November 2008

VAC Views

A publication of the Visualization and Analytics Centers

Features:

Visual Analytics Abroad Novel visual analytics initiatives are underway in Europe (page 5)

The Power of Sensemaking Future Point Systems' products help turn complex information into actionable understanding (page 12)

First Look First Look provides a quick video summary of how news stories change over time (page 14)

***Pam Scanlon** is the Executive Director for the Automated Regional Justice Information System (ARJIS). ARJIS is an integrated justice enterprise network and system used by more than 75 local, state, and federal criminal justice agencies throughout San Diego and Imperial Counties. ARJIS serves as the information hub for the region's public safety incidents, photographs, gang information, calls for service, officer notification, and more, accessed by over 11,000 justice personnel via a secure intranet.*

Automated Regional Justice Information System

The Automated Regional Justice Information System (ARJIS) has been leading the way in supporting information-led policing for the better part of three decades and prides itself on teaming with organizations such as the International Association of Police Chiefs, the Department of Homeland Security (DHS), and the National Institute of Justice. ARJIS is responsible for major public safety initiatives, including wireless access to photos, warrants, and other critical data in the field as well as an enterprise system of applications that help officers solve crimes and identify offenders. ARJIS also serves as the San Diego region's information hub for officer notification, information sharing, and the exchange, validation, and real-time uploading of public safety data.

ARJIS uses national operational and technical standards to seamlessly share critical information in real time across multiple jurisdictions and disciplines. ARJIS is currently engaged in initiatives sponsored by DHS to share critically needed data among the Western States with a focus on protecting the border and in a wireless project, in partnership with NVAC, to share critical data and photos among all justice and homeland security agencies in the region. It is our goal and my belief that providing every officer access to real-time information and analysis is one critical piece to protecting our borders, reducing crime, and saving lives.

To accomplish the initiatives described above, ARJIS has deployed over 600 PDAs to more than 40 justice agencies in San Diego and Imperial Counties. Using the ARJIS PDAs, officers access booking information, driver's licenses, and gang photos as well as wanted persons information, National Crime Information Center data, and officer notifications without having to return to their stations. Other capabilities, including GPS location-based services, facial recognition, and messaging, are resulting in tremendous enhancements to officer and public safety.

The work we are doing with DHS is serving as a model for law enforcement and counter-terrorism information-sharing systems around the country and internationally. ARJIS is dedicated to improving law enforcement practices in information sharing and analysis to protect citizens, officers, and the country.

Pamela Scanlon
Executive Director
Automated Regional Justice Information System

ARJIS
San Diego's Justice Web

"We use ARJIS in house and in the field on a daily basis by our 21-Officer ICE [Immigrations and Customs Enforcement] Fugitive Unit. ARJIS applications are directly responsible for assisting the Fugitive Unit with the locating and apprehension of the 854 fugitives within San Diego that have been arrested since Oct 1, 2007. Thanks again for allowing us the privilege to access these ARJIS systems."— Field Agent from the DHS Immigration and Customs Enforcement Fugitive Unit

Current Happenings

As I write this, many of us have just returned from two very full conference weeks. The Technologies for Critical Incident Preparedness (TCIP) Conference 2008, held the last week of October 2008, highlighted an important and increasing role for the visual analytics community. IEEE VisWeek 2008, which includes the Visual Analytics Science and Technology (VAST) symposium, was held the week before. This year, VAST had 21 paper presentations, 10 posters, and was involved in several VisWeek panels and birds-of-a-feather gatherings. Christian Chabot, CEO of Tableau Software, gave a thought-provoking keynote presentation on how and why visual analytics is important from a business perspective. A highlight was the VAST Challenge, with 73 submissions from 13 countries. What a fantastic international response! Congratulations to everyone involved in VAST for putting on a super symposium. If you didn't make it this year, put it on your calendar for next year, Oct 11 - 16, 2009, in Atlantic City.

Speaking of international interest in visual analytics, the VAC community is growing around the world. In past issues, we highlighted the Canadian efforts to develop a visual analytics research program. In this issue, Lance Valcour (page 4) talks about how Canada and U.S. agencies are working together on information interoperability issues for first responders and how visual analytics is a part of that. Moving across the Atlantic, Daniel Keim (page 5) provides insight into ongoing and emerging European Union programs for visual analytics.

