Machine Learning & Artificial Intelligence Working Group
May 2023

The AI-Enabled Analyst: The Future of Geospatial Intelligence

Abstract

This USGIF white paper is intended for government and industry leaders involved in the defense, intelligence, and, specifically, the geospatial intelligence ("GEOINT") community with an interest in Artificial Intelligence (AI) and Machine Learning (ML). The paper provides a look into the future of GEOINT through the lens of how analysts will work with AI and ML based systems to produce more robust and accurate intelligence faster. This paper presents a subset of GEOINT focused AI/ML applications, including generative AI, AI for Data Fusion, democratized AI through AI services, practical AI at scale via low-code solutions, and AI solutions driven by the metaverse. These approaches will revolutionize GEOINT tradecraft by enabling analysts to answer questions that were previously unanswerable. Finally, the paper concludes with specific recommendations for realizing an AI-enabled GEOINT future.

Introduction

As AI- and ML-powered systems propagate throughout the GEOINT community, day-to-day GEOINT analysis will evolve to answer questions that could not be answered before on a faster timeline. Through the use of AI, we believe Geospatial Analysts will be able to:

1. Use Large Language Models (LLMs) incorporating Generative AI to support the creation of GEOINT content, including reports and other products;
2. Discover and utilize more data than ever before when conducting analysis through automated data fusion;
3. Build and maintain trust in the AI-generated outputs through training and re-training of models through self-improving AI services, without the need to code;
4. Automatically conduct analysis covering massive geographic areas over multiple time scales to answer questions that cannot be answered using existing manual methods;
5. Explore AI capabilities in dynamic metaverse applications.

In this paper, we consider these advancements and imagine the future of AI-empowered analysts. We conclude by providing specific recommendations to help these advancements become reality.

Generative AI

One of the most exciting AI advancements of the last five years is the recent proliferation of Large Language Models - in particular, generative pre-trained (GPT) models including OpenAI's ChatGPT and Google's Bard. These models take users' plain-text input and generate responses based on the massive corpuses of data used to train them. USGIF has recently published a separate white paper, "The Evolving Role of Synthetic Data in GEOINT Tradecraft" that offers an in-depth look at Generative AI and how it can be used to support GEOINT analysis.

