

» Q&A FEATURE SERIES

» IMAGING SCIENCE AT RIT

» USGIF CERTIFICATION UPDATE

2016 ISSUE 2

trajectory

THE OFFICIAL MAGAZINE

OF THE UNITED STATES GEOSPATIAL INTELLIGENCE FOUNDATION

'RECALCULATING' GPS

GPS IS THE GOLD STANDARD OF POSITIONING, NAVIGATION, AND TIMING— BUT WHAT HAPPENS WHEN IT ISN'T?



TECHNOLOGY TO CONNECT,
INFORM AND PROTECT™



MANAGE YOUR DATA. DISCOVER ANSWERS. MAKE DECISIONS.

Analysts in today's world are expected to have the right information at their fingertips to answer urgent questions at a moment's notice. **Jagwire™** allows analysts to spend less time searching for the right data and more time providing answers for time-critical operations. Stop by **Harris booth #828** at the **GEOINT Symposium** to learn more.

harrisgeospatial.com/trajectory



Jagwire™



IMAGE COURTESY OF LOCATA

Australia-based Locata has created a radio location system that mimics GPS on the ground. Instead of a space-based network of satellites, the system employs a terrestrial network of transceivers called LocataLites, which emit signals with centimeter-level location accuracy.

02 | VANTAGE POINT

The GEOINT Revolution is here and USGIF is all in.

04 | INSIDER

Intelligence and the illegal wildlife trade; Los Angeles launches GeoHub; White House creates Police Data Initiative.

06 | IN MOTION

USGIF certification update; shifting collection at NGA; Foundation partners with an elementary school to support its STEM program.

12 | ELEVATE

Rochester Institute of Technology offers unparalleled studies in imaging science.

Features

16 | 'RECALCULATING' GPS

GPS is the gold standard of positioning, navigation, and timing, but it has weaknesses. GEOINT offers alternative solutions.

By Matt Alderton

Q&A FEATURE SERIES

27 | Catherine Johnston, DIA's director of digital transformation and operationalizing IC ITE.

34 | Stephanie O'Sullivan, principal deputy director of national intelligence.

14 | COMMON GROUND

USGIF launches NGA Advisory Working Group to promote faster, more agile acquisition processes.

40 | MEMBERSHIP PULSE

Engineering services firm AECOM designs and maintains infrastructure from the ground up.

42 | HORIZONS

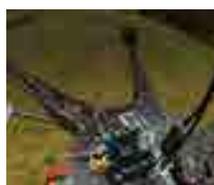
Reading List, Peer Intel, and USGIF Events Calendar.

44 | APERTURE

Using commercial satellite imagery to model North Korean launch station buildings and structures.

On the cover: A Global Positioning System IIF-series satellite undergoes final encapsulation inside a four-meter diameter protective payload fairing Oct. 16, 2015, at Cape Canaveral Air Force Station, Fla. The United Launch Alliance Atlas V rocket carrying the GPS IIF-11 satellite launched from Space Launch Complex-41 Oct. 31, 2015.

TRAJECTORYMAGAZINE.COM



WEB EXCLUSIVE

Autonomous vehicles of tomorrow will require sensor synthesis for precision navigation.



WEB EXTRA

Download the Global Navigation Satellite Systems PDF chart for quick reference.



RESOURCE

Download the 2016 State of GEOINT Report.

LOOKING TOWARD THE GEOINT COMMUNITY'S FUTURE

USGIF has championed the message of the GEOINT Revolution for about 18 months now. The idea sprung out of our 2015 State of GEOINT discussions, flowed through a number



of presentations I made to various audiences in and around our Community, was debated a bit at the GEOINT 2015 Symposium, and was more completely articulated in the Q4 2015 issue of *trajectory*.

We've been overwhelmed by the response to the article and to the underlying thesis. Already among the most frequently accessed articles on *trajectorymagazine.com*, the message of the GEOINT Revolution is clearly resonating. It's being referenced in other publications, on social media, and in government and industry briefings and documents. As we intended, it has led to reflection and discourse, and thus seemed to be the perfect theme for GEOINT 2016. Building on the 2015 idea that we are collectively opening the aperture regarding our concept of

GEOINT, and to an ever-broadening community of GEOINTers, it's appropriate to spend our time in Orlando really digging into the idea, and most importantly, sorting out what's next for the GEOINT Community.

There's little doubt the revolution is underway, and there is a certain sense of urgency—certainly in our traditional areas of intelligence, defense, and homeland security—to get out ahead of the revolution in order to take maximum advantage of it for national security. In the broader GEOINT Community, there is genuine excitement fostering remarkable innovation and creativity.

In the broader GEOINT Community, there is genuine excitement fostering remarkable innovation and creativity.

USGIF is all in. Our Board of Directors has made it clear we should aggressively follow our educational mandate, continue to be the recognized convening authority for GEOINT in its largest sense, and continue providing thought leadership. We will germinate discussions and publish in print, online, and on social media. We will hold events such as our recent Data Analytics Forum, engage speakers like Parag Khanna at our events, and aggressively partner with other organizations to seek synergy as we purposefully expand into burgeoning GEOINT business areas.

The content in this issue of *trajectory* is yet again emblematic of that commitment. We explore the current state and future of positioning, navigation, and timing. We present uniquely in-depth interviews with two visionary leaders in our Community: Cathy Johnston and Stephanie O'Sullivan. We update you on myriad ongoing USGIF activities, including GEOINT professional certification, as a testament to our commitment to the GEOINT Revolution.

Your commitment, in the form of elevating USGIF's sustaining membership to more than 260 organizations, and our individual membership to more than 1,000, is loud and clear. There's never been a more exciting time to be in our business—nor a more pressing demand to get our business right.

KEITH J. MASBACK | CEO, USGIF
@geointer



USGIF CHAIRMAN OF THE BOARD
The Honorable Jeffrey K. Harris

USGIF CEO AND PUBLISHER
Keith J. Masback

EXECUTIVE EDITOR
Jordan Fuhr
jordan.fuhr@usgif.org

MANAGING EDITOR
Kristin Quinn
kristin.quinn@usgif.org

EDITOR
Brad Causey
bcausey@glcdelivers.com

ART DIRECTOR
Gretchen Kirchner Rund
grund@glcdelivers.com

ASSISTANT EDITOR
Lindsay Tilton Mitchell
lindsay.mitchell@usgif.org

AD SALES
Erik Henson
ehenson@naylor.com



Trajectory is the official magazine of the United States Geospatial Intelligence Foundation (USGIF).

HOW TO REACH US LETTERS AND COMMENTS

For comments on *trajectory*, contact trajectory@usgif.org.

SUBSCRIPTIONS

For information on subscribing to *trajectory*, sign up for free at trajectorymagazine.com.

USGIF MEMBERSHIP

For more information on USGIF or becoming a USGIF member, contact 888-MY-USGIF (888-698-7443).

TWITTER
[@trajectorimag](https://twitter.com/trajectorimag)

PUBLICATION MANAGEMENT



847-205-3000 | GLCDELIVERS.COM

Visualization and Analytics Platform for Big Data Geospatial Intelligence

Import, Analyze, Query and Visualize Large Volumes, Velocities and Varieties of Data Using a High Performance, User Friendly Workflow



Open APIs Drop-In Compatible With the Most
Demanding Enterprise Deployments

Securely Import Large
Datasets or Streams

Perform High Speed Geocoding,
Routing, and Analytics

Create Dynamic, Queryable
Maps Without Pre-Rendering



MAPLARGE
we bring DATA to life

GEOINT 2016 Booth #1828

www.maplarge.com

 **aws marketplace**

NEWS UPDATES AND HIGHLIGHTS



INTELLIGENCE AND THE ILLEGAL WILDLIFE TRADE

The Intelligence Community (IC) and nonprofit organizations have formed a network to help stop illegal wildlife trade. This network convened on Capitol Hill March 8 in a Congressional forum titled “Criminal Nature: The Global Security Implications of the Illegal Wildlife Trade.”

Sponsored by the International Fund for Animal Welfare and hosted by the American Geographical Society and the United States Geospatial Intelligence Foundation (USGIF), the forum brought together several leaders in the fight against wildlife crime for an afternoon of presentations and discussions.

Terrance Ford, national intelligence manager for Africa with the Office of the Director of National Intelligence (ODNI), shared what the IC is doing to support the President’s National Strategy for Combating Wildlife Trafficking released in 2014.

“Illicit trafficking of wildlife products is a global criminal enterprise

of epic proportions,” Ford said, adding that such crimes continue to increase and tackling this problem is an enormous challenge.

In response, ODNI formed a Counter Wildlife Trafficking Community of Interest to facilitate information sharing with the objective to provide law enforcement agencies and partner nations with actionable intelligence needed to interdict transnational organizations, poachers, financial institutions, and middlemen who enable wildlife trafficking. Dr. Odean Serrano, formerly of the National Geospatial-Intelligence Agency, joined ODNI to lead this effort.

According to Ford, ODNI is exploring ways to develop an unclassified information sharing environment that will encourage data exchange and cooperation among the IC, all of U.S. government, NGOs, the private sector, and select international partners. Options for analytic support are being considered as well.

got geoint? got geoint?

NOAA’s geostationary operational environmental

satellite (GOES) series has provided more than



years of environmental information.

SOURCE: NOAA



LOS ANGELES LAUNCHES GEOHUB

Earlier this year, the city of Los Angeles unveiled GeoHub, a multifaceted geographic information systems platform for exploring, visualizing, and downloading location-based open data. The goal of GeoHub is to share data between city departments and create applications allowing inter-department users to get information about systems that interact with one another. GeoHub currently has a catalog of more than 500 data sets, and is expected to continue to grow. The city hopes the platform will create more efficiency and help agencies target their work more effectively. The platform is also public, allowing city residents to search and explore the data.

DIGITALGLOBE PARTNERS WITH SAUDI FIRMS TO DEVELOP SMALLSATS

DigitalGlobe formed a joint venture with Saudi Arabian technology firm TAQNA and independent scientific organization KACST to develop a constellation of small sats. The companies will develop six or more satellites to collect imagery at 80-centimeter resolution. The small sats are expected to launch in late 2018 or early 2019.

According to DigitalGlobe CEO Jeffrey Tarr, the partnership will offer customers the ability to monitor some of the world's most dynamic and volatile locations up to 40 times per day for indications of relevant change.

"These high-revisit satellites will tip and cue our industry-leading high-resolution satellites to collect the precise detail needed for critical, time-sensitive decision-making," Tarr said. "DigitalGlobe's global network of relay sites, centralized tasking, highly secure operations, and geospatial big data analytic platform will enable us to control and exploit this constellation in support of the broadest range of customer applications."

TED PRIZE WINNER TO LAUNCH CROWDSOURCING APP

Sarah Parcak, space archeologist and 2016 TED Prize recipient, announced she will use her \$1 million prize to launch a digital platform to help map archaeology sites around the world. The platform,



PHOTO BY RYAN LASH / TED

called Global Xplorer, will leverage crowdsourcing and satellite imagery to discover and protect archeological sites. Global Xplorer will be in an app format and have gamification features to make the mission more interactive and fun for users. Parcak has dedicated her career to combining satellite imagery with infrared and thermal capabilities to detect and pinpoint archeological sites.

PROCRASTINATION TOOLS

FATMAP

Pairing satellite imagery with ski area trail maps, the FATMAP app offers the world's most detailed 3D mobile ski maps. The app is interactive and models trails from ski resorts around the world, offering users better planning and navigation for their runs.

fatmap.com



NEXAR

With a mission to crowdsource road safety data, Nexar is an artificial intelligence dashcam app for your smartphone. The app continuously records the



road while its sensors auto-detect dangerous situations.

getnexas.com

SWARM

Created by FourSquare, Swarm is a fun way to meet up with friends and discover new locations. Earn points when checking in at locations all while competing with friends for points via social media. Available on iTunes, Google Play, and Windows Store.

swarmapp.com



WHITE HOUSE CREATES POLICE DATA INITIATIVE

In 2015, the White House launched a Police Data Initiative, which mobilized 30 law enforcement agencies across the country to take action on recommendations in data and technology. These police organizations are establishing a law enforcement community that facilitates knowledge sharing, community-sourced problem solving, and the establishment of documented best practices for police departments nationwide. Esri is supporting the White House effort with its own ArcGIS Open Data Initiative for Law Enforcement, which allows police agencies of any size to build and share authoritative data for better policing and community engagement.



got geoint? got geoint?

In 2015, NOAA assisted in the rescue of



lives using its polar-orbiting and geostationary satellites.

USGIF PARTNERS WITH ELEMENTARY SCHOOL

USGIF has partnered with Moorefield Station Elementary School in Ashburn, Va., via the Loudoun School Business Partnership, which helps K-12 students at Loudoun County Public Schools prepare for careers in science, technology, engineering, and math (STEM).

