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The Geo-Singularity

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About GeoSpark Analytics

GeoSpark Analytics' products enable humans to understand inhuman amounts of information. We combine sourced multi-variant data from space, social media, news reporting and IoT together with machine learning, artificial intelligence, and natural language generation to deliver insight needed to make informed decisions.

Broad, deep data-wrangling by machines and human analysis is merging into a new, bold, real-time processing movement

Human decisions and the information that feeds them are the basis for modern success. Throughout many industries, automation and complex adaptive systems—artificial intelligence (AI)—have steadily improved the quality, efficiency, and timeliness of human decisions. Humans are inherently sequential and relational thinkers; we enjoy anecdotes and stories. This method of thinking, along with a relative lack of technological progress in spatial analysis, saw a stagnation in spatiotemporal analysis. A new collaboration is realizing the opportunity to connect complementary attributes. Broad, deep data-wrangling by machines and human analysis is merging into a new, bold, real-time processing movement honoring the best application of both capabilities.

The simultaneous availability of useful, new technologies has created what we call the "geo-singularity." In this new paradigm, human analysts and machines work side-by-side to ask and answer critical questions using tremendous datasets in real-time. This capability has already been demonstrated to speed up and deepen decision-making. The future is now.

In this article, we describe scenarios that provide an understanding of what is viable using current tools. We also predict what is immediately possible given smart adoption and full application of capabilities. The principles of the new movement are shown by detailing the geo-singularity's main processes of data analysis and decision-making.

Activity Monitoring

Informed decisions require clear information and context. Improved satellite datasets and the spread of remote sensors have enabled powerful, reliable data collection. This data requires both processing and the application of learning models to be useful.

Building and using data refineries makes a clear set of conclusions and insights possible. A data refinery takes huge datasets and turns them into relevant signals an organization can use to make decisions.

GeoSpark ANALYTICS

Three primary functions continuously update a relevant image set:

1. **Data Ingest and Harmonization**: Platforms ingest a variety of remote sensing data and pre-processes to support machine learning and massively scalable computer vision.
2. **Development of Machine Learning Capabilities:** Classifiers are trained on known sample data to develop signatures for site and target identification, classification, and change detection.
3. **Search and Classification:** Classifiers are run at scale to identify sites and label their purpose. These classifiers are run over the entirety of the region or associated areas and through time using a combination of medium- and high-resolution data sources.

As the data refinery runs, the results are available as a shared resource among human data scientists, operational staff, and the machine learning tools they employ. AI starts the assessment process by identifying signals and creating semantic information. The data team completes the analysis feedback loop by ensuring the validity of this information before updating the models and repeating the process. The continuous outputs are used in real-time to inform decisions and conclusions made by executives and analysts.

Identification and Development of Context

Establishing context is the next step to provide a high-value dataset. Fully refined data of one variety is not sufficient to meet most analysis needs. The use of many datasets in context with each other to identify correlations in space and time is critical.

Areas of Interest (AOIs) can be identified for new development prior to traditional GEOINT analysis. AOIs are detected by machine learning analysis of nontraditional GEOINT sources. News stories, social media, financial data, and other social and cultural indicators all carry signals of places to watch.

Machine learning models for context development look globally at indicators of change. Anomalies are identified by comparison to “normal behaviors” whose descriptions must also be continuously updated. The models must monitor a range of complementary data sources to avoid surprises.

A wide area search is possible when the entire Earth is turned into pixels—a broader digital twin. If changes in a facility signal danger or abnormal production, efficient signature identification is crucial to realize risk and loss before a disaster occurs. Point signatures and shifts in the operating environment are detectable across borders with the right models.

Leveraging the right individual’s expertise at the right time makes a huge difference in the outcome of any situation. A network of spatial and subject matter experts available to provide the intelligence answer is ideal. Sourcing and plugging the right expert into current AI results and detection creates a highly efficient system to run and finish actionable assessments. Automation makes it possible for people to think clearly and act fast.

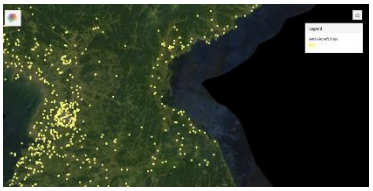

Figure 1. Identifying potential anti-aircraft sites based on low-quality raw data sources.
Image courtesy of Descartes Labs.

Human Finish Assessments

Human expert analysts are critical to ensure end users get a complete, understandable geospatial intelligence (GEOINT). The analysts provide meaning and context to “finish” the assessment from the output of AI monitoring and data processing. The geo-singular organization leverages a network of imagery, geospatial datasets, and subject matter experts. The expertise is critical for the intelligence call. Machines do more of the heavy lifting in data analysis, allowing humans to focus on giving the results meaning and steering the intention of the assessments. This approach amplifies the expertise of any one analyst, resulting in high output and quality analysis.

Data refinement and assessment is the first element of the geo-singularity. It leads to the next questions: How is this intelligence used? How do we apply the new power of the geo-singularity?

Monitoring Energy Development

As a broad example, energy infrastructure development offers a use case for the geo-singularity. It starts with developing context relevant to the energy industry. Automated broad-area search and existing models bootstrap analysts to identify new energy development sites of interest all along the supply chain. Rather than manual scanning, AI tools see opportunities and threats faster.