Pam Scanlon highlights the use of visual analytics for law enforcement in her guest letter (page 2) and Kris Cook talks about how the VAC Consortium is stepping up to support technology transition (page 6).

Plenty of excellent visual analytics research articles are in this issue as well. For example, Future Point Systems, a Provider-level Consortium member, is the focus of page 12, and a collaborative effort between Stanford and NVAC is described on page 10.

As always, we are looking for input to make *VAC Views* more useful and of interest to the entire community. Please send us a note if you have thoughts or suggestions for future issues of *VAC Views*.

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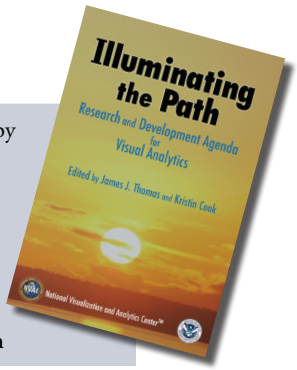
Illuminating the Path: The Research and Development Agenda for Visual Analytics is available for download at **http://nvac.pnl.gov/agenda. stm**



Pacific Northwest NATIONAL LABORATORY

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About CITIG

CITIG was created to raise awareness about communications interoperability for first responders in Canada. CITIG aims to:

- *create forums for the exchange of information and ideas*
- *facilitate communications among Canadian public safety interoperability stakeholders*
- *bring together the collective wisdom of public safety and communications leaders and experts (best and brightest)*
- *respond to regulatory issues that affect public safety communications*
- *provide a testbed where aspects of the five elements of SAFECOM's interoperability continuum (governance, standard operating procedures, technology, training & exercise, and usage) can be understood, designed, tested, negotiated, implemented, trained, exercised, standardized, or shared.*

Working Together Toward Interoperability

Lance Valcour, Ottawa Police Service

When you bring the right people together, things get done. Proof of that is the progress made on cross-border interoperability. While much work had been done at the regional level, the emergence of the Canadian Interoperability Technology Interest Group (CITIG) has created a more cohesive national focus on this important issue. The cooperation of many organizations, both US and Canadian, has led the incredible momentum on the cross-border interoperability front.

CITIG was formalized in early 2007 under the auspices of the Canadian Police Research Centre (CPRC), when the Canadian Association of the Chiefs of Police joined with the Canadian Association of Fire Chiefs and Emergency Medical Services Chiefs of Canada to improve public safety interoperability in Canada. The National Public Safety Telecommunications Council soon accepted CITIG as their first international member. The US Department of Homeland Security (DHS) SAFECOM® program also has welcomed CITIG as a participant on many of their initiatives, most notably Emergency Response Council activities and the National Emergency Communications Plan (NECP) creation.

One CITIG priority is facilitating development of the Canadian Voice Interoperability Plan, along with Public Safety Canada (PS). The draft plan will be presented at the Second National Voice Interoperability Workshop, December 7 to 10, in Toronto. Event delegates will have an extensive opportunity to revise, refine, enhance, and, hopefully, endorse the overall scope and direction of the Canadian Plan.

CITIG and PS are also working with DHS Office of Emergency Communications to ensure proper linkages between the Canadian plan and the NECP. The goal is to present the draft plan to the Government of Canada by March 31, 2009 and then send the plan to Provincial counterparts and other federal departments for input and consultation.

Another activity is working with the DHS Science and Technology Directorate on various initiatives on both sides of the border. In May, CITIG presented "Visual Analytics—Case Studies in Operational Policing" at the VAC Consortium meeting. As a result, John Dill, Simon Fraser University and a CNVAC leader, was invited to present in Toronto at the information-sharing Vendor Outreach Forum, which brought together first responders and industry.

A cross-border forum is tentatively planned for the second quarter of 2009. This event, being jointly planned by Canadian and US officials, is designed to get stakeholders to share information and work together toward common solutions (http://www.cprc.org/citig).

Canada is also proud to host DHS's Dr. David Boyd and Chris Essid as they speak in Victoria, BC, February 15 to 17, 2009 at the Canadian Association of Chiefs of Police Informatics Conference titled "Supporting Public Safety Operations Through Current and Emerging Technology" (http://www.cacp.ca/index/eventscontent?contentId=555). A number of sessions will be related to both visual analytics and interoperability.

The evolution of CITIG from its humble beginnings can be characterized as "significant." It now has over 300 members from the responder community, government, associations, academia, international organizations, and industry. CITIG has made major strides in raising awareness about public safety provider interoperability. Most importantly, interoperability stakeholders from both Canada and the United States will benefit as work on fostering a more cooperative approach continues.