USGIF staff taught two third-grade classes about satellites and led students in activities such as identifying cities in satellite imagery and studying National Geographic's Giant Traveling Map of Europe. Additionally, USGIF participated in the school's STEM Night, an annual event at which partner organizations teach students and their families about STEM topics.



USGIF FILE PHOTO

MOOREFIELD STATION ELEMENTARY third-grade students match satellite images to locations on National Geographic's Giant Traveling Map of Europe.

FIRST INTERNATIONAL GEOINT PROGRAM ACHIEVES USGIF ACCREDITATION



The NOVA Information Management School of the Universidade Nova de Lisboa (NOVA IMS), located in Lisbon, Portugal, recently became the 13th university to achieve USGIF academic accreditation—as well as the first non-U.S. school to be accredited by the Foundation. The inclusion of NOVA IMS represents a major step for USGIF and signals the broadening of GEOINT as a globally recognized professional discipline. NOVA IMS's GEOINT curriculum was developed collaboratively across its federated university structure and is truly interdisciplinary in its design.

"This accreditation is very important for NOVA IMS since it certifies that the master's program in geographic information systems and science follows the highest international standards in the area," said NOVA IMS Dean Dr. Pedro Coelho. "This will constitute an additional incentive for the school to be committed with goals of excellence in all its activities. The certification will also reinforce our international focus and create new opportunities for our graduates."

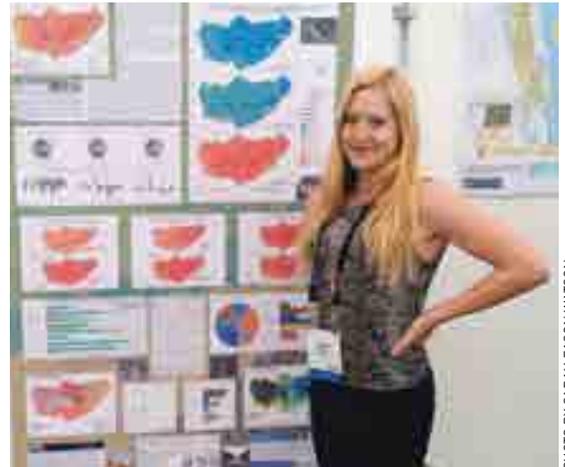


PHOTO BY SARAH EASON WATSON

SCHOLARSHIP SPOTLIGHT: SARAH EASON WATSON

Sarah Eason Watson in 2010 received a USGIF Scholarship while an undergraduate student at Texas State University at San Marcos. She said the USGIF Scholarship was a financial boon for her education.

"The scholarship definitely helped make a lot of things possible," Watson said.

Watson applied her scholarship toward achieving a master's degree through the Erasmus Mundus Master in Geospatial Technologies program, a joint curriculum between the Universidade Nova de Lisboa in Portugal, the University of Münster in Germany, and the Universitat Jaume I in Spain, in which students spend a semester at each school. Watson believes the program was a challenging yet heartening and memorable experience.

"Compared to a U.S. graduate program, [the European program] was very different and fast-paced," Watson said. "In the U.S. we're used to three or four graduate courses at a time, but at this program I had to take 11 courses at a time with only six months to write my thesis. It was intense but very enriching and eye-opening. It was also culturally enriching to meet other students from all over the world."

Watson now works as a GIS analyst for the Edwards Aquifer Authority in San Antonio, Texas.

Bringing GEOINT to the cloud.

For U.S. Department of Defense and intelligence organizations, working in the cloud isn't the future- it's now! Join IGS at booth 1012 to see how our technology enables your organization to successfully advance from a desktop-centric model to the cloud.

Also stop by to play Minute-to-Win-It for your chance to win a Fitbit Charge HR™ daily!



USGIF FILE PHOTO

YOUNG PROFESSIONALS taught children about satellites and GEOINT in January at the International Spy Museum's annual Spy Fest in Washington, D.C.

YOUNG PROFESSIONALS UPDATE

USGIF's Young Professionals Group (YPG) has been busy in 2016 hosting and participating in a variety of events. In January, YPG once again participated in the International Spy Museum's annual **Spy Fest**, an interactive, educational family event that offers attendees a rare glimpse into the secret world of espionage. YPG volunteers taught families basic imagery analysis and provided a build-your-own satellite-model station for children.

In February, young professionals attended an **"Acquisition 101"** discussion led by USGIF's NRO Application Service Provider Industry Advisory Working Group. The discussion's topic was "Finding and Picking Contract Types and Vehicles" with guest speakers Keith Barber of OGSystems, Nick Buck of Buck Consulting, and Gary Kyle Sr. of the U.S. Air Force and NRO.

As part of **Esri's 2016 FedGIS Conference** in February, YPG co-hosted a happy hour with Esri's Young Professionals Network in Washington, D.C., to expand its networking reach further into the federal government community.

Both the D.C. and St. Louis YPG chapters took their networking to the **ice rink**. In February, the St. Louis YPG gathered at a St. Louis Blues vs. New York Rangers game, and in April, the D.C. young professionals attended a Washington Capitals vs. New York Islanders game.



Get involved! Email YPG@usgif.org.

SHIFTING COLLECTION AT NGA

John Goolgasian, director of the National Geospatial-Intelligence Agency's (NGA) Source Operations Management Directorate, wants to employ commercial GEOINT and change collection processes to fill intelligence gaps.

"How do I learn what's going on in the 'white spaces'? How do I train—not people—but our systems to automatically understand and sense those areas?" Goolgasian said.

Around 120 people heard Goolgasian speak at USGIF's Jan. 12 GEOINTeraction Tuesday networking event, sponsored by NT Concepts and held at the Children's Science Center in Fairfax, Va.

"We've changed our collection paradigm completely on its head," Goolgasian said. "For those of you who have worked in the community for a long time, the adage is 'analysis drives collection.' It's been true and it's still true, but I think we can change that."

He added the agency is trending toward change detection driving analysis—a goal commercial GEOINT will help meet with its large constellations and high revisit rates.

According to Goolgasian, another piece of NGA's collection transition will be the Commercial Initiative Buying Operationally Responsive GEOINT (CIBORG) program, which aims to create new mechanisms for the procurement of imagery and imagery-derived products and services. NGA aims to begin procurement under CIBORG within the next year.

JOHN GOOLGASIAN of NGA spoke about the agency's changing collection processes at USGIF's GEOINTeraction Tuesday event in January.



USGIF FILE PHOTO

STAFF CORNER

In February, USGIF CEO **Keith Masback** was appointed vice chair of the National Geospatial Advisory Committee, which provides recommendations to the Federal Geographic Data Committee, the interagency executive group responsible for providing leadership and direction in federal geospatial programs.

In December, USGIF's **Anna Kimmel** was promoted to director of events, and **Justin Franz** was promoted as the Foundation's new volunteer engagement manager. Both will also assist the USGIF committees and working

groups and serve as liaisons between the groups and the Foundation.

At the beginning of the year, **Dr. Maxwell Baber**, former director of academic programs, left the Foundation to pursue new opportunities. Baber began working at USGIF in 2009. Under his leadership, the Foundation accredited nine collegiate GEOINT programs, bringing the total to 13 universities. He also managed the selection process for the USGIF Scholarship Program, which has awarded nearly \$1 million to GEOINT students.



Universal GEOINT Certification Program

THE FIRST OF ITS KIND

Transparent and Transportable

Demonstrate
your expertise.

Advance
your career.

Stand out among
your peers.

Earn all 3
certificates
and become
eligible to be a

**Universal GEOINT
Professional**



CERTIFICATES IN

GIS and
Analysis Tools

Remote Sensing
and
Imagery Analysis

Geospatial
Data Management

Learn more at usgif.org or visit booth #901 at GEOINT 2016.

USGIF CERTIFICATION UPDATE

Standards emerge and converge

By Dr. Darryl Murdock, Vice President of Professional Development, USGIF

Geospatial intelligence has grown far beyond the banks of the Potomac and is now a global phenomenon. In just more than a decade since the term was coined, a large GEOINT Community has sprung up around the world that is significantly impacting commercial business as well as the more traditional defense, intelligence, and homeland security communities.

Workers across the globe and in varied industries are becoming GEOINTers by the very nature and requirements of their jobs. And as the world demands more precision location information, geographical representations, and data visualization, the most challenging issue the Community faces is ensuring the professional workforce has the right knowledge, skills, and attitudes (KSAs), as well as a way to demonstrate this domain expertise—or a pathway to achieve such proficiency.

USGIF will officially launch its Universal GEOINT Certification program in May at the GEOINT 2016 Symposium in Orlando, Fla. This program marks an exciting milestone for the GEOINT Community as USGIF broadens its GEOINT pipeline from university accreditation and scholarships to include the professionalization of the GEOINT workforce.

USGIF's certification program includes three exams with corresponding certifications: GIS and Analysis Tools; Remote Sensing and Imagery Analysis; and Geospatial Data Management. A fourth competency—data visualization—is incorporated throughout all of the exams.

Each of the three exams and subsequent professional certifications are valuable as standalone credentials. Many GIS, remote sensing, or data management professionals within the GEOINT Community may choose to take only one or two of the exams. However, for GEOINT practitioners, passing all three exams offers added value. Those who earn and maintain

all three USGIF certifications simultaneously will be eligible to apply for USGIF's overarching Universal GEOINT Professional designation. Universal GEOINT Professionals demonstrate a true understanding of the broad geospatial intelligence discipline.

Leveraging best practices, USGIF created an independent Certification Governance Board (CGB) that directs certification efforts by writing and maintaining the candidate handbook, determining passing scores, and evaluating Universal GEOINT Professional program processes. The CGB has met several times in the lead-up to the official launch of the certification program. The board will hold its first annual meeting May 17 during the GEOINT 2016 Symposium.

ALIGNING WITH NGA CERTIFICATION

Parallel with USGIF's efforts, the National Geospatial-Intelligence Agency (NGA) has created a certification program designed specifically for the U.S. Defense Intelligence Enterprise. GEOINT analysts from all branches of the U.S. military, the Defense Intelligence Agency, and NGA participate in the NGA program, which includes an entry-level doctrinal test and 10 full-proficiency GEOINT-related exams. While USGIF's certifications are applicable for all GEOINT practitioners, NGA's certifications are designed specifically for Defense Intelligence Enterprise analysts.

USGIF and NGA are developing an initial reciprocity model based on the functional equivalence of the certifications to benefit certification candidates seeking a transportable, transparent certification that carries weight both inside and outside of the U.S. DoD and Intelligence Communities.

USGIF and NGA have agreed upon a plan for reciprocity. Recognizing differences in intended audiences, USGIF and NGA determined there is close alignment between the three USGIF assessments

and four NGA assessments. The goal between the programs is to achieve transferability through the concept of functional equivalence. Functional equivalence allows hiring officials to agree that more than one certification meets current organizational needs.

The following table, based on initial evaluations by NGA and USGIF, shows the most current and likely alignment.

NGA	USGIF
Imagery Analysis	Remote Sensing and Imagery Analysis
Image Science	Remote Sensing and Imagery Analysis
Geospatial Analysis	GIS and Analysis Tools
Geospatial Data Management	Geospatial Data Management

This concept of transportable and transparent professional certification with universal applicability will continue to be paramount to USGIF membership as well as the growing global GEOINT Community.

The only prerequisite to be eligible to sit for a USGIF certification is to be at least 18 years old and have at least one year of real-world professional experience or related coursework; however, each assessment is designed for individuals with three to five years of real-world GEOINT experience.

USGIF's certifications will offer GEOINT professionals the opportunity to advance their careers by differentiating themselves from peers, demonstrating their ability to perform beyond the skill level at which they were hired, and making them more marketable for new positions and eligible for promotions, awards, bonuses, etc.

Universal GEOINT Certification program testing will begin in June.



Additional information regarding the Universal GEOINT Certification program will be available at the GEOINT 2016 Symposium, May 15-18, in Orlando, Fla., or at usgif.org. If you have questions regarding USGIF certification, please contact USGIF at credential@usgif.org.

The Integrated Information Age

Forging a Path to Activity Based Intelligence

We're providing the next generation of automated data integration and change detection solutions, preparing you for an increasingly complex and dynamic world.

Learn more at:

GEOINT 2016 | BOOTH 703



leidos.com/GEOINT-ABI

ONE OF A KIND

Rochester Institute of Technology offers unparalleled studies in imaging science

By Andrew Conner

THE WILDFIRE AIRBORNE SENSOR PROGRAM (WASP)

developed by RIT captured this image during a 2012 search and rescue experiment that positioned human subjects in a field and under significant tree coverage in an attempt to find them using data from various sensors.



PHOTOS COURTESY OF RIT

IN THE STUDY of imaging as a science, the Rochester Institute of Technology (RIT), located in Rochester, N.Y., is an outlier. While many programs across the country offer degrees in geographic information systems, electrical engineering, physics, or other topics that touch on aspects of imaging science, RIT is currently the only school offering both undergraduate and graduate degrees in the field.

“When we say we’re the only place, it’s because we look at imaging writ large, from a very high-level perspective,” said David Messinger, professor and director of the Chester F. Carlson Center for Imaging Science at RIT.