Once identified and contextualized, development is monitored and efforts are adapted as development progresses. What used to require literally an army of military intelligence gatherers can now be accomplished with powerful AI platforms directed by a handful of humans on a data team, or even a single engineer. Using automated observations of key signals, machines can tip off and efficiently use the attention of human analysts. Decision-makers avoid surprises and react fast and early.

Change detection in energy operations can range from picking up ground disturbances to flare activity. Refinery production tracking can be accomplished by quantifying output and shipments of finished resources. All of this is detectable with the unblinking eye of a constantly scanning satellite monitoring system.

Abnormal activity is often associated with abnormal language. Hot spots are found by detecting shifts from normal operation, often seen in unusual and unscheduled production and logistics changes.

We are rarely surprised when we know where to look and what to look for. Machine learning models that pattern human behavior globally are required to drive current government and commercial intelligence, security, and business operations. A model continuously assesses activity levels, defines normal patterns of behavior, and identifies anomalous activity. The system alerts users to actions that may pose a threat, risk, or opportunity to their operations, people, or investments.

Human teams built around automation can triage, respond, and focus on real events, in real-time, and at scale. Along with lag time, the need for damage control is reduced. Reactive mind-sets give way to proactive strategy and preparation. The more the teams consistently know, the more efficient and targeted the response. Small teams can monitor a large corpus of signals to prioritize key activities and incidents for further investigation. For example, widespread site monitoring across several perspectives establishes forewarning of disruption in the energy sector.

There is a balance to be struck here. Experience has shown that models hold up well over time when properly designed, however, there is always drift and change that threatens to change our understanding of how the world works. For example, identifying facility activity is reliable up until the underlying facility or workflow changes. Correcting models to match these changes in the real world can be autonomous, but people must be involved to communicate and adapt the model properly to new goals.

Global Threat and Risk Assessment

Few organizations understand the risks for their employees and operations at a global scale. Industrial-age processes still rule most of the risk assessment industry. Hundreds, if not thousands, of analysts toil away scanning newspapers, trying to cull through a growing mountain of social media, and reading field reports. These tasks steal precious time from strategic thinking, overwhelm analysts with a volume of data, and offer only a small glimpse into what is happening across the globe. Static reports are written on a monthly or quarterly basis and sold at high costs.

Figure 2. An integrated picture of assessed risk and underlying interpretation. Image courtesy of GeoSpark Analytics.

"We are constantly looking for capabilities that help us prevent strategic surprise, and we recognize that evaluating open source and publicly available information is critical to staying ahead of developing world events. Unfortunately, that has always been a very difficult and time consuming prospect for an operations center focused on managing the very large enterprise.

Our evaluation of Hyperion makes it very clear that it can help us identify hot spots and high priority topics faster and with more surgical precision than any other approach we've evaluated previously, and doesn't necessarily require an increase in personnel, which is a critical factor in adding mission capability. We are currently in a pilot evaluation period and are working on plans to operationalize the capability and implement it as part of our portfolio of tools."

– US Government Ops Center Lead

GeoSpark Analytics' employs A founding team of experienced threat and risk professionals from the US Intelligence Community, DoD and Commercial Security organizations with decades of experience conducting and leading analysis and operations.

Machine learning models in advanced analytic platforms are gradually replacing the old process. These models record billions of calculations of activity and stability. They visualize those findings graphically and textually in accessible platforms and through automated prompts. Alerts show changing patterns and present ratings of current and forecast potential stability levels on a global level.

Again, these models do not replace the human analyst. Instead, they augment his or her ability by a factor of 10. They enable the analyst to have a full picture of global events as they break and offer a glimpse into future potential scenarios.

This trend is being seen across verticals like trading and supply chain management. It is directly tied to modeling actions in the physical world. Those with a strong profit motivation are moving first, of course. Yet even within the environmental/non-governmental organization (NGO) world, there is a move toward the use of automated monitoring systems backed up by sophisticated human analysis.

Moving into the Future

The improvements from augmentation and collaboration with machines in the geo-singularity is clear. Realizing this new state prompts the question: How is all of this built from current processes?

An effective transition begins with a bootstrap of what is already known by human-driven search and filtering strategies. A campaign is built to understand and monitor, and to use leading indicators to get ahead of the problem before it gets out of control. An organization begins to operate at a deeper level of integration and feedback with technology when understanding increases the performance of the system and the system increases understanding.

Recently, new technical abilities such as deep learning, large-scale data processing, and highly connected models have simultaneously created a huge opportunity to aid human decision-making. We now have the computational tools to tell stories in geospatial terms, at scale, and across different disciplines. This rapid expansion of technical capabilities has outpaced the application of these technologies to our human endeavors—and created opportunities.

The adaptive organizations of today are creatively applying these new technologies. Iteration cycles are accelerating. Entirely new ways of conducting business are being developed, enabling humans to be more informed, effective, and successful in their choices.

There is merited discussion, shown in this larger USGIF report, about what the future will bring for the GEOINT Community. But the future is already here. Our current technical capacities often outpace our ability to use them effectively, and additional technology will not solve this problem. The promise of the geo-singularity is to become a focal point to change the way we work. We will emerge on the other side of the transition with new ways of operating in and thinking about the world.

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