joint, interoperable force. Geospatial intelligence offers the visual picture of the battlespace and the situational understanding that is essential for operational decision making throughout the spectrum of conflict and at all levels of warfare. It is a major source of content for the Common Operational Picture (COP) and the primary means of visualizing it.

Geospatial intelligence modeling capabilities are powerful predictive tools for Intelligence Preparation of the Battlespace, giving Joint Force and Component Commanders unparalleled decision superiority.

Geospatial intelligence is the critical ingredient that enables dominant maneuver and precision engagement. In conjunction with advanced navigation and targeting systems, it provides important tactical advantages. Precise knowledge of the battlespace in a common frame of reference enables the synchronization of widely dispersed maneuver forces to achieve a common objective. When strike missions are complete, geospatial intelligence is the primary means of battle damage assessment, enabling commanders to assess the results and order re-strikes if necessary [2]. Digital maps and imagery give every Component Commander and every combatant a shared view of the battlespace. This common picture enables dissimilar forces distributed throughout the area of operations to provide mutual support, massing effects in time and space in unified action to decisively defeat an adversary.

3.3. Homeland Security and Civil Support for Critical Infrastructures Surveillance

Geospatial intelligence plays a critical role supporting protection of the homeland and other civil missions. In supporting homeland security, geospatial intelligence is valuable both for reducing the probability of terrorist attacks and for managing the consequences of attacks. Geospatial intelligence can provide the means to conduct detailed assessments to identify vulnerabilities in critical national infrastructure where the probabilities of successful terrorist attack are highest.

In addition, geospatial intelligence provides data and products on selected urban areas of interest, land and maritime entry and exit points, identification and assessment of foreign threats, and extent and scope of natural and manmade damage. In cases of terrorist attack or natural disaster, geospatial intelligence can rapidly give federal agencies and first responders a comprehensive and detailed view of the scene, helping them to make the best possible decisions in preparation, response, and recovery actions. Geospatial intelligence also plays an essential role in a wide range of other civil applications including drug interdiction, humanitarian relief and as permitted by law, support to law enforcement.

4. GEOINT sources and products

Integral to GEOINT is any source of data that indicates location, spatial relationships, and geographic features or references. Imagery in all its forms across the electromagnetic spectrum by its nature depicts spatial data and therefore is an integral source. But equally important is the full range of geospatial information that derives from other sources, including but not limited to terrain, geodetic, hydrographic, topographic, elevation and aeronautical data. Also relevant are sources of information that provide data related to meteorological, oceanographic, and space weather (METOC) conditions and ecology, as well as geographically referenced data and intelligence about human activity and manmade feature specifications. GEOINT also uses multiple types of sensors to expand the analysts “view” of a target.

Different sensor types allow the analyst to overcome obstacles such as unfavorable weather, poor lighting conditions, or non-
cooperative targets. While electro-optical sensors provide a clear daytime picture of a target, synthetic aperture radar (SAR) may provide a critical view of its activities at night. An infrared image may offer a glimpse into the inner workings of an industrial plant. Multi-spectral imagery can provide detailed hydrographic and topographic data that would be unobservable using conventional methods. Motion imagery and moving target intelligence (MTI) technologies have added a new dimension to spatial data, one where movement and change can be instantaneously recorded. New sensor types, such as light detection and ranging (LIDAR), interferometric SAR, and hyperspectral imagery are expanding the scope of what an analyst can see, and ultimately, understand, about a particular target.

Source managers (responsible for the discovery, acquisition, delivery, and management of GEOINT data) and analysts are looking to commercial sources, intelligence services, and other intelligence sources such as SIGINT and HUMINT, for spatial information. GEOINT relies on a wide range of data types and sources, all designed to provide the needed characterization or picture of its targets.

GEOINT products provide the spatial foundation essential for the analysis of information from all sources, providing the baseline starting point for all geographically referenced analytic efforts. It brings together cartography, imagery analysis, geospatial analysis, geodesy, aeronautical analysis, maritime analysis and regional analysis thus providing unique intelligence capability. The main GEOINT operational products are as follows:

- IA Reports (RECCEXREPs)
- IA Value Added Data
- Change Detection (Multi-date Comparisons)
- Satellite Image Maps (SIMs)
- SIM Pan-Sharpening
- 3D Data (3D View, Dynamic 3D Visualization)
- SAR SIMs
- GIS Applications

5. Romanian GEOINT capabilities

5.1. CGINT – Center for Geospatial Intelligence

The Center for Geospatial Intelligence (CGINT) is a 400,000 EUROS project financed under the national program for research and development CEEX. The research Consortium is formed of Military Technical Academy (MTA), Romanian Space Agency (ROSA), and other national security organizations.