Students at RIT approach imaging as a chain, starting with photons and ending with data extraction. This approach helps students develop a background in multiple disciplines that all play a role in the imaging process.

“I liked the multidisciplinary aspect of the program,” said Brian Daniel, a senior image scientist at Harris Corp. who received a Ph.D. in imaging science from RIT in 2009. “Mechanical engineers work on mechanical structures, electrical engineers work on breadboards and signal processing, but imaging science is the whole chain: the fundamental physics of light and matter, the optics, the lens assembly, the detectors—which is solid state physics—the engineering of it, and finally the computer science, where you’re figuring out

how to get voltages off these detectors and make them into pretty pictures.”

RIT’s multidisciplinary approach to imaging science grew out of the school’s renowned photography program. Rochester is home to Kodak and Xerox, so the specialization was a natural fit for the school. RIT has offered a course in photographic sciences and technology (a precursor to study imaging sciences) since the 1950s, and is regularly ranked among the top photography schools in the nation. In 2016, RIT’s graduate photography program ranked sixth, according to *U.S. News & World Report*.

In the mid-1980s, as photographic technology became more complex, the university created the Center for Imaging Science, which began as a multidisciplinary research center. A few years later, the center became a part of the College of Science when RIT decided to offer degrees in imaging science.

Since then, RIT imaging science professors and students have been involved in numerous projects that have contributed to the study of imaging science. Notable among these is the Digital Imaging and Remote Sensing Image Generation model (DIRSIG), a tool used by many government and private organizations—the National Geospatial-Intelligence Agency, the U.S. Geological Survey, NASA, Lockheed Martin, and

THIS DIGITAL MICROMIRROR DEVICE (DMD) is being designed and built for NASA by RIT students and faculty.

Boeing—that allows for advanced analysis of panchromatic, multi-spectral, or hyper-spectral imaging data.

Hands-on work with these types of systems gives RIT students an edge in the demanding geospatial intelligence field. For Julia Barsi, an instrument engineer at the NASA Goddard



Space Flight Center who received both her undergraduate and master's degrees in imaging science from RIT, this was particularly true. Her current work at NASA on calibration of thermal Landsat imagery is an extension of research she began at RIT.

“That’s the benefit of [RIT’s] program,” Barsi said. “Your school research is generally funded by a real-world project, so you come out of school being tied into some aspect of a real project that’s going on. I was preparing presentations on my work for my professor to take to his calibration meetings. I don’t know how many students get to do that.”

This immersion in real-world research and projects makes RIT graduates highly desirable to employers. RIT graduates are also coveted by National Labs and academia.

Amanda Ziemann, a post-doctoral research associate at Los Alamos National Labs (LANL) who received her Ph.D. from RIT in 2015 and was awarded a 2014 USGIF Scholarship, talked to many potential employers, including Livermore National Labs, MIT, and Lincoln Labs, before deciding to

work at LANL. Like Daniel, she found the transition from RIT to the working world to be “seamless.”

“The way the imaging science program is structured, you’re not working on a deep, theoretical problem without real data,” Ziemann said. “You’re working on real, application-based problems. These are problems that labs and places in industry are really interested in, so when you go to work there it’s very similar. There’s not a huge learning curve in terms of the material and research process.”

Smooth transitions to the imaging industry are common for students such as Ziemann, who don’t just graduate from RIT ready for the working world, they’re already a part of it during their studies. ■■

DO YOU KNOW WHAT REAL-TIME IS?



Multi-int combined in a 2D/3D DEM model in Real-time.



**CONSOLIDATED
RESOURCE
IMAGING**
WWW.CRI.US.COM

Visit us at **GEOINT 2016**
Booth # 1037

The experts for EO/IR Wide Area/SWIR/MWIR

PARTNERING TOWARD INNOVATION

USGIF launches NGA Advisory Working Group in an effort to promote faster, more agile acquisition processes

By Melanie D.G. Kaplan



USGIF'S NGA Advisory Working Group hosted its monthly meeting in April at USGIF Headquarters.

SHORTLY AFTER THE NEW YEAR, the National Geospatial-Intelligence Agency (NGA) posted a request for information (RFI) called Tundra. The goal was to solicit feedback on how to make NGA more agile when purchasing commercial services, but the brief document was difficult to decipher.

It wasn't long after the request was issued that Michael Geggus, NGA's industry innovation advocate, started to hear grumbles.

"[The agency has] been hyper aware since [the GEOINT 2015 Symposium] that we have difficulty in how we communicate specific program acquisition processes," Geggus said. "While we think we're being plain in our language, we're not. The Tundra RFI is a prime example."

Tundra isn't a unique anecdote of a government request frustrating the private sector. Often, NGA issues an unclassified RFI or request for proposal (RFP) that requires a security clearance to visit government facilities—even to get online to view and respond to the document. This means competitive materials are not accessible to many smaller or nontraditional companies. Geggus hopes to ensure the process remains secure at an appropriate level while promoting—rather than restricting—collaboration and fairness.

But he also recognizes the challenges in overhauling agency practices and that it's particularly difficult to get all

perspectives from the inside. As a result, Geggus welcomed the opportunity when government and industry veterans Jim Kwolek and Skip Maselli approached him in spring 2015 about creating an NGA Advisory Working Group (NAWG) at USGIF. The group would recommend ideas for improving the agency's procurement processes.

"As [NGA's] industry innovation advocate, I'm only as good as how much perspective I have access to from all the different folks outside the organization," Geggus said. "More than anything else, it's about understanding each other."

Kwolek, vice president of strategic planning for NT Concepts, and Maselli, on the business development side of Raytheon Intelligence, Information & Services, have noticed challenges in how NGA communicates and presents the acquisition process to industry. Some examples they cited are a risk-averse culture, an understaffed and younger acquisition workforce, and substantial delays in procurement, which cost companies resources. By starting a dialogue and promoting cooperation, the NAWG suggested, government and industry could reduce risk, cost, and unnecessary award protest while also incentivizing innovation. Ultimately, the group said, these changes would lead to better NGA customer service and improved national security.

"NGA isn't necessarily doing anything wrong," Maselli said, "but there are ways of doing things better."

The working group charter was approved by USGIF in August 2015, and in September co-chairs Kwolek and Maselli held the group's first meeting. NAWG members come from about 50 small, medium, and large companies and also include 10 independent consultants who conduct business with NGA. The group's charter not only addresses the cultural differences between government and industry but also the nuances between NGA's traditional acquisition process and emerging agile acquisition processes found in the commercial sector.

The working group meets monthly and has created sub-working groups in the areas of procurement communication, innovation, business size, security, and clarity and efficiency. The NAWG is this year planning to organize a mock acquisition with NGA. During this day-long event, industry and government will gather and play out the various parts of an acquisition—from the establishment of an RFP to the award of a contract, followed by a protest. A moderator will run the event, and all topics covered by the sub-working groups will be addressed.

"Rather than thinking of acquisition as a one-way street or as simply an exchange of products or services, we're trying to make it more of a two-way street," Geggus said.

While NGA is known for seeking industry feedback, Geggus described the group as a neutral zone for sharing such

"[The working group is] a safe environment of sharing in a really constructive way. Sometimes problems get solved just in talking between partners." —Michael Geggus, NGA's industry innovation advocate

insights and consolidating them to provide clear recommendations to the agency.

"It's a safe environment of sharing in a really constructive way," Geggus said. "Sometimes problems get solved just in talking between partners."

Geggus acknowledges it will take time for the group's recommendations to yield a new way of doing business but said its mission aligns with NGA Director Robert Cardillo's messages of communication, culture, and transparency.

Kwolek looks forward to the group promoting more openness within the Community.

"We want to create empathy on both sides," Kwolek said. "The goal is increasing transparency between government and industry." ■■



The NAWG will host meetings at the GEOINT 2016 Symposium. Visit geoint2016.com to learn more.

Global Aerial/Satellite Imagery & Value-Added Remote Sensing Solutions Extensive Foreign Mapping Datasets – Off-the-Shelf & Custom

LANDinfo

WORLDWIDE MAPPING LLC

IMAGE PROCESSING

DIGITAL ELEVATION MODELS

VECTOR FEATURE EXTRACTION

MONITORING & CHANGE DETECTION

SPECTRAL & OBJECT-BASED CLASSIFICATION

See Our Solutions @ GEOINT 2016, Booth #907

Roof, agriculture, building foot-print & roof material-type feature extraction of Colombo, Sri Lanka via automated Object Based Image Analysis in Trimble® eCognition. Map data was used to generate economic indicator statistics at the neighborhood level – contact us for a case study.

ARRIS DEFENCE & SPACE Image Partner • DigitalGlobe Distribution Partner
Authorized Vexcel Reseller • Authorized Intermap Distributor • USGIF Member
USGS Business Partner • Esri® Business Partner • Planet Labs/RapidEye Direct Distributor

tel +1.303.790.9730 • fax +1.303.790.9734

sales@landinfo.com • www.landinfo.com

6 *recall*

ALTHOUGH GPS IS THE GOLD STANDARD OF POSITIONING, NAVIGATION, AND TIMING, IT'S NOT WITHOUT WEAKNESSES. GEOINT OFFERS ALTERNATIVE SOLUTIONS.

BY MATT ALDERTON

A LocataLite transmitter antenna broadcasts over a vast area of the White Sands Missile Range in New Mexico.

culminating, GPS

anyone who reads the Sunday comics has probably chuckled at the antics of red-bearded, big-bellied Hägar the Horrible. Part Viking, part “everyman,” he spends his days pillaging and plundering, and his nights embroiled in quagmires that satirize both medieval and modern living. One time, for example, Hägar’s wife, Helga, chastises him for “eating like a barbarian,” then remembers that’s exactly what he is.

Thanks to caricatures like Hägar, it’s easy to stereotype Vikings as vulgar, brutish, and dim. However, Vikings were extremely astute — especially when it came to navigation. In a world without even compasses to guide them, Vikings traversed the Baltic Sea and Atlantic Ocean using nature as their only guide. By tracking the sun, moon, and stars, Vikings could determine whether they were traveling in the desired direction. And when the sky was overcast, they memorized landmarks and used migrating whales and birds as guides.

Although civilization's most trusted navigational aide remains the sky, humanity now trusts in satellites rather than the sun. In particular, the 30 satellites that constitute the United States Global Positioning System, otherwise known as GPS.

"GPS is a worldwide enabler that is depended on by billions of users," explained Col. Steve Whitney, director of the GPS Directorate within the Space and Missile Systems Center at U.S. Air Force Space Command, which manages and maintains the nation's GPS capabilities. "The constellation provides a minimum of four satellites in view from any given place on the surface of the Earth to deliver sub-meter positioning accuracy to military and civil users worldwide."

GPS provides more than positioning—it is essential for positioning, navigation, and timing, or PNT. Communities across the globe rely on PNT, according to Capt. Dana Goward (Ret.), the U.S. Coast Guard's former director of marine transportation systems. This speaks to PNT's remarkable influence, he said—but also to its increasing vulnerability, which stems from a reliance on GPS as the "be all, end all" of PNT systems.

"An extended GPS outage could quickly pose a near-existential threat for America," predicted Goward, who is also executive director and president of the

Resilient Navigation and Timing Foundation and a member of the National Positioning, Navigation, and Timing Advisory Board. "PNT is really, really important, and we should have as many sources of it as we need and can use."

Thanks to the GEOINT Revolution, which is making location awareness as pervasive as it is powerful, worldwide efforts are underway to provide exactly that: more and better sources of PNT that will work in tandem with GPS to preserve the capabilities on which humanity has come to rely.

OVERNIGHT CHANGE, DECADES IN THE MAKING

Like many other technologies that emerged from the Space Race, the world can thank the Cold War for GPS. When the Soviet Union launched Sputnik in 1957, American scientists discovered the radio signals transmitted by the world's first satellite grew stronger as it approached their receivers and weaker as it passed. The scientists theorized that one could determine the location of a receiver by measuring its distance from satellites overhead, which could be calculated based on the speed at which the signals arrived.

So was born the premise for GPS. Receivers such as the ones found in smartphones and vehicle navigation systems "listen" for signals from the nearest GPS satellites, each of which includes a

timestamp generated by an atomic clock on board the satellite and a celestial location uploaded by monitor stations tracking its position from the ground. Upon receiving the signals—signals from four different satellites are needed to deliver accurate positioning—receivers note the satellites' locations then calculate their relative distance from each by comparing the time at which the signals were sent and received. By plugging the distances into a basic geometric formula, receivers approximate their location on a map.

"Each GPS satellite is transmitting a time signal, and that's all it really is—a very precise, well synchronized time signal," Goward explained.

Although the concept of GPS seems simple, it took the U.S. military more than 30 years to develop it, starting in 1959, when the U.S. Navy built the first satellite navigation system to locate submarines, and culminating in 1995, when the first GPS constellation was declared fully operational.