For more information, see the CITIG website (http://www.cprc.org/citig). E-mail any suggestions, questions, or concerns to citig@cprc.org.

Visual Analytics in Europe

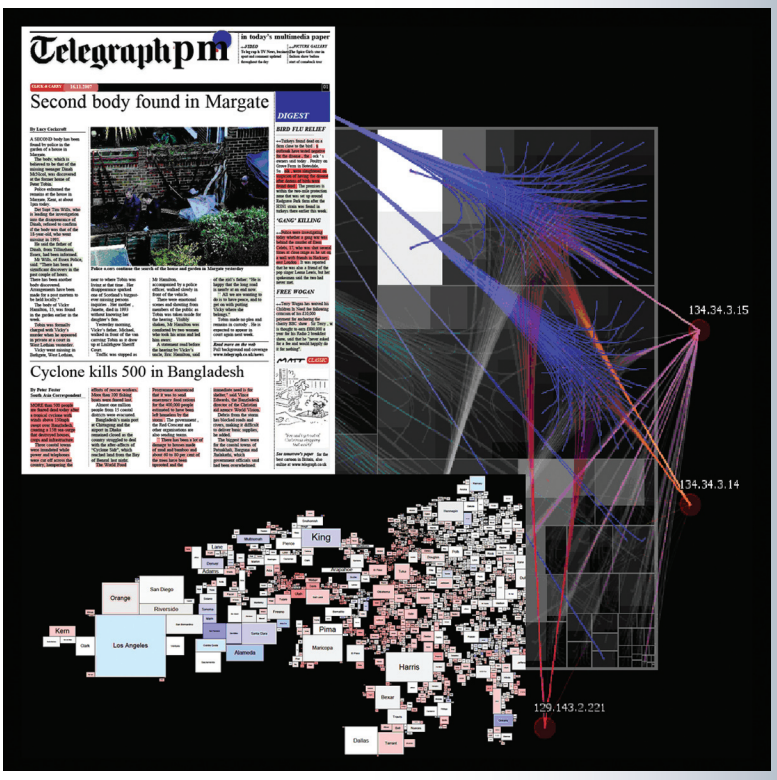
Daniel A. Keim, University of Konstanz, Germany

With significant funding by national governments and the European Union, numerous novel visual analytics research initiatives are underway in Europe. One of these initiatives is the EU Coordination Action, a consortium that unites leading European visual analytics researchers and diverse strategic national research initiatives. Visual analytics groups in Europe specialize in explorative analysis and visualization of large information spaces from diverse data sources, such as multidimensional, textual, multimedia, web, and geographic data. Recently, the research groups have successfully created research partnerships, secured public funding, and established industry partnerships for meeting real-world challenges.

The EU Coordination Action Network, called "VisMaster: Visual Analytics–Mastering the Information Age," joins European academic and industrial R&D excellence from all related disciplines to form an effective visual analytics research community. Researchers from Fraunhofer IGD in Darmstadt and the University of Konstanz lead the Coordination Action consortium, which comprises an array of thematic working groups focusing on advancing the state of the art in visual analytics. The working groups try to combine the strengths of intelligent automatic data analysis with the visual perception and analysis capabilities of the human user. One of the goals of the Coordination Action is to define a European Visual Analytics Research Roadmap and to expose public and private stakeholders to visual analytics technology, setting the stage for larger follow-up visual analytics research initiatives in Europe.

In addition to VisMaster, a framework for research and training in visual analytics is being developed by a number of European and international partners to provide a complementary research and training mechanism to leverage European Commission funded actions. Its main purpose is to put into place a framework for knowledge and technology transfer within Europe and between the United States, Canada, Australia, and Europe.

Significant national initiatives include the Strategic Research Initiative "Scalable Visual Analytics: Interactive Visual Analysis of Complex Information Spaces" funded by the German Science Foundation (DFG) as well as similar initiatives in the UK and Sweden. In addition, close collaborations with major industrial players combine the research expertise in visual analytics with the in-depth competence of the practitioners in the field to meet real-world challenges. The national and European initiatives work closely together with the international visual analytics research initiatives to leverage the European and international talents and solve the increasing information overload problems of our societies.