![Figure 2. Center for Geospatial Intelligence](image)

**CGINT Objectives**

The main objective of CGINT is to elaborate technical specifications and design procedures for creating a pilot center for geospatial intelligence capable of implementing GEOINT concepts and offering an open system using various resources and thus creating a well structured methodology answering the specific needs expressed by the users in the security field.

The specific objectives of CGINT are:

- concentrate the needed information / resources forming the basic infrastructure allowing the application of GEOINT principles and concepts and create a functional architecture demonstrated by a model;
- organize technical and human resources supporting the functional architecture and develop methods and techniques and algorithms needed to obtain specific information products;
- develop the existing training facility.

**CGINT Main Applications**

Four categories of applications can be mentioned for justifying this project [3]:

- Informing national policymakers;
- National security and civil support;
• Supporting military operations;
• Intelligence cooperation.

**CGINT results and capabilities**

These project research topics are as follow:

- Exploitation of Aerospace Imagery and Geospatial Data for Change Detection;
- Automated coherent change detection techniques; Moving Target Intelligence (MTI); Classification Algorithms;
- Management of very large databases, smart databases and content based image retrieval (data mining) [4];
- Data fusion and 3D mapping;
- Data transmission / encryption / decryption techniques.

The CGINT Centre concentrates expertise in the following domains:

- Multi-source data and sensor fusion;
- Advanced image processing methods for feature and knowledge extraction;
- 2D/3D dataset visualization,
- Database mining and information retrieval;
- Geospatial data development, integration, application tools.

5.2. **Operation Iraqi Freedom**

To highlight the Romanian GEOINT operational capacities, we’d like to quote some appreciations from an article entitled Romania Provides Real-Time GEOINT in Iraq, published by Pathfinder–The Geospatial Intelligence Magazine, NGA, January / February 2006 [5]:

“Romania’s GEOINT system is an outstanding example of how U.S., Coalition and Iraqi troops on the ground are the direct beneficiaries of multinational collaboration in geospatial intelligence to support operations in real time (Figure 3).”

“Exploiting a combination of commercial multi-spectral and multi-temporal real-time imagery and video taken by unmanned aerial vehicles, the Romanian Imagery Intelligence Team was able to identify and track enemy vehicles transporting and hiding ammunition and weapons within the Wadi Al Salam Cemetery.”

“This clearly demonstrates the critical role that GEOINT provides in support of Coalition military operations and highlights the benefits derived from expanding NGA’s collaboration and cooperation with America’s allies and partners.” [6]

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**Figure 3. UK & Romanian joint mission**

“Fortunately, a Romanian real-time GEOINT operation led to the successful discovery and capture of numerous possible weapons and ammunition caches” [7].

In Romania, the military specialists from the Military Technical Academy (MTA) have developed GEOINT training and research activities inside the GEOINT Training Center [8].

In 2001, MTA organized and conduct, in cooperation with GDTA, Toulouse, the first computer assisted tactical image analysis course for Romanian military analysts.

This training course, entitled “Aerospace Imagery Analysis for Military Operators” was NATO IRI/AR compliant (STANAG 3596).

The course has been developed and still performed on different levels (standard, advanced, and expert). The MTA’s GEOINT Training Center performs specific and customized courses, on Tactical and Strategic Image Intelligence, Image Analysis, Space Mapping, Terrain Analysis, Remote Sensing and GIS.

6. **Conclusion**

The convergence of one nation’s imagery and geospatial capabilities is an imperative of the current era, made necessary by the challenges of the changing national security environment and the emerging concepts of warfare, and made possible by the revolution in information technology.
Geospatial intelligence is a unique intelligence discipline, defined by its analytical methods and its fundamental spatial and temporal nature. It unifies the imagery and geospatial tradecrafts, capitalizing on the abilities both to precisely model the Earth and to obtain detailed and dynamic understanding of world events through remote sensing (Figure 4). The GEOINT integrated discipline unites a broad range of evolving and emerging information processing and remote sensing capabilities, providing a comprehensive set of tools for characterizing the security situation. This convergence enables us to leverage an expanded set of powerful analytical tools, bringing together capabilities such as the power of Geographic Information Systems for organizing and accessing information and the enhanced perception made possible by Measurement and Signals Intelligence processing techniques.

Our goal is an environment that provides geospatial intelligence online, taking advantage of the full potential of our geospatial intelligence tradecrafts, leveraging an all-digital infrastructure, harnessing the best practices of e-business, and using the visual power of the evolving COP to provide our customers the knowledge advantage for decision, planning, and action.

References