"It's important to remember that GPS is a U.S. military program that was developed to provide positioning to units in theater," said Dr. John Janis, a senior systems engineer at Harris Corp., which supplies the navigation payload for all GPS satellites. "When [GPS] was first envisioned and developed, there was never any conception that it would



IT TOOK THE U.S. MILITARY MORE THAN

30

YEARS TO DEVELOP GPS

MOST GPS satellites on orbit have surpassed operational design life, and users are demanding more advanced capabilities. To sustain and modernize the constellation, the U.S. Air Force is developing the next generation satellite system, GPS III.

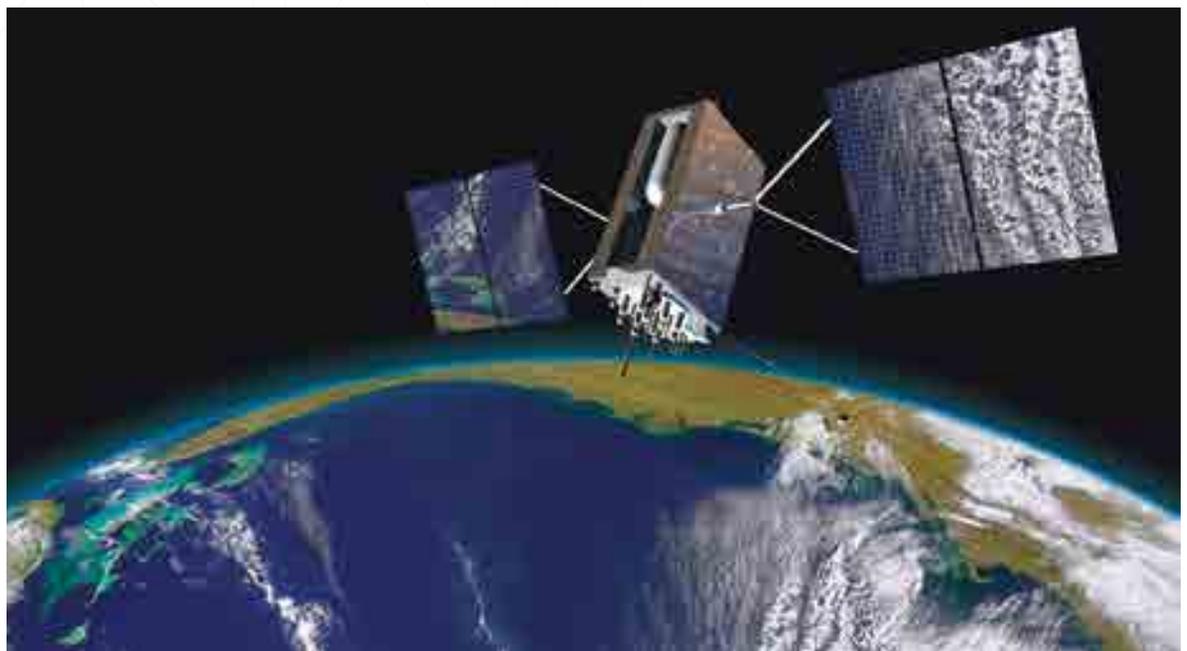


IMAGE COURTESY OF LOCKHEED MARTIN

With powerful multi-source analytics platforms and advanced algorithms, DigitalGlobe delivers the keys to empower you to unlock critical information at speed, and at scale.



SEE ANSWERS

Harness the power of DigitalGlobe's Geospatial Big Data platform to help you to understand your world as never before.

POSITION, NAVIGATION AND TIMING (PNT) MULTI-LEVEL RESILIENCY MODEL



ILLUSTRATION COURTESY OF RESILIENT NAVIGATION & TIMING FOUNDATION

THE NAVIGATION and timing services provided by GPS are silent utilities upon which almost all technologies depend. The Resilient Navigation & Timing (RNT) Foundation supports a multi-layered architecture, a resilient ecosystem, of multiple, complementary sources for navigation and timing that have different failure modes. This resilient ecosystem will ensure users always have access to these essential services and help protect critical infrastructure.

become as integrated into every facet of our lives as it is today.”

Presidents Ronald Reagan and Bill Clinton ensured that it did. When an errant airliner was shot down in Russian airspace in 1983, Reagan recognized the potential safety benefits for commercial aviation and issued an executive order allowing civilian use of GPS signals in advance of the system’s completion. The military degraded those signals for national security purposes until 2000, when Clinton ordered the Department of Defense (DoD) to end the practice known as “Selective Availability.”

“In plain English, we are unscrambling the GPS signal,” said Dr. Neal Lane,

Clinton’s science advisor, during the 2000 press conference. “It’s rare that someone can press a button and make something you own instantly more valuable, but that’s exactly what’s going to happen today. All the people who bought a GPS receiver for a boat or a car ... are going to find that they’re suddenly 10 times more accurate as of midnight tonight.”

UNREALIZED UBIQUITY

When the U.S. turned off Selective Availability, the commercial sector began exploiting the new, more accurate GPS signals to develop everything from in-car navigation systems to “assisted GPS” technology integrating GPS into cellphones.

“Now, GPS is everywhere. It’s a ubiquitous concept,” said Dr. Mark Petovello, a professor of geomatics engineering at the University of Calgary, where he studies PNT as a member of the university’s Position, Location, and Navigation (PLAN) research group. “It’s become a critical component of our society—especially with mobile phones, which in many respects are walking positioning engines.”

Petovello said his students illustrate the ubiquity of GPS. They use their cars’ navigation systems to find the fastest route to school and work, and to find the nearest Starbucks on their way to class. They use wearable devices to calculate the distance of their morning run. They use their laptops to track textbooks ordered from Amazon. And they use their smartphones to request rides home from parties or find eligible dates in the dormitory next door.

All of that leverages GPS for positioning and navigation. What neither college students nor the general public realize, however, is they also rely on GPS for exquisite timing.

“Timing happens largely without us knowing it, but it’s equally ubiquitous,” Petovello said.

Timing begins with the nation’s power grid, which leverages GPS timestamps on diagnostic data to prevent and resolve power outages using root cause analysis.

“GPS signals are used to synchronize power substations across the country to make sure the grid is functioning properly,” Janis explained. “Each of these power stations has specialized receivers that require accuracy on the order of milliseconds, which they get from ... GPS.”

Cellphone networks also depend on GPS to operate cell towers, which are synchronized using precision time signals so phones can find available frequencies on which to conduct their calls without interference or overlap. The same principle applies to computer networks, including the internet, which uses synchronized timestamps to regulate the flow of information from one computer to another. Meanwhile, the Federal Aviation Administration (FAA) uses GPS to synchronize hazardous weather reporting, seismic researchers

use it to monitor earthquake threats, and Hollywood studios employ it for the movie slates that help filmmakers synchronize on-screen audio and video.

Even the global financial system is powered by GPS.

“There are 250 million trades a second on the New York Stock Exchange,” Goward said. “How are they sure they’re buying and selling in the sequence in which orders are received? Well, all of that is time stamped using GPS.”

IMMINENT INTERFERENCE

It’s easy to imagine the consequences of a large-scale GPS failure. Unfortunately, the risk isn’t merely imagined.

“The potential threats to the GPS constellation are vast and very real, ranging from physical attack [to] cyber-attack and signal interference or jamming,” Whitney said.

Mother Nature is one of the most innocuous threats, but also one of the most probable. “In the last 10 years solar flares have caused several outages of GPS for 10 to 14 minutes,” said Goward, noting the most recent outage occurred in 2014 and caused some ships to lose their way. “That’s because during a solar flare the ionosphere is disturbed and GPS’s very faint signals were unable to get through... If there was a solar flare large enough, it could fry our satellites and most of our ground electronics.”

Collisions with manmade space debris or enemy attacks could also disable GPS satellites.

“The Chinese, North Koreans, and Russians all have the capability to launch weapons and interfere with satellites in space,” Goward continued. “Of course, they depend on GPS almost as much as we do, so they’d be cutting off their noses to spite their faces. But the Department of Defense thinks it’s a serious enough threat that it [plans to spend] \$5 billion over the next five years to protect our national security space assets.”

An attack on GPS satellites may never occur, but attacks on GPS signals aren’t uncommon. In 2011, for instance, Iran spoofed—or faked—GPS signals to redirect and capture an American surveillance UAV from Afghanistan. A year later, North Korea successfully jammed

GPS in South Korea, an attack strategy Russia is currently replicating in Ukraine.

“When a satellite is 12,000 miles away from a receiver and has limited power generation capabilities, as GPS does, it’s very easy to disrupt that signal,” Janis said.

Low signal strength makes GPS vulnerable for yet another reason—even when satellites and signals go unharmed, the system often cannot function in indoor, urban, or other environments

that lack “line of sight” access to multiple satellites.

“The amount of power you get from a GPS satellite is roughly equivalent to the amount of light one of your eyes gets from a 100-watt light bulb about 1,500 kilometers away,” Petovello said. “That amount of power is very small, yet you’re trying to do quite a lot with it. As soon as you go into an urban canyon, underneath a tree, or inside a building, that power drops by another factor of 10, 100, 1,000, or more.”

GPS: BROUGHT TO YOU BY GEOINT

Since its inception in 1963, GPS has been an asset of the U.S. Air Force, which manages and maintains the nation’s GPS constellation from the Space and Missile Systems Center (SMC) at Los Angeles Air Force Base in El Segundo, Calif. GPS would not function, however, without GEOINT or the National Geospatial-Intelligence Agency (NGA).

“NGA does not design positioning and navigation systems, but we provide the geospatial data that allows them to work,” explained NGA Senior Scientist for Geodesy and Geophysics Stephen Malys.

According to Malys, NGA traces its PNT roots to the mid ’80s, when its predecessor, the Defense Mapping Agency, created World Geodetic System 1984 (WGS84), the standard Earth coordinate system that remains the foundational reference

system on which GPS operates.

Some 30 years later, NGA remains a pivotal GPS actor.

“One of the most dramatic ways [NGA contributes] is by operating a global network of [terrestrial] monitoring stations that track GPS data 24 hours a day, seven days a week,” continued Malys, who said monitor stations record where in the sky GPS satellites are and at what speed they’re traveling while also facilitating synchronization of onboard atomic clocks—all of which are fundamental to the operation of GPS.

The U.S. has 17 GPS monitoring stations around the globe, 11 of which are operated by NGA and six of which are operated by the Air Force.

“Up until 2005, the Air Force had its own small network of five monitor stations,” Malys

explained. “With such a small network, there were a few gaps in coverage—a few hours on any given day when a satellite would not be in view of a ground station. We filled in those holes with our stations and made it possible for ground stations to more fully monitor what’s going on with all our satellites at any given time.”

More monitoring has led to improved accuracy, which bolsters NGA in its other role: that of a GPS consumer.

“We directly contribute to the GPS operation, but we’re also a beneficiary of it,” concluded Malys, who said military and commercial platforms collecting GEOINT typically rely on GPS for positioning. “GPS is the starting point for all geospatial data in the community... We wouldn’t have geospatial data at a global basis today without it.”

PNT PINCH HITTERS

These gaps and vulnerabilities leave little doubt that the world needs more than one PNT system.

“It’s important to have GPS backups,” attested Petovello, who said efforts to augment GPS generally fall into one of two camps. “The first camp is looking at complete backups to the system in case GPS were to completely fail ... The other camp is looking at systems that complement GPS in places where it doesn’t work very reliably.”

President George W. Bush led the first camp’s charge in 2004 when he established the National Space-Based PNT Executive Committee (EXCOM) to oversee creation of a GPS backup. Led by the U.S. Departments of Transportation (DoT) and Homeland Security (DHS), the interagency committee in 2008 recommended the U.S. designate as its official “Plan B” a long-range marine navigation system known as eLoran.

The U.S. has been leveraging Loran technology—which uses land-based beacons to emit low-frequency radio signals to receivers for the purpose of positioning—since 1945, when the Navy deployed a Loran system to assist with marine navigation. The system’s first iteration, Loran-A, included 72 Loran stations and as many as 75,000 receivers. Engineers continued to improve the technology to make it more effective, accurate, and affordable. The most successful version, Loran-C, was operational in the U.S. from 1957 until 2009, when the Obama Administration declared Loran technology obsolete and instructed the Coast Guard to dismantle the country’s network of 24 Loran-C stations, which it did in 2011.

“Loran provides similar services to, but is very different in its physical characteristics from GPS,” explained Goward, who noted that nine other nations still operate Loran systems, including Russia and China. “While GPS is in space, Loran is tower-based on Earth. While GPS has a very weak signal, Loran has a very powerful signal. While GPS transmits at a very high frequency, Loran transmits at a very low frequency.”

Although Loran is still considered inferior to GPS for most applications, the eLoran system proposed by EXCOM—the

“e” stands for “enhanced”—represents an improvement over Loran-C in several respects, according to Goward. For one, eLoran offers improved accuracy, availability, and stability for positioning. Secondly, it provides the same synchronized precision-timing capabilities as GPS; the system proposed by EXCOM would deliver GPS-like timing signals to receivers from 19 towers across the country, each with a range of approximately 1,000 miles and the ability to penetrate indoors, underground, and even underwater.