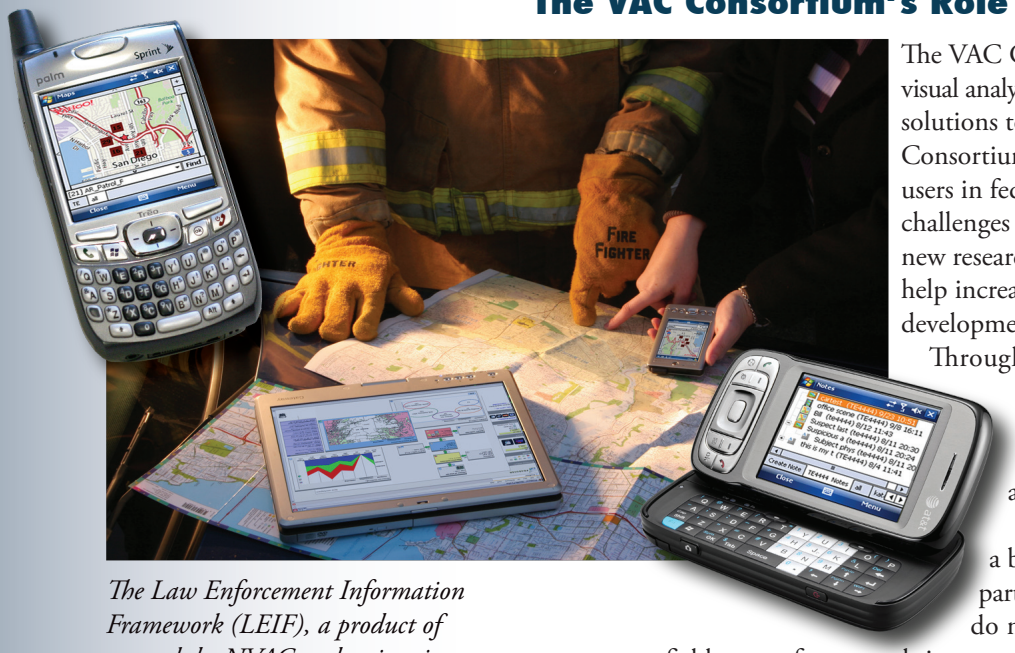
European research groups focus on advancements in information visualization, knowledge discovery, and visual analytics. Application areas include network-traffic analysis, opinion analysis, visual geographic analytics, and multimedia analytics.

From Research to Reality: Visual Analytics Technology Transition

Investments by the Department of Homeland Security and other government partners have resulted in creation of a wealth of new visual analytics capabilities over the past four years. Researchers at NVAC and the university-led Regional Visualization and Analytics Centers have developed new techniques to support analysts in fusion centers and other environments, law enforcement and first responder personnel, and public health practitioners, to name a few. Many of these capabilities have potential applications that go far beyond current uses.

The process of bringing research into operational reality requires a strong team of committed individuals from government, academia, and industry. Each partner in this process brings unique capabilities to the team.

The VAC Consortium's Role in Technology Transition



The Law Enforcement Information Framework (LEIF), a product of research by NVAC and university partners, is being used today in the Automated Regional Justice Information System.

The VAC Consortium plays a central role in helping the visual analytics community develop and deploy high-impact solutions to challenging analytical problems. Through the Consortium, researchers and tool providers learn from users in federal, state, and local government about their challenges and needs. This critical knowledge can inspire new research and provides a basis for design choices that help increase the relevance of the resulting research and development.

Through demonstration sessions at Consortium meetings, researchers and tool providers can get feedback on their work directly from their future user base. This enables further refinement and development.

Industry members of the Consortium provide a bridge from research to application. Research partners at government laboratories and universities do not typically have the available support infrastructure to field new software tools in operational use. Industry partners, however, often see this as a core part of their business and have the well-developed infrastructure necessary to provide a robust program of training and support for a wide range of users. Through membership in the Consortium, industry partners can not only identify unmet user needs but also identify promising new technologies that they can pursue to help meet those needs.

Over the long term, the success of visual analytics will be measured by the degree to which users in a variety of domains are actively using visual analytics tools as a key part of their work. The VAC Consortium is dedicated to bringing together the essential expertise from government, industry, and academia to set the stage for moving this promising research into widespread operational reality. Please consider joining the VAC Consortium and helping us all meet this goal.

For more information, see http://nvac.pnl.gov/consortium.stm.