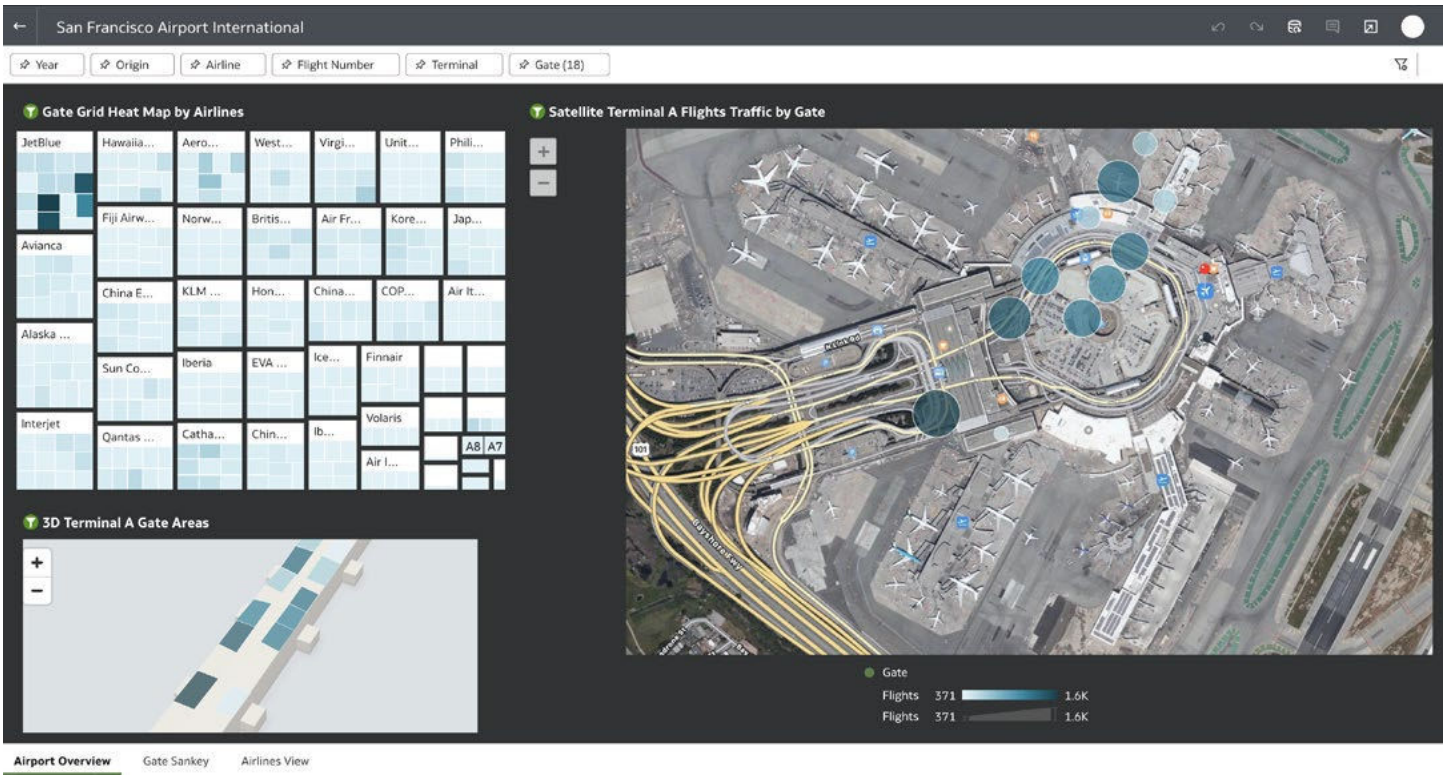

Figure 1: AI Service Example: Oracle Augmented Analytics - AI services (example, computer vision) can be embedded into traditional analytics to allow faster access to insights derived from massive amounts of structured and unstructured data.