Although DoT and DHS said as recently as December 2015 that EXCOM remains committed to building an eLoran system, Nunzio Gambale doesn’t believe that’s the answer. Even the “enhanced” version is too expensive, too

cumbersome, and not accurate enough, he said. Instead, his company, Australia-based Locata, has created a radio location system that mimics GPS on the ground. Rather than a space-based network of satellites, the system employs a terrestrial network of VHS-sized transceivers known as “LocataLites,” which emit signals with centimeter-level location accuracy.

“GPS is a synchronous network of transmitters ... our devices mesh to become a synchronous network of transmitters,” explained Gambale, Locata’s co-founder. “Functionally, they provide the same capability.”

To maintain synchronous timing, GPS satellites rely on atomic clocks that synch with a master clock on the ground as they orbit overhead. Such clocks aren’t just sophisticated—they’re



PHOTO COURTESY OF NSRDEC

A GPS-GUIDED Joint Precision Air Drop System (JPADS) 2K parachute flies to its ground target. The U.S. Army is testing visually-aided navigation systems for JPADS use in GPS-denied environments such as canyons and cities.



GO WITH HIGH CONFIDENCE.

HIGHER RESOLUTION.

Ball Aerospace enables the most precise, high-resolution data-gathering capabilities available today. We ensure a clear view of Earth—and clear advantages in exploration, defense, navigation and mapping—so customers can always **Go Beyond.™**

   [BALL.COM/GOBEYOND](https://www.ball.com/gobeyond)

VISIT US AT THE GEOINT SYMPOSIUM EXHIBIT BOOTH 1401

“Now, GPS is everywhere. It’s a ubiquitous concept. It’s become a critical component of our society—especially with mobile phones, which in many respects are walking positioning engines.”

— Dr. Mark Petovello, professor of geomatics engineering at the University of Calgary

expensive. To mimic GPS timing capability, LocataLites are outfitted with timing chips that synchronize with each other rather than an external time source. The result is a continuous feedback loop wherein each transceiver adjusts its outgoing signals to reflect the timing of its incoming signals. Although they’re not as precise as GPS, the signals are equally synchronous and infinitely more affordable, which makes them ideal for backing up or complementing GPS at a local or regional level.

“Locata gives you everything about GPS except the ‘G,’” explained Gambale, who likens GPS to Swiss cheese—Locata, he said, fills the holes. At Australia’s Boddington Gold Mine, for example, LocataLites provide positioning in deep pits and against high walls where GPS signals are blocked. “Locata is to GPS what

Wi-Fi is to the cellphone system. It’s what you would invent if you wanted to have GPS for a business instead of GPS with a global military imperative.”

Eventually, Gambale envisions a nationwide infrastructure of LocataLites.

“There are 1.8 million cellphone towers in America alone,” he mused. “If you put a LocataLite on every one of those cellphone towers ... you’d have a backup to GPS.”

Another GPS backup concept uses localized sensors such as video. Draper Laboratory is betting on vision-aided navigation software called Lost Robot. Building on prior work in image-based absolute localization (IBAL), Lost Robot is being tested by the U.S. Army’s Natick Soldier Research, Development, and Engineering Center (NSRDEC) for potential inclusion in the Army’s Joint Precision Airdrop System (JPADS).

“IBAL uses a camera to correlate objects seen by the camera against pre-loaded images. By correlating what the camera sees with what was expected to be seen, and taking advantage of some ancillary sensors, an absolute navigation reference is produced,” explained

Chris Bessette, Draper’s JPADS program manager. “Using very coarse initial navigation knowledge, along with observed and stored imagery, Lost Robot can determine its absolute position.”

Lost Robot won’t work on featureless terrain, like water or snow, but elsewhere the camera can register landmarks such as trees, rocks, and pavement, then surmise its positioning and navigation by comparing live visuals to pre-loaded maps and imagery.

It’s a needed capability for a program such as JPADS, which uses GPS and steerable parachutes to airdrop equipment and supplies to soldiers in remote, adverse terrain where GPS is often jammed or inoperative.

“GPS is our primary navigation system, but we need redundancy to be able to handle certain environments that GPS may not be particularly well-suited for,” said Gary Thibault, cargo air delivery team leader for product manager force sustainment systems at NSRDEC. “Vision-aided navigation is intriguing because it’s something we as humans use every day.”

SATELLITES’ STAYING POWER

Along with vision-aided navigation, scientists are exploring inertial navigation systems that use motion sensors to determine positioning and orientation relative to a known starting point, as well as quantum compasses that could one day determine location by comparing the effects of gravity on cooled atoms with a gravitational map of the Earth. However, experts agree the most reliable PNT system remains a global navigation satellite system (GNSS) such as GPS.

“I don’t see GNSS going away anytime soon,” Petovello said. “There are other technologies out there—vision, inertial, and so on—that are quite good and maturing all the time, but ... they provide relative instead of absolute position. For that reason, a GNSS component is still going to be very important.”

Therefore, as policymakers and scientists debate the merits of eLoran, LocataLites, and vision-aided navigation, the U.S. Air Force is doubling down on GPS with a new constellation of GPS satellites known as GPS III, the first three of which are scheduled for launch in 2018.

“GPS is the world’s global utility and our systems are the ‘gold standard’ for positioning, navigation, and timing services reaching over 4 billion users worldwide,” Whitney said. “The Air Force is actively engaged in a modernization effort to provide better, more secure capability.”

GPS III satellites will be more powerful, more secure, and have a longer life than previous iterations. According to Lockheed Martin, which is building the first eight GPS III satellites, the systems will transmit signals three times more accurate than current capabilities, provide military users up to eight times more effective anti-jamming capabilities, and have a 25 percent longer lifespan.

GPS III satellites will also host a new civil signal that will make them interoperable with international GNSS, which are poised to play a growing role in the PNT ecosystem.

“In the next decade, you’ll see a proliferation of many different constellations, whereas until now it’s really only been GPS that’s been available,” Janis said.

International constellations include Russia’s Global Orbiting Navigation Satellite System (GLONASS), which was fully restored in 2011 following years of neglect; India’s Indian Regional Navigation Satellite System (IRNSS), which completed its seven-satellite constellation in March; Europe’s Galileo, which will begin offering initial services this year; China’s BeiDou Navigation Satellite System, which is partially operational now and along with Galileo will be fully operational in 2020; and Japan’s Quasi Zenith Satellite System (QZSS), which will be fully operational in 2018.

“GPS is a military system; governments in different countries want their own systems because they don’t want the United States to have the power to shut off their navigation signals,” Janis continued. “But there are advantages for the user, too.”

Those advantages are apparent in commitments by the National Geospatial-Intelligence Agency (NGA), the Air Force, and others to support development of a universal GNSS receiver.

“There is an international effort to become interoperable with [other] systems,” explained NGA Senior Scientist for Geodesy and Geophysics Stephen Malys. “It is another way to mitigate some of the concerns about vulnerability. Because if you have a GNSS receiver—as opposed to just a GPS receiver—that is receiving signals from all those systems, you’re somewhat protected ... If one system goes down, you still may have usable signals from the other systems.”

Redundancy isn’t the only benefit of international systems.

“As you add more satellites, you increase the availability of signals when you start going into places like urban canyons,” Petovello said. “More importantly, your ability to compute a solution more accurately also improves.”

A PNT-POWERED FUTURE

Near-term efforts to update GPS with new satellites and augment it with alternative constellations will go a long way toward preserving capabilities

and addressing vulnerabilities. To fully secure a PNT-powered future, however, long-term challenges must be addressed.

The first step is naming a federal executive agent in charge of PNT, according to Gowan, pointing to a bill introduced by Congress last year—the National Positioning, Navigation, and Timing Resilience and Security Act of 2015—nominating DoD as that agent.

“Everybody agrees we need a complementary and backup system to GPS as part of the nation’s PNT architecture, but it’s nobody’s job to get it done,” Gowan said. “The senior leadership needs to recognize the problem and put one department in charge to lead the effort with other agencies and departments helping.”

More fundamentally, the nation needs a new PNT workforce, according to Malys.

“In our community at large, GPS is taken for granted,” Malys said. “People assume it’s always going to be there. We do not have thousands of people here at

NGA who work directly with GPS. We have a small cadre of people who are working with it closely, and not enough in my opinion.”

Malys added, NGA is trying to raise PNT awareness with efforts such as “Time and Navigation,” a PNT exhibit the agency introduced in 2013 at the Smithsonian Institution’s National Air and Space Museum. “We’re trying to motivate young people to develop an interest in PNT.”

Malys remains confident the nation will solve its PNT problems, but traditional navigation artforms must not be forgotten: In 2015, the U.S. Naval Academy announced it was going the way of the Vikings by reinstating celestial navigation classes after axing them from its curriculum more than 15 years ago.

“It is a core competency of a mariner,” U.S. Naval Academy Director of Professional Development Cmdr. Adan Cruz said in the Navy’s announcement. “If we can navigate using celestial navigation, then we can always safely get from point A to point B.” ■

Adaptable, Independent Solutions from a Trusted GEOINT Broker

RIVERSIDE RESEARCH

Riverside Research is developing a cloud-based solution to broker affordable, actionable, and timely imagery products from existing and emerging commercial, civil, national, and foreign data providers. Our proven expertise and not-for-profit status enables us to be a trusted GEOINT broker for US government agencies at all levels, allowing them to stay focused on their vital civil and national missions.

Visit us at GEOINT Booth 1309

www.riversideresearch.org



TRAJECTORY MANAGING EDITOR KRISTIN QUINN RECENTLY MET WITH TWO INTELLIGENCE COMMUNITY LEADERS TO GET THEIR THOUGHTS ON TECHNOLOGICAL TRENDS, THE FUTURE OF THE IC, THE GEOINT REVOLUTION, AND MORE.

Q&A *series*



prepare for profound *change*



PHOTOS BY DIA PUBLIC AFFAIRS

CATHERINE JOHNSTON AND HER TEAM AT DIA ARE BUILDING THE DEFENSE INTELLIGENCE ENTERPRISE OF THE FUTURE.

Cathy Johnston is the Defense Intelligence Agency's (DIA) director of digital transformation and operationalizing IC ITE as well as co-chair of the IC ITE Mission User Group. Prior to this position, Johnston was appointed DIA director for analysis in October 2012, during which time she led DIA's all-source analytic effort. From January 2011 to September 2012, Johnston served as National Intelligence Manager—East Asia with the Office of the Director of National Intelligence (ODNI), where she led the Intelligence Community's efforts on East Asia. Prior to assuming her position at ODNI, Johnston was Asia mission manager in the Directorate for Science and Technology (DS&T) at the CIA. >>

Johnston met with *trajectory* in February to discuss intelligence integration, what lies ahead for the Intelligence Community, how the GEOINT discipline is leading the way with its embrace of open-source information, and much more.

HOW DID YOU GET YOUR START IN THE IC?

I had the huge benefit in grad school of working for Ken Lieberthal and Mike Oksenberg, who were both National Security Council advisers. During the summer, as grad school was wrapping up, they made a number of calls and introduced me to a variety of intelligence communities. I had spent my time in grad school studying the Chinese military and this was back in the day when absolutely nobody cared about the Chinese military. It was a very different environment. When I started applying to IC jobs, because my focus was on the military, there was a lot of interest in DIA in my field. I applied and got into DIA first. I started in April 1990. My whole point was to do Chinese military analysis. I thought I was going to do Chinese leadership and I ended up

So it gave me experience in a variety of collection disciplines, into the business of doing intelligence and IC-wide intelligence integration. That really gives you a very different color when you come back and look at the analytic business and the operations and how we should be changing it.

WHAT DOES YOUR NEW ROLE AS DIRECTOR OF DIGITAL TRANSFORMATION AND OPERATIONALIZING IC ITE MEAN TO YOU? WHAT ARE YOUR MAIN OBJECTIVES FOR THE FUTURE OF DIA?

Let's start with the digital transformation part. It is all about helping DIA adapt to the 21st century information environment and the 21st century environment writ large. There are a huge amount of changes that have happened in the last 15 years in the commercial world and industry. In the outside world, all of us are living in a very different way than we did 15 years ago when we sent information by fax machines. A lot of government, and particularly the IC, missed out on much of that revolution. Since we have not adapted to it to date,

benefit of IC ITE is that it will remove legacy stovepipes by putting the IC into a single platform. That has profound implications for the IT world, but those implications frankly pale in comparison to how it will enable mission. It will tear down the barriers that prevent the kind of integration we all want to achieve. It will be an evolution to get there. It's not like we're going to turn on a switch and have a completely reinvented world.

The way we look at data is closely tied to IC ITE. We need to look at data and treat it as a national asset—at a minimum as an agency asset, as an IC asset. That's a really major culture change. Yes, there are technical implications. But it has much more to do with the way we handle data sharing policies and the way we cooperate and collaborate with each other.