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News Briefs

Spring VAC Consortium Meeting

The Spring 2008 VAC Consortium meeting, held May 21 and 22, in Laurel, Maryland was the setting for two very intensive days of learning and collaboration. This meeting brought together 170 people, evenly divided among government, academia, and industry, to focus on the theme of regional and national security working together.

The meeting featured a strong and diverse agenda, with invited speakers representing the Department of Homeland Security, the Department of Justice, the Intelligence Community, the Canadian police force, the Port Authority of New York and New Jersey, the Baltimore and Newport News Police Departments, and industry partners such as Boeing and Microsoft. In addition, researchers from NVAC, the RVACs, and industry demonstrated their latest breakthroughs at an exciting poster and demonstration session.

Of special note is the strong level of industry support for this meeting. Consortium member Boeing provided a significant contribution to co-sponsor the event, and Endeca Technologies Inc. and NVIDIA sponsored a lunch and dinner. Johns Hopkins University Applied Physics Laboratory provided facilities for the event.

This meeting clearly demonstrated the users' needs for tools to address their analytic challenges and their enthusiasm for the new visual analytics research that is being produced by the community. This meeting helped connect research teams and user communities and is already producing fruitful opportunities for both research and applications of visual analytics to address regional and national homeland security missions.

This meeting was the inaugural meeting for the newly announced VAC Consortium Director Kris Cook. A special thanks and congratulations to Kris on her new role!

Consortium attendees enjoy the poster and demonstration session.

RVAC Professor Demonstrates Technology Down Under

John Stasko, Director of the Georgia Tech component of the Southeastern Regional Visualization and Analytics Center (SRVAC), visited with Australian university, industry, and government representatives June 9-13, 2008 to discuss visual analytics, present SRVAC's Jigsaw visual analytics tool, and establish directions for further collaboration. In Brisbane, John was an invited guest of the Australian Research Council's Centre for Excellence in Policing and Security (CEPS) at Griffith University (http://www.griffith.edu.au/policing-security). John presented his work on the Jigsaw system at the CEPS Intelligence Meeting attended by law enforcement, security, and intelligence officials from Australian federal, state, and private organizations. John also taught a one-day seminar about visual analytics and Jigsaw to a group of young intelligence analysts, researchers, financial investigators, and lawyers taking a course on Crime Analysis and Intelligence. In Adelaide, John presented Jigsaw to researchers at the Defense Science and Technology Organization (DSTO), the Australian Government's lead agency charged with applying science and technology to protect and defend Australia and its national interests (http://www.dsto.defence.gov.au/).

Australia benefits from John Stasko's visit.

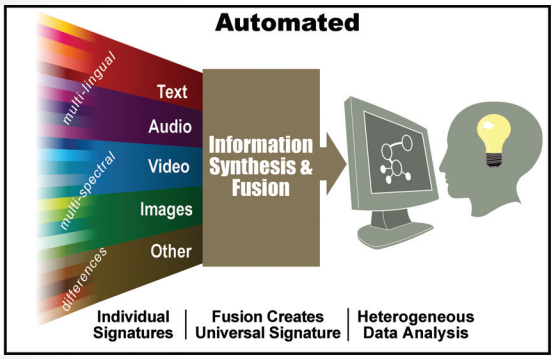
NVAC Advisory Board Update

To ensure the National Visualization and Analytics Center and the VAC enterprise are focusing on the DHS missions and the critical visual analytics research needs of our nation, an NVAC advisory board was established and has been recently updated. In order to more fully leverage the board members' technical and business expertise, NVAC leadership meets with the full board twice a year and interacts with board members thoughout the year.

Current board members representing government, academia, and industry.
Top: Alan Turner, Pat Hanrahan, George Robertson, Doug Lemon
Bottom: Larry Rosenblum, Jim Thomas, Joe Kielman, Michael Tobia
Not pictured: John Hoyt, Daniel Keim, Jim Williams

Information Synthesis and Fusion

Combining Text, Audio, Images, and More on a Semantic Level for Analytics



Analysts have to manually fuse various data types (text, audio, imagery, documents), and most analysts have to use many separate, non-interoperable tools to analyze each kind of data, making it difficult to understand the big picture. The goal of this work is to provide a semi-automated means of fusing various data types on a semantic basis, using existing signature techniques, and generating fused signatures that can be leveraged by existing systems.