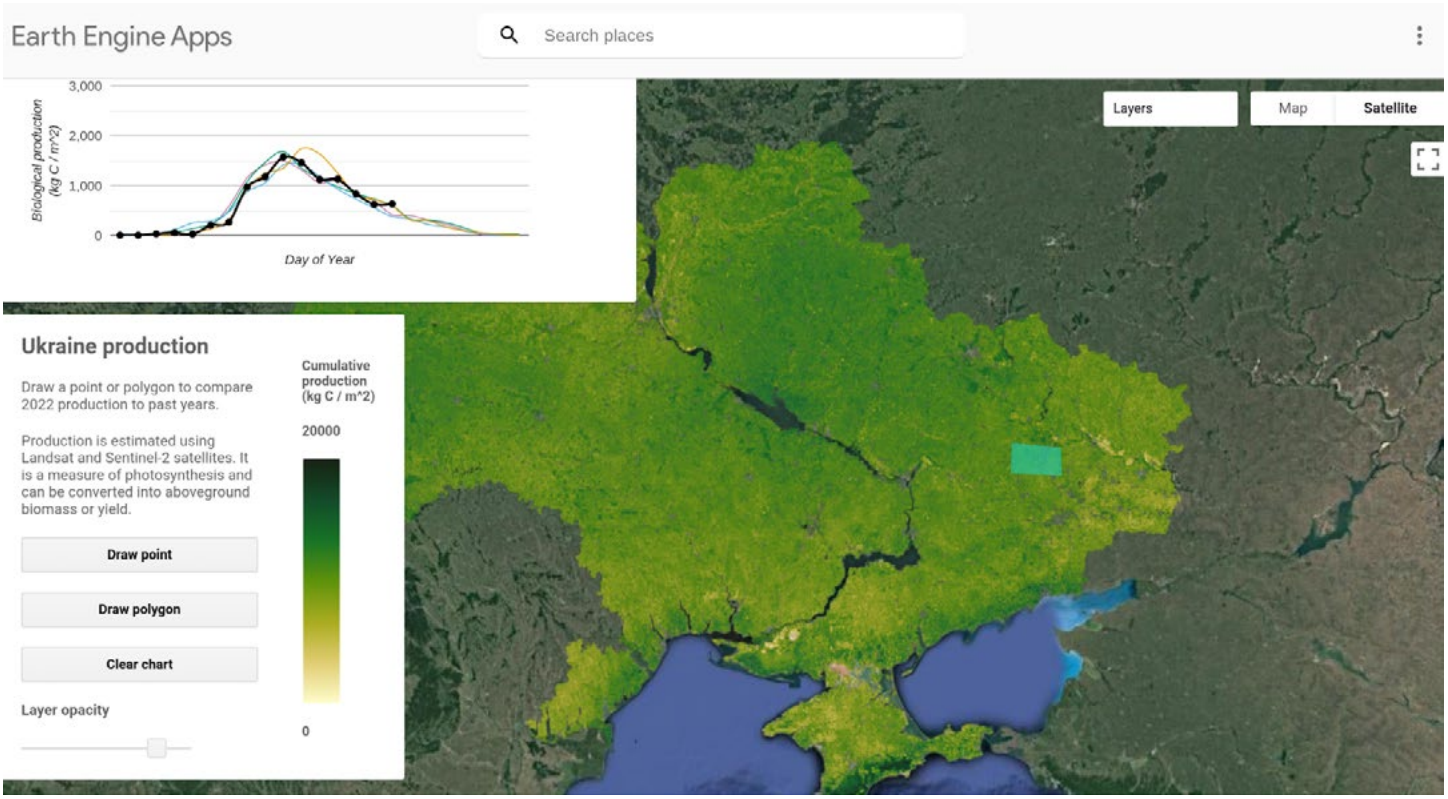

Figure 2: A screenshot of Google Earth Engine showing how AI/ML can perform deep GEOINT analytics showing the crop health of any area within Ukraine.

Fusion of Data Sources

Analysts face a challenging task of understanding complex global situations and issues. They have a broad range of available data, but accessing it, filtering conflicting data points, and discovery of datasets can present challenges. At the same time, expectations on analysts are increasing with more data and ever-changing global inter-dependencies. Machine Learning (ML) approaches are assisting analysts to find items of interest in large amounts of data, but the GEOINT community is still in the early phases of moving to higher order analysis leveraging ML. There is an evolution from finding or categorizing information to baselining patterns of behavior and identification of anomalous or escalating indicators. The future analytic work environment will have higher-level capabilities that notify analysts as patterns change.

In order to start addressing the higher order analysis and addressing key questions, we believe there must be a fusion not just of data sources but also the teams supporting the analysts. This should start with a tighter integration of ML teams (data scientists, ML engineers, data stewards, and program managers) with GEOINT analysts and stakeholders to collaborate and identify the required tradecraft to replicate in ML models. This tight integration enables the ML teams to develop models across many different sensors with the alignment of spatial and temporal information. The results of the ML models would then need to be vetted and aligned in consolidated systems for known sources of truth to allow faster iteration of models and approaches.

We assess there is also an underlying need to identify and use common terminology and communication, leveraging data literacy programs, so that the entire organization can interpret results and have more effective feedback loops. Higher order analysis will come through a result of scaling the human expertise with multiple data sources and machine learning models and approaches, as well as a broader team alignment. Analysts will be able to more rapidly understand observed current behaviors and predict future states and outcomes by leveraging multiple data sources for a more comprehensive context of activity.

Improved AI adoption with AI services

From our experience, large volumes of data, ready access to high-performance computing capability, and the need for competitive advantage are three factors driving AI adoption in the GEOINT community. The role of building, managing, and deploying complex AI systems is typically performed by data scientists, machine learning engineers, or statisticians. However, professionals of all backgrounds and skill levels need access to the benefits of AI – without requiring degrees in science, technology, engineering, or mathematics (STEM) or extensive training.