Open-source information is another aspect of digital transformation. The amount of data that is publicly available rivals our classified holdings. Commercial imagery is a really good beta case for this where you see how much information is available and how much you can do using commercial imagery. It causes you to rethink our culture, what we've valued in the past, our tradecraft, how we characterize different standards—all of that. Open source is going to change even more dramatically in the next five to 10 years.

We're also looking at over-the-horizon, disruptive events. The Internet of Things, the move to mobility in the commercial sector. We do not have a particularly mobile framework and the fact that industry innovation is moving to mobile first will present a challenge to us and we will need to rethink some of our assumptions. We're also identifying new trends in biotechnology and identity intelligence and detection. All of these things present great opportunities but also great challenges to us.

WHAT'S YOUR DAY-TO-DAY LIKE?

About 30 to 40 percent of my day is reading mostly unclassified papers from industry and some from academia on new, disruptive trends. So block chain technology, just a wide variety of things. Many of them have a technical underpinning, but all of them are about changing business models. Some of

“The benefit of IC ITE is that it will remove legacy stovepipes by putting the IC into a single platform.”

—Cathy Johnston, DIA's director of digital transformation and operationalizing IC ITE

doing ground order of battle. And while I was in baby analyst training class, Desert Shield happened. Saddam Hussein invaded Kuwait. And I ended up doing Iraq chemical biological warfare, nuclear missiles, absolutely everything I knew nothing about, and so that started my intelligence career.

HOW DOES IT FEEL TO BE BACK AT DIA FOLLOWING YOUR POSITIONS WITH CIA AND ODNI?

It's awesome. Part of having my time away was also time away from analysis.

we are now faced with challenges that require us to rethink a number of our assumptions, operating models, business processes, and tradecraft. The most immediate thing impacting the IC right now in that sphere is the Intelligence Community Information Technology Enterprise (IC ITE). While all of these things have a technical dimension they're really not about the technology. It's digital transformation, but digital with a really tiny D. It's really about operating model adaptation and changing the way we do business and interact. The

BUILD YOUR MARKET SHARE



with **trajectory**

Reach 13,000 industry professionals, including highly qualified buyers and key decision makers

USGIF offers a wide variety of print and online advertising opportunities within *trajectory* magazine, *trajectory* eNewsletter and trajectorymagazine.com. Research has proven that an integrated media buy provides advertisers with the best return on investment as compared to traditional marketing programs. To create a customized marketing plan with USGIF, please contact:

Erik Henson
Media Director
Naylor Association Solutions
(352) 333-3443
ehenson@naylor.com

trajectory
quarterly magazine
.....
trajectory
monthly eNewsletter
.....
trajectorymagazine.com
website





CATHY JOHNSTON meets with an Army analyst assigned to DIA, March 2015.

them are new industry concepts on how to have effective, agile, organized teams. Some of them have nothing to do with technology; they're all about how to get things done. I also read *Wired* and *Fast Company* religiously.

I spend another major chunk of my time dealing with what I call “ants.” Things that seem very little but are massive irritants and prevent forward progress for some of our pilots. Things like data-sharing policies. In most cases, it's not the policy, it's an interpretation of how the policy is being implemented—so really breaking through the “no barrier” when you're trying to do something new and innovative. If it hasn't been done before, it's easy to find a voice that will prevent you from making forward progress; but in almost all cases, those voices are doing a standard interpretation of the way we've always done things and there's usually a reasonable workaround.

In this new environment, we're looking for unprecedented agility in the way government responds, and this requires that all of our enabling capabilities likewise have unprecedented agility, including our acquisition systems. So I dig into what those options are, learn from a lot of the civil agencies such as

the Department of Health and Human Services that have been able to figure out agile acquisition, and try to make sure we can learn from their experiences and build a similar system. Things like that are not sexy, they are not a lot of fun, but they are totally necessary to build an environment that allows for the kind of innovation we need.

WHAT'S YOUR TEAM LIKE?

I have a broad team made up of all parts of the agency. We also have service representation and people who have experience with the combatant commands. The core of the team is heavily represented by mission, and we have some high-powered representation from the CIO—in large part because there's a heavy technical play, but the technology is the easiest part. The implications for operations and technology collection tradecraft are pretty amazing when you look at some of the innovations happening in the commercial world. We have a number of analysts who are on the team, some of whom have experience in the cyber dimension, in future analysis on where the threats are going to be. We have acquisition specialists. We've said to them, “We at DIA are good

at predicting what the world and the adversary is going to look like in the future. We need you to look at how DIA will need to operate in the future.”

WHAT IS THE ROLE AND SIGNIFICANCE OF GEOSPATIAL INTELLIGENCE TO THE DIA MISSION?

As an all-source agency, GEOINT is a component of every single problem we look at. As a warfighting agency, GEOINT has a special place in the DoD warfighting requirement set. Probably the tightest partnership that we had when I was director of analysis was with my counterparts at NGA—NGA and NSA—but especially my counterparts at NGA because so much of what we do is to meet the foundational intelligence requires that both NGA and DIA have. When you look at the digital transformation space, the poster child for the intelligence discipline that is changing the most dramatically, in my opinion, is imagery. The advent of commercial imagery, the advent of data analytics tied to those data layers, the rethinking of data, the way NGOs are rethinking data layers and combining them with geospatial analysis is just a prototype. It's at the vanguard of where all the rest of us are going to be.

WOULD YOU SAY DIA IS WATCHING NGA FOR LESSONS LEARNED?

My belief is within five to 10 years the majority of the information we're going to be processing will be open source just because of the explosion in that sphere. NGA is seeing it first because of what is available and open in commercial imagery. We are starting to see it, but we're all investing in trying to understand those big data analytic methodologies, trying to understand the implications for our tradecraft—things like how to assess reliability for some of these new data sources. They're just too new. We don't understand them well enough yet to be able to apply standard tradecraft to them. It is a huge field of exploration for all of us, and NGA and the GEOINT sphere is at the forefront of redefining that.

WHAT ARE SOME OF THE GREATEST CHALLENGES FACING THE DEFENSE INTELLIGENCE COMMUNITY? HOW CAN INDUSTRY HELP TAKE THEM ON?

The lack of adequate experience across the disciplines leads to a lack of creativity and inventiveness in thinking about

what our business process should be in five years. For example, today we have inventive analysts who can improve upon the business processes they know using the tools they know. But in the architecture of the future, where we have a common IC platform, each of us bringing our existing production processes to that common platform will sub-optimize an integrated response. Because we don't have enough familiarity with each other's work processes, because we are still very discipline- and agency-specific, it's hard to develop what we know we need to achieve in five years. It is helpful that the IC has joint-duty assignments where we seed people throughout other agencies to start to learn those processes, but we haven't been doing it for long enough.

Generally, if you started off at NGA, you are an imagery analyst and you have stayed an imagery analyst for most of your career. It is a rare analyst who will go from being an imagery analyst to a SIGINT analyst, for example. We don't have many officers that can understand the production systems within the stovepipes

When you look at the digital transformation space, the poster child for the intelligence discipline that is changing the most dramatically, in my opinion, is imagery.

Map Out Your Future

USC Dornsife
Spatial Sciences Institute



Advance Your Career with Online Graduate Programs in Geospatial Intelligence

Students in USC's online geographic information science and technology (GIST) programs, including the **Graduate Certificate in Geospatial Intelligence** and **M.S. in GIST**, develop career readiness to work in areas such as human security, disaster management, international relief, and many other fields.

Recognized worldwide for its academic programs and actionable research, the USC Spatial Sciences Institute is an innovator in online GIST education.



The USC Spatial Sciences Institute is a member of the United States Geospatial Intelligence Foundation (USGIF), which has accredited the USC Graduate Certificate in Geospatial Intelligence.



The National Geospatial-Intelligence Agency and United States Geological Survey have designated the USC Spatial Sciences Institute as a Center of Academic Excellence in Geospatial Sciences.

Visit us at GEOINT in Booth 111 or contact us:



888-907-5029



gis.usc.edu

The *wonderful* thing about the IC is there are so many different kinds of jobs. There are so many opportunities. You should never be bored.

CATHY JOHNSTON presents a Defense Counter-Proliferation (DCP) Outstanding Role Model award to a DCP employee for exemplary representation of the DCP code of professional conduct in July 2015.



such that they can imagine what a truly integrated system would look like. And that's what we need to be building. Right now. We need to imagine what that world needs to look like, but because of the lack of exposure, there are few people who can imagine it. That's what we need a lot more ideation on. We'll get better as we get more exposure and start doing more real-time collaboration as opposed to working a project first in the GEOINT discipline then sending it to the SIGINT guys to iterate on. With real-time collaboration, I think imagineering will happen and that creativity will be there.

Stovepipes remain our most consistent challenge. Many people say our fiscal environment is, but I actually think that's not so much a challenge as a benefit. It is a challenge in the near term, no question. But because we're all feeling the pinch, it's causing us to look to each other to collaborate.

WHAT HAS BEEN YOUR FAVORITE JOB? WHY?

I have had so many great jobs. It's hard to pick. So I'd go with the job that was the most different, the one that took me farthest from my comfort zone. The farthest out of my comfort zone was working at DS&T which took me from being an analyst where I had spent my entire career doing analysis on Asia mostly and all of a sudden getting exposed to every conceivable collection discipline and understanding what all of the other agencies could bring to bear and what their limitations were. The learning curve was immense. When I look back on the job that probably influenced me the most, it would be that one. And it also set me up in great stead to then go work at ODNI and then come back to DIA with a very different perspective of defense analysis.

WHAT ADVICE WOULD YOU GIVE TO YOUNG INTELLIGENCE PROFESSIONALS? IS THERE ANY PARTICULAR ADVICE YOU WOULD GIVE TO YOUNG WOMEN ENTERING THE WORKFORCE?

I would advise young professionals to take risks, to take on new challenges, and to constantly be learning and growing. If they are in a position where they are not learning and growing, it's time to look around. The wonderful thing about the IC is there are so many different kinds of jobs. There are so many opportunities. You should never be bored.

I have a multiple part answer for women. Women especially should take risks because women have a tendency not to take risks. I have a "4-A" strategy for women: ask, act, advocate, and apply. Women don't ask for challenges, they wait to be identified, to be tapped on the shoulder. It's called "head down, pencil up syndrome." You need to ask to go, ask for the challenges, seek them out. Act. If you wait to be told something, you will miss your opportunity. Take the initiative and act. Make a decision, do something.

Advocate for yourself. Again, women are not terribly good about advocating for themselves and have a tendency to undervalue what they have accomplished and what they are capable of. I have made a habit of calling both men and women when I have a senior position available and asked officers of all sorts to apply. In 100 percent of the cases, I called a woman and asked her to apply for a stretch assignment she said, "I would never have presumed to think that I was qualified for this job." And I'd say, "Well, I wouldn't have called you if I didn't think you were qualified for the job and I don't expect that anybody will be perfect at a position the day that they take it." If there are 10 requirements, women have a tendency to want to see themselves as qualified in all 10 of those areas, and men will apply if they see themselves as qualified for one in 10—and these are all generalities. So women need to put themselves out there more and they need to understand they are capable of so much more than they give themselves credit for.

DESCRIBE WHERE YOU SEE THE INTELLIGENCE COMMUNITY IN FIVE YEARS. WHAT TRENDS EMERGING TODAY WILL HELP MAKE THIS FUTURE A REALITY?

Five years from now, I think we will be so much more integrated—that a number of the impediments that prevent us from having seamless collaboration across the agencies and the disciplines will have evaporated. The majority of our work processes will be informed by big data analytics that will allow us to process far more information than we can even imagine processing today when things are still mostly manually curated. We will be achieving what is today unimaginable effectiveness in terms of mission delivery. We will have a more customizable delivery mechanism for our knowledge. Our customers will be able to extract content the way they want it in a timeframe that is much faster than they are currently able to gain it. And probably most importantly, we will be operating with much more open-source information than we've ever operated with. Open-source data and insights from industry, academia, and the open world will become the bread and butter. So that entire relationship between the IC and industry and academia will start to change. ■■

THE GEOINT REVOLUTION HAS ARRIVED

SEE WHAT'S NEXT FOR GEOSPATIAL SOLUTIONS



Stop by booth #1402 at GEOINT to learn more about our investment in the future of geospatial intelligence.

textronsystems.com/geospatial
geosales@textronsystems.com
(800) 937-6881



TEXTRON Systems

INGENUITY ACCELERATED

Textron Systems Geospatial Solutions is a business of Textron Systems.
All trademarks mentioned herein belong to Overwatch Systems, Ltd.
© 2016 Overwatch Systems, Ltd. All rights reserved.

“not on *my watch*”

Stephanie O’Sullivan became Principal Deputy Director of National Intelligence (PDDNI) in February 2011. As PDDNI, she focuses on the operations of the Office of the Director of National Intelligence (ODNI) and manages Intelligence Community (IC) coordination and information sharing.

Before this assignment, O’Sullivan served as the associate deputy director of the CIA since December 2009. Prior to becoming associate deputy director of the CIA, O’Sullivan for four years led the CIA’s Directorate of Science and Technology (DS&T), which is responsible for developing and deploying innovative technology in support of intelligence collection and analysis.

Earlier in her career, O’Sullivan held various management positions with DS&T, where her responsibilities included systems acquisition and research and development in fields ranging from power sources to biotechnology. O’Sullivan joined CIA in 1995 after working for the Office of Naval Intelligence. She met with *trajectory* in March to discuss the foundational nature of GEOINT, the President’s Daily Brief, new technology, and much more.

HOW DID YOU GET YOUR START IN THE IC?

Sort of serendipity, a little bit of luck. I had just graduated from engineering school and I answered an ad for an ocean engineer. It turned out that it was a large company. I didn’t know it at the time, but they were doing business for the Intelligence Community. The ad was really vaguely worded. It asked for an ocean engineer, I was an engineer. I lived on a boat at the time, so I figured I was qualified. I applied and found out it was really the IC, and I never looked back.

YOU LIVED ON A BOAT?

I did. When my parents moved up here we’d always taken sailing vacations. They’d done their final move to live on a sailboat.

BASED ON YOUR SERENDIPITOUS PATH, WHAT ADVICE WOULD YOU GIVE TO YOUNG INTELLIGENCE PROFESSIONALS?

Well, you have to get up every day and like what you’re doing, so seek work that’s interesting, challenging, and motivates you.

ODNI’S STEPHANIE O’SULLIVAN DISCUSSES INTELLIGENCE COMMUNITY CHALLENGES AND OPPORTUNITIES

Look for people that you want to work with and you respect. I found both in my 35 years in the Intelligence Community.

IS THERE ANY PARTICULAR ADVICE YOU WOULD GIVE YOUNG WOMEN ENTERING THE IC?

Recognize that being different is a strength. In the IC in particular, we can’t afford to repeat patterns or fall into just doing the status quo and hitting repeat, so the people who bring different viewpoints or experiences are particularly valuable. It’s why diversity of viewpoints and avoiding groupthink are really important. I often find myself being in a room—big tables these days—and I’m thinking, “I don’t think like everybody else here.” But that’s a strength.

WHAT ARE YOUR ROLES AND RESPONSIBILITIES AS PDDNI? HOW WOULD YOU DESCRIBE YOUR DAY-TO-DAY TASKS?

My No. 1 job is delivering on DNI Clapper’s objectives, which is basically summed up in one word: integration. Integrating the Community, integrating our capabilities. The way he puts



STEPHANIE O'SULLIVAN in December 2015 visited Columbia Heights Educational Campus, a multicultural, multilingual public middle and high school located in downtown Washington, D.C.



that into practice is largely by investing in the men and women of the IC. That's his motivating drive, so that drives what I do. My day-to-day job is unpredictable. It could be everything from administrative trivia—our parking garage, for example, is one of the main features of working here. We're always told on our climate surveys employees say they love working here, and when you peel into it, they love the parking. So it could be administrative trivia all the way to the incredibly profound. And you just don't know when you walk in every morning what it's going to be next. But if I'm lucky, my usual day starts with the President's Daily Brief (PDB). It's one of the privileges of my job and one of the most rewarding things I do every day because it is, in essence, the boiled down product of the entire Intelligence Community. You're seeing everything that everyone throughout the Community is striving to put together. It's the end results of what they do.

HOW DOES INVESTING IN THE MEN AND WOMEN OF THE IC HELP MEET THE GOAL OF INTEGRATION?

One of the primary signature initiatives we've had going since the stand-up of ODNI has been joint duty assignments. It's about getting the full capabilities of the IC instead of a bunch of, to use the old word, stovepipes. DNI Clapper is trying to demonstrate that we are so much more together than we are as separate pieces. It's a standard statement, but it's true. And I think it's our secret advantage for the IC in the United States—the ability to know what we know and work together.

WHAT ARE YOUR THOUGHTS ON THE FUTURE OF GEOINT?

The golden age of GEOINT is in front of us, not behind us. I know it's a well-established fact that GEOINT is foundational, is the starting point for much of what we do in the Community.

Even when I worked at CIA, we'd be talking about some operation and the first thing you'd see come out is imagery. There's a lot more that we could get out of GEOINT than we are today. There are new sources, new analytic techniques, new kinds of capabilities that we can put in orbit, and we can better leverage that which we already have. For instance, training our overhead architecture as an architecture instead of a bunch of single-point satellites.

BEING THAT GEOINT IS FOUNDATIONAL, HOW DOES THE DISCIPLINE HELP FACILITATE INTEGRATION?

GEOINT is probably the most common capability across military, the IC, and the U.S. government. You think of things like FEMA after a disaster. It's almost the common denominator that all of us, despite all of our different missions, use and turn to more than any other capability. GEOINT is like the common lingua franca across the IC.

WHAT WOULD YOU CONSIDER THREE OF THE GREATEST CHALLENGES THE IC CURRENTLY FACES?

Well, I was in the Community on 9/11, so not on my watch, I don't want to see that happen again. The pervasive instability you see around the world. Dealing with the huge scope of change and turmoil in the Middle East. Changes that Russia's driving and where Europe is going. And big data analytics, both as a threat and an opportunity.

HOW IS BIG DATA ANALYTICS A THREAT AS WELL AS AN OPPORTUNITY?

It's all about finding patterns in massive amounts of data. We have to worry about things like cover. For our operations, the same techniques could be used against our activities.

WHAT ABOUT THESE CHALLENGES KEEPS YOU AWAKE AT NIGHT?

I spend too much time awake at night, I actually have this formula—about 80 percent of the time it's worrying about something I might have missed. Whether it's a factor I didn't think of, or an opportunity I've overlooked. That's why I value people who think differently. I know what I think. I want to hear from someone who comes from a different

perspective that might help me not miss something key. The other 20 percent is worrying that I got something wrong. The business of intelligence is ambiguity, so you're always trying to discern insight from scattered pieces of data. You're always worrying you missed a key piece or you assembled the pieces you had into the wrong picture.

USGIF SITS AT THE INTERSECTION OF GOVERNMENT, ACADEMIA, AND INDUSTRY. HOW CAN INDUSTRY AND ACADEMIA HELP THE IC TAKE ON SOME OF THOSE CHALLENGES?

It's a little simple, but I think academia has new ideas, like strategic opportunities. New technology, new concepts. They also drive new policy thinking, think tanks. I think of academia as new idea possibilities. Industry I think of as new capabilities. Academia produces ideas; industry turns ideas into capabilities—things you can use—at capacity. And then government is about putting those things to use. Now, the government also has requirements to generate

new ideas and capabilities, but we can't do that on our own.

OF ALL THE POSITIONS YOU'VE HELD, WHAT HAS BEEN YOUR FAVORITE AND WHY?

Well it kind of changed over time, which is a good thing. It means I'm not regretting that the best job I had was 20 years ago. When I started out, I wanted to be an engineer because I wanted to build things. I had an uncle who built bridges over the Mississippi and I thought it was so cool. It connected two sides of the river and there was something real there. That's why I was attracted to engineering. And I did that for the first decade or so. And then after a while, I found myself getting pulled into positions where I was building teams or putting together teams of people so they could build things. The last part of my career has been more about building organizations, or in the case of ODNI, community. So it seems like a continuum. You're trying to do the same thing all the time, create something that will leave a lasting mark. That mark was really easy to see when you're

building things, but then I started realizing that when you hire someone and we bring a new officer into the organization, they could be here for 30 years. I've built a lot of cool stuff, but it might have a life of 15 or 20 years. The bigger impact you're having—the longer term, lasting legacy—is probably in developing those officers. They're the ones who will carry on and that's a long-term decision. And then you think about organizations. ODNI is now at 10 years, and hopefully we've laid the foundation for something that will go on and help the Community be integrated, connected, and everything it can be for much longer.

WHAT ARE SOME THINGS YOU'VE CHAMPIONED?

The Intelligence Community Information Technology Enterprise (IC ITE), and that's integration writ large across our IT enterprises. It's enabling all the ways that we work together, that we can share information, that we can be more closely integrated. Next is the integration we're trying to do around things like



REAL-TIME SITUATIONAL AWARENESS AT INCIDENT COMMAND AND AT THE EDGE

PAR Government is partnering with Ursa Space Systems to bring the power and reliability of SAR imagery and its derived insights to the GvSA mobile platform

SEE OUR DEMO AT GEOINT Booth 432

Download the App from the GEOINT App Store



STAY CURRENT

Access Live Video and Imagery

STAY INFORMED

Track Personnel Location & Mission Progress

STAY CONNECTED

Extend the Network to Remote Areas

STAY COST-EFFECTIVE

Leverage Legacy Radios and Enterprise GIS



Contact PAR Government Systems Today!

Email us at gvs-a2@partech.com

Visit us at www.pargovernment.com

STEPHANIE O'SULLIVAN chats with Columbia Heights Educational Campus students and faculty during her December 2015 visit.



activity-based intelligence (ABI) and our satellite architecture. Allowing our satellites to tip and cue each other, that's part of what ABI does. And that's why I believe we're at the cusp of the golden age of GEOINT, not looking back at it. Then there are things like our new Cyber Threat Integration Center where we're trying to take all of the cyber intelligence we have and figure out how to share that most widely with our policymakers and customers across government.

WHAT IS A BOOK YOU RECOMMEND TO INTELLIGENCE PROFESSIONALS?

The President's Book of Secrets by David Priess. I have been waiting and downloaded it last night. I've made it to the second chapter. President George H. W. Bush wrote the foreword. The book is sort of a compendium on the presidents' and senior policymakers' experiences getting the PDB every day. Which I said in the beginning, to me, that's the coolest part of the day, where you open that book and see some great collection or some NGA imagery. Or you hear about some assets reporting or an assessment an analyst did. That's the Community in microcosm and this book is about the history of that. Presidents talk about how they used the PDB and what it meant to them.

SO IF YOU'RE AN INTELLIGENCE PROFESSIONAL THAT BOOK COULD HELP YOU BETTER REALIZE THE FRUITS OF YOUR LABOR?

Yes, and the sweep of history. That's sort of the privilege we have being in this business. You're at the front row watching history happen and helping to inform

our policymakers. As intelligence professionals, part of our tradecraft is we don't do policy. So when I brief the President, we try to give him the most straight-up set of facts and insight we can and then we leave the room and they talk policy. The policy part is their job and you can't really get sucked

into it because then you start cheering from one side. You want their policy to work, but you need to be separate from it. It's great hearing the presidents' voices from the past talk about what it meant to them and how they used information. I don't really see that right now.

I leave and I don't hear them debating how that piece of information I just told them will inform some choice they're making. It's fascinating to hear the presidents talking about how they used all this information.

THAT'S SOME POWERFUL PERSPECTIVE.

It's sobering. It's a huge responsibility. Which is why I worry about getting it wrong. After I brief, for the next three weeks I'm picking up traffic every day and I'm going, "Thank God I got that right." You're watching how things play out and I had told the President, "this is what to look for, this is what might happen," and then I'm going, "Thank goodness I was right."

WHERE DO YOU SEE THE IC IN ABOUT FIVE YEARS?

I hope I see them doing something new, something different that I never thought of. Because another truism of the intelligence business is that if you're standing still or repeating patterns, you're becoming obsolete, you're becoming irrelevant because the world doesn't stand still. I really hope they won't have forgotten all the reasons we got to where we are today, the lessons about integration, the lessons about working together, that mission focus, but you don't have mission without

people. I hope they don't forget any of that, but I really hope they aren't doing exactly what they are doing when I leave next January, or Director Clapper leaves next January. If they do, we will have failed. Because you really have to believe that you've brought along the team that's going to inherit the organization, to be able to respond and adapt and think, not just hit repeat, to whatever new situations they're going to get, because there are going to be new situations. Things that I never dreamt of when I started are facing us today, so they'll have their own set of challenges. Anyway, I hope they surprise me.

WHAT ARE SOME EMERGING TRENDS THAT ARE GOING TO LEAD THE IC INTO THE FUTURE?

Well that stability problem is going to drive change. You just don't know where you might be looking at a crisis tomorrow. That's going to be driving the business of intelligence, which is both about trying to be strategic and move forward, but also being at the mercy of the crisis of the day and trying to provide information on it.

The other thing is technology. One of my favorite things to do around here is to champion the researchers and the STEM people because I think they're cool and they create things. But technology is changing, it's a truism, it's changing so fast that the world you will be living and working in 20 years from now, you couldn't imagine today. That's both threat and opportunity and the IC is going to have to adapt.

ARE THERE ANY OTHER TOPICS YOU'D LIKE TO DISCUSS?

Some of the things that I'll miss most. I'll miss reading the PDB. The ops guys are great. The analysts are wonderful. I'll miss those tech and research guys. They can create a new future. You know the analyst takes all of those bits and pieces of information and gives you insight from it, the ops guy responds to the opportunity to recruit the greatest agent ever, but the tech guy or a researcher, you can tell them a problem and they can invent something that changes you. Like cellphones—think about when we didn't have cellphones. Somebody invented that and it changed everything about how we work. ■

Your Imagery. Delivered.



MANAGING GEOSPATIAL DATA HAS NEVER BEEN EASIER

Your country is depending on you. Whether you're sending an aerial image to a low-bandwidth environment on the battlefield or evaluating a crop crisis to mobilize aid, accurate data – delivered quickly – is critical.

With LizardTech you can compress, manipulate and distribute enormous amounts of raster imagery and LiDAR data without sacrificing visual quality.

WE COUNT ON YOU, AND YOU CAN COUNT ON US.

TRY OUR SOFTWARE FOR FREE: www.lizardtech.com/freetrial

CALL US: 1-866-725-5211

EMAIL US AT: fedsales@lizardtech.com

 **GeoExpress**  **ExpressServer**

 **LIZARDTECH**
Creators of **MrSID** Compression Technology

© 2016 Celartem, Inc. d.b.a. LizardTech. All rights reserved. LizardTech, MrSID, GeoExpress, Express Server, and Express Suite are registered trademarks in the United States and LiDAR Compressor and the LizardTech, GeoExpress, Express Server, Express Suite, LiDAR Compressor, ExpressView and GeoViewer logos are trademarks, and all are the property of Celartem Inc. dba LizardTech.

Aerial Photo Credit: U.S. Geological Survey Department of the Interior/USGS | Marines Photo by Lance Cpl. David Staten | Aerial Recon Photo by Sgt. Jarred Woods



BUILDING AND SECURING A SMARTER WORLD

AECOM TAKES INFRASTRUCTURE AND DATA ANALYSIS TO NEW LEVELS

AECOM is a fully integrated engineering services firm with a mission to design and maintain infrastructure from the ground up. The company was formed 26 years ago with the goal to make the world a better place via architectural services.

“We’re not a company that builds airplanes or satellites or is an [Original Equipment Manufacturer],” said Jill Bruning, executive vice president and general manager of AECOM’s Intelligence Community business. “The company is organized around the engineering lifecycle: We design it, build it, operate it, and maintain it. We also have the capability to finance it.”

AECOM has grown significantly since it formed in 1990. Today, it generates \$18 billion in revenue with employees working across 150 countries. From oil, gas, and transportation to sporting venues and cities, AECOM supports clients in 12 markets. The company has built 80 percent of United States sports stadiums as well as contributed to the design and planning of the last three worldwide Olympic Villages. AECOM also helped build One World Trade Center, which according to Bruning, incorporates many state-of-the-art security and safety features.

◀ **AECOM PROTECTS** the Defense Information Systems Agency's Global Information Grid by providing computer network defense, policy management, operations services, and more.



PHOTO BY U.S. NAVY MASS COMMUNICATION SPECIALIST 2ND CLASS ROADELL HICKMAN

AECOM HAS WORKED with the U.S. Navy for nearly 20 years to develop flexible education programs for every level of personnel operating "Virginia" class submarines.

SECURING THE WORLD

Though AECOM is known for designing and constructing some of the world's most architecturally unique buildings, one-third of the company serves the government market in the areas of security, U.S. and international counterterrorism, and energy and environmental cleanup.

Cybersecurity, information technology, and analysis are some of AECOM's sweet spots. The company also operates infrastructure for classified environments to include facilities, bases, power systems, cooling systems, building automation, and energy systems.

"AECOM serves both the public and commercial sector markets," Bruning said. "What we're seeing on the commercial side that's now becoming relevant in the Intelligence Community is safeguarding critical infrastructure ... Something that differentiates AECOM in the service markets is we're involved in things that are high hazard and high consequence."

For example, AECOM for decades has been at the forefront of nuclear and hazardous site management and cleanup.

"We have destroyed more chemical weapons than any other company in the world," Bruning said. "So when we say we're built to deliver a better world, it's about making the world safer as well."

The company also serves the National Geospatial-Intelligence Agency (NGA), having won the agency's Base Operations Support-East contract to support central plant and facility operations and management, security, logistics, construction, shipping and receiving, property disposal, and grounds maintenance at NGA Campus East in Springfield, Va. NGA is just one of the multiple intelligence agencies employing AECOM for operations and management.

INTELLIGENT BUILDINGS

Although most people tend to not associate infrastructure companies with deep analytics, according to Bruning, AECOM offers open-source analysis and intelligence services for a data-driven world.

"Our infrastructure is getting more and more sophisticated not only from a safeguarding and protection perspective, but also from an energy efficiency perspective," Bruning said. "Smart

buildings, smart roads, smart data systems—[infrastructure is] collecting data all the time."

With everything now being built to be "smart," AECOM is focusing on analyzing infrastructure-generated data to draw conclusions and predict outcomes. It is also using open-source methods to help safeguard its customers' infrastructure.

"With everything that happens in the world, there's usually an infrastructure component that needs geospatial information," Bruning said. "What's happening with your water, transportation, or roads? We do a lot of that for our design, construction, and operations. For example, we look at how crowds move in our Olympic Villages and gather data to see what's normal and to determine what doesn't look normal."

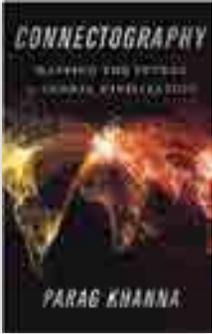
Having built iconic skyscrapers, contributed to urban design, and secured classified government agencies, AECOM continues to leverage best practices in infrastructure, bringing those efficiencies to military bases, government facilities, and beyond.

■ BY LINDSAY TILTON MITCHELL



Visit usgif.org/membership to learn more about becoming a USGIF Organizational Member.

READING LIST



CONNECTOGRAPHY: MAPPING THE FUTURE OF GLOBAL CIVILIZATION

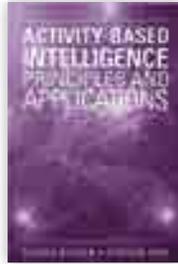
By Parag Khanna

Leading global strategist, best selling author, and TED speaker Parag Khanna illustrates a future shaped less by national borders than by global supply chains, in which the most connected powers—

and people—will win. This book circumnavigates the globe to explain how militaries are deployed to protect supply chains as much as borders, and how nations are less at war over territory than engaged in tugs-of-war over pipelines, railways, shipping lanes, and internet cables.



Meet Parag Khanna and get a signed copy of his book at GEOINT 2016.



ACTIVITY-BASED INTELLIGENCE: PRINCIPLES AND APPLICATIONS

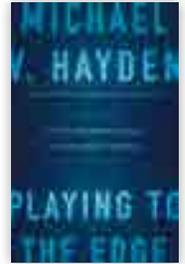
By Patrick Biltgen and Stephen Ryan

Authors Biltgen, technical director of analytics at Vencore, and Ryan, chief architect of Northrop Grumman’s Mission Systems sector, provide definitions, examples, and discussion on the activity-based intelligence (ABI) tradecraft in this new book. Readers will gain an in-depth understanding of ABI and how it can be applied to real-world problems.

PLAYING TO THE EDGE: AMERICAN INTELLIGENCE IN THE AGE OF TERROR

By Michael V. Hayden

As a retired U.S. Air Force four-star general, former director of both the National Security Agency and Central Intelligence Agency, and former principal deputy director of National Intelligence, Hayden writes about his experience with America’s intelligence wars. He goes in depth on the



Intelligence Community’s response to terrorism, how agencies changed after 9/11, and other tales of national security.

The world has never been more complex.
Are you ready for it?

Academic excellence and technological innovation in the National Capital Region.

Making a difference, one graduate at a time.
Meeting the needs of tomorrow, one discovery at a time.

Department of Geography and Geoinformation Science
703.993-1212 | gm.gis@geog.mason.edu



THE PRESIDENT'S BOOK OF SECRETS: THE UNTOLD STORY OF INTELLIGENCE BRIEFINGS TO AMERICA'S PRESIDENTS FROM KENNEDY TO OBAMA

By David Priess

This book dives into the President’s Daily Brief (PDB). Starting in the Kennedy administration and still used today, this highly classified document is a daily report from the Intelligence Community to the President summarizing global threats affecting U.S. national security. Priess, a former intelligence officer, looks into the decision-making, production, and delivery of the PDB.

USGIF EVENTS CALENDAR

MAY
15-18
GEOINT
2016 Symposium
Orlando, Fla.

JULY
12
GEOINTeraction
Tuesday
Northern Virginia

NOVEMBER
14-18
GEOINT
Community Week
Northern Virginia

PEER INTEL

Engility's Board of Directors named **Lynn Dugle** CEO. Dugle brings more than 30 years of experience in defense, intelligence, and telecommunications. Additionally, **John Hynes**, Engility's executive vice president and COO was named president and COO. Previously, Hynes was CEO of TASC.

Harris Corp. named **Rahul Ghai** senior vice president and CEO. Ghai brings more than 20 years of global business experience.

Esri promoted **Patty Mims** to deputy director of federal government business development. Mims was previously Esri's director of intelligence business development and has been with the company since June 2002.

Dr. Steven Omick was appointed president and CEO of Riverside Research. Omick previously served as president at Vencore Labs and president and CEO of Rincon Research Corporation.

HERE appointed **Edzard Overbeek** CEO to lead the company as a newly independent entity. Overbeek was most recently the strategic advisor at Cisco.

KEYW elected **Mark W. Sopp** to its Board of Directors. Sopp most recently served as Leidos' executive vice president and CFO, and has 25 years of experience serving in senior financial executive roles for public and private companies.

The American Geographical Society elected **Dr. Christopher K. Tucker** as its chair-elect. Tucker is on USGIF's Board of Directors and manages Yale House Ventures.

Dan Whalen was named vice president of business development of Altamira Technologies Corp. responsible for leading new business growth across current portfolios and future markets. Prior to joining Altamira, Whalen served in business development and program management roles with Lockheed Martin and Boeing.

Charles Woodburn was appointed BAE Systems' COO. He has more than 20 years of experience including a number of senior management positions in the oil and gas industry.

USGIF Accredited Programs

Thinking about going back to school?

There's no better time than the present. Earning a geospatial intelligence certificate from a USGIF-accredited institution provides the skills required to address challenges, offers competitive advantage, and ensures organizations get high-caliber employees who understand GEOINT.



Learn more at usgif.org

Aperture



IMAGE BY NATHAN HUNT FOR 38 NORTH

Eye on North Korea

This 3D CAD model of North Korea's Sohae Satellite Launching Station's gantry tower with the Kwangmyongsong satellite launch vehicle in place was developed using commercial satellite imagery and open-source intelligence. The model was created by Nathan Hunt and published in March on 38 North, a website dedicated to the analysis of North Korea by the U.S.-Korea Institute at the Johns Hopkins School of Advanced International Studies. 38 North, which aims to raise the bar on the level of discussion and understanding about North Korea, has been using commercial satellite imagery from companies such as Airbus Defence and Space and DigitalGlobe since 2012 to create panoramic models of Sohae and other sites. Hunt employs satellite imagery and Google Earth to determine the basic dimensions and create initial draft models of North Korean launch station buildings and structures, then mines open-source intelligence such as photos released online by the North Korean government to enhance the models in detail. 38 North has more models in the design phase and will soon implement new, more accurate geo-terrain features.



Visit 38north.org to learn more and to view satellite imagery and other models by Hunt.

DigitalGlobe
WorldView-3 satellite
10cm resolution
Al Makkalla, Yemen 12.18.2013
acquired with SpyMeSatGov



SpyMeSatGov

Easy Access Imagery

For Government Use

GEOINT APP STORE
EXPLORE MORE

Go to the
GEOINT App Store:
<https://apps.nga.mil>

Search for
SpyMeSatGov



**On Demand
Global High Resolution
Satellite Imagery Downloads**
with EnhancedView Account

**Real-time Satellite
Overflight Notifications**

ORBIT LOGIC
www.orbitlogic.com

disaster response • environmental studies • security applications • crisis monitoring

WE ARE S2

Excellence in Execution

We are transforming acquisition processes for our customers

We are delivering GEOINT on-demand to bandwidth-limited users

We are Certified AWS Solutions/ Enterprise Architects

We are CISSP, ITIL, PMP and SAFe certified practitioners

We are delivering integrated solutions for ABI and OBP

We are an outcome-based company

We are Certified Defense Financial Managers



We are leading enterprise migration to IC ITE

We see the big picture, translating strategy to execution

We are providing mission-driven portfolio aligned technology solutions

We have an independently certified Quality Management System

VISIT US AT THE 2016 GEOINT SYMPOSIUM, BOOTH 720 / WWW.S2ANALYTICALSOLUTIONS.COM

S2 Analytical Solutions is a trademark of S2 Analytical Solutions, LLC and all other trademarks are owned by their respective owners.