A major challenge in analytics is creating the capability to process, organize, and analyze heterogeneous data. With the proliferation of various mobile devices, the amount of available digital information will only increase analysts' load. Analysts already must deal with a cadre of information sources and types (e.g., images, video, text). However, many tools can only analyze one type of data, causing analysts to use several tools to understand each data type's information space. As the number of data types included in an analysis increases, so do the tools; the analyst begins a juggling act of combining various analytic products from each tool. Unfortunately, this aggregation operation is not managed within a single process or tool but in the analyst's mind. Today's analytic environment and computational models have not addressed the need for an integrated analytic environment, especially at the semantic level.

Information Synthesis and Fusion

Information synthesis and fusion is the process of combining various informational elements and producing more content than the sum of the parts (or, in this case, new information nuggets). The concept itself is not new and has been fostered by using sensor data in military applications with a map as a basis. However, analysis is not always performed in the context of maps, and hence, the fusion concept becomes a more technically challenging problem, especially if the approaches necessary to summarize various data types need to describe the semantic content. To address this issue, NVAC assembled a small team to investigate previous approaches and techniques and to learn if any would enable combining various data types for the purpose of analytic discourse.

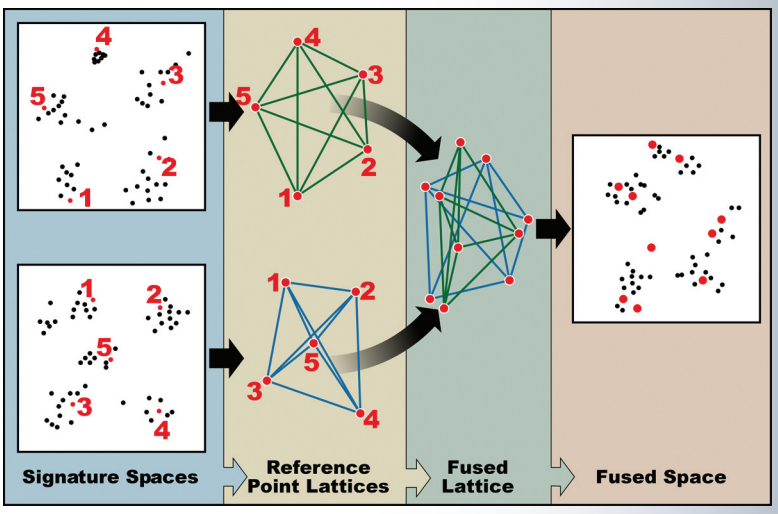
Over the past year, NVAC has developed an approach that leverages the foundational semantic characterization technology of the analytic and computational communities. These communities have focused on developing signatures that semantically represent content of their research. Signatures, generically, are computational summaries based on specific features of a data item (where a *data item* represents images, text, video, etc.) and can be defined in several ways. Semantic signatures are based on semantic features within the data item and thus can help define a common basis in which information can be analyzed and represented. Also, by characterizing information as a signature, many visual analytic systems are already poised to leverage this type of representation. Therefore, the methodologies this team developed incorporate the semantic signatures of various information types and produce a fused signature where all data types could coexist.

Equinox: An Engine, Framework, and Sandbox for Information Fusion

To create fused signatures, NVAC developed Equinox, a system that comprises an engine, framework, and sandbox for fusing and validating various semantic signature types. The Equinox engine does not require complex ontologies (although it could use them) or a large knowledge base; instead, it is based on specifying equivalence relationships using a set of content from the different data spaces being fused. For example, consider

combining a set of structured category records and a set of unstructured text documents. The NVAC team's approach is to first establish a set of equivalent or parallel data items that exist in both datasets. These data items establish the semantic bridge between the different data spaces. Note these equivalent data items can be generated or be identified from the data sources a priori. Analysts then use the semantic signature algorithms to convert their respective datasets into semantic signatures. These signatures are then fused, using Equinox, via the equivalent data items resulting in a new signature set for both datasets. The new signatures are structurally equivalent to their predecessors and can be used in many of the visual metaphors and analytic processes as before.

A distinguishing feature of this process, in contrast to other fusion-based systems, is what it's *not* trying to do. It does not attempt to identify individual low-level semantic features and then align and reconcile them between spaces. Instead, it uses the co-occurrences of those low features and draws on those statistical properties to organize the fused space. It also recognizes the importance of context in the fusing of various datasets. Equinox can resolve the context issue by relying on the context as defined by the individual signature spaces. If the equivalence data items can be fused, then those portions of the space are deemed contextually similar. If, however, they are not, then the individual spaces control the context of their content, and the accuracy improves as the signatures for the spaces improve.