AI services – software capabilities that make AI models accessible to users and software applications through application programming interfaces (APIs) – provide a pathway for bringing AI into the mainstream GEOINT community. In our experience, AI services improve adoption by allowing AI to be directly integrated into applications and workflows analysts already use today. This enables more efficient 'human to machine teaming' to enable faster discovery of actionable insights. In our experience, integrating with a pre-existing AI service is significantly cheaper than standing up a new AI project from scratch because the models behind those services already exist – they do not need to be created from scratch. We believe that providing analysts with the ability to explore and build trust in these services, especially in unclassified test environments, would continue to accelerate AI adoption in the GEOINT community.

Practical AI/ML at scale, without code

We foresee a future where the integration of data fusion and AI services will enable analysts to cover huge geographic areas in minutes in an automated manner, allowing them to focus more on the analytic value and less on the "technology plumbing" of manual GEOINT. Eventually, users will be able to monitor the earth in a much easier manner for a wide variety of mission, including tracking and analyzing emissions and water scarcity. These same techniques can be applied to other analytic problems including change detection assisting in and missions such as humanitarian assistance.

Figure 3: An image overlaid with a virtual representation of Seattle - demonstrating the high levels of fidelity that can be achieved in common representations of environments in the metaverse.

Figure 2 shows an example of how an analyst can perform massive scale AI GEOINT analytics, in this instance looking at Ukraine crop health analytics. Without writing one line of code, the user draws a polygon of any size (such as a few acres or the entire country) and within seconds the AI/ML workflow presents to the user a chart as depicted in the upper left of the example. In this way, analysts can access the power of AI/ML to conduct analysis on huge data sets without needing to know specifically how the models were coded to work, resulting in analysis that could not be conducted previously due to time or technology constraints.

Metaverse Applications

Applications that allow interaction with dynamic information are a boon to the analyst, providing better understanding of the implications of rapidly changing, complex scenarios. Just as AI models continually benefit from new data, an analyst requires continuously updated information from diverse sources made available in easy to understand and utilize formats. However, traditional analyst workflows often result in data dead-ends, with information represented in ways that are difficult or impossible to utilize across applications.

In contrast, metaverse applications draw on multiple streams of information to build a common representation of an environment (be it virtual or real-world) and enable live collaboration in that environment. This is accomplished via open data standards and modern software architectures, which enable the free exchange of information across the system. We envision a future in which metaverse applications that harness AI/ML for pattern analysis and scenario modeling will be applied to intelligence workflows to improve mission outcomes.

Recommendations

While these technologies will continue to advance through investments being made by commercial industry, we believe the federal GEOINT enterprise can accelerate the impact it will have on geospatial intelligence by following these specific recommendations:

- Develop standard governance and "rules of the road" for analysts using generative AI and large language models like Bard and ChatGPT and the incorporation of their outputs into intelligence products. Work to make these technologies available for unclassified and classified workloads.
- Ensure executive leadership uses comprehensive, understandable, and compelling communication to highlight support for AI/ML modernization of the processes and technologies in GEOINT workflows, analytic tradecraft, and analyst training.
- Provide unclassified learning and testing environments to empower analysts to build trust in AI/ML technologies without having to wait for full system accreditation, which can take months or years
- Continue to invest in comprehensive AI/ML training to demystify the technology, demonstrate its benefits, and reduce the barrier to technology adoption
- Continue to invest in metaverse-enabled research environments to discover novel visualization techniques, develop digital twin approaches, and enable real-time collaboration in high-fidelity geospatial simulations.

Acknowledgments

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Jeff Spugnardi, Google Public Sector
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Todd Bacastow, Maxar
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About USGIF

The United States Geospatial Intelligence Foundation (USGIF) is a 501(c)(3) nonprofit educational foundation dedicated to promoting the geospatial intelligence tradecraft and developing a stronger GEOINT community with government, industry, academia, professional organizations, and individuals who develop and apply geospatial intelligence to address national security challenges. USGIF achieves its mission through various programs and events and by building the community, advancing the tradecraft, and accelerating innovation.

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