Through a process of trilateration, we use reference data items representing parallel content in different spaces (e.g., audio and text). We transform individual signature spaces into trilaterated spaces, which form a common dimensionality for each space. Using reference data, we form a lattice for each space and merge these lattices together, forming a fused space. The results are fused signatures derived from each space's semantic basis.

A Community Effort

For Equinox to be successful, the community must develop high-quality semantic signatures for the various data types. The ability to fuse various data types will come only as research matures for other data types. Research in image and video analysis at several RVACs has made substantial progress in developing semantic signatures for those types. NVAC expects to fuse these data types with existing data types (e.g., text) within the next few months. Also, the visual analytics field will likely develop new visual representations and interactions to complement the new mixture of data types. Unifying the semantic landscape for heterogeneous data will continue to be a challenge, but with this initial research and university collaborations, researchers are overcoming the obstacles and allowing analysts to focus on the problem and not just on how the pieces fit together.

Team Members

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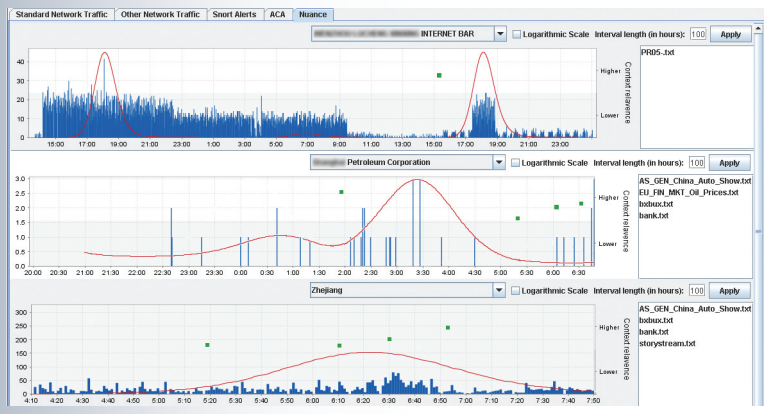
New Partnership Brings Visual Analytics to Federal Cyber Security Organization

Discovering new threats in massive volumes of computer network traffic is a challenge that analysts at the Department of Homeland Security's US-CERT (United States Computer Emergency Readiness Team) face daily. Through a new technology transition effort funded by the Command, Control and Interoperability Division of DHS's Science and Technology Directorate, NVAC and the Stanford University RVAC are collaborating to bring novel visualization tools to US-CERT that can help reveal intrusions, anomalies, and other suspicious activity in this traffic.

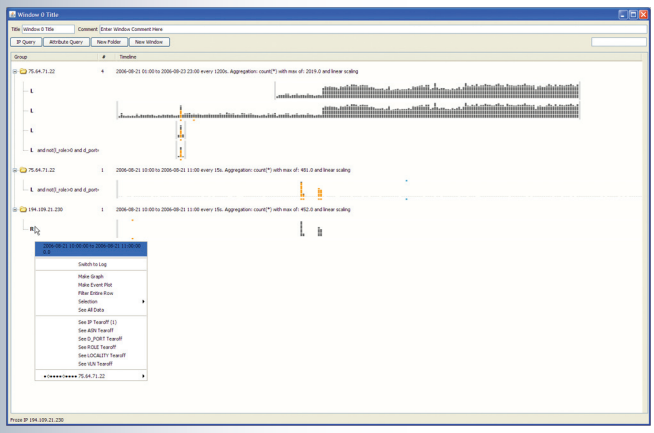


Pacific Northwest National Laboratory's Nuance system models baseline activity (red curves) of machines on a network, which can be compared to current activity (in blue) to detect anomalies.

Scalable Exploration of Network Flows

US-CERT is a public-private partnership that is charged with protecting the nation's internet infrastructure by coordinating defense against and responses to cyber attacks. One kind of data available to US-CERT analysts is network flows that summarize communication sessions between federal computer systems and external parties; US-CERT collects nearly two billion flows each day, with the volume continually growing. Given this amount of data, visualization approaches must scale to support high-throughput streaming analytics while still giving analysts the ability to drill down all the way to individual transactions.

Both the Pacific Northwest National Laboratory (PNNL) and Stanford have been developing independent visualization tools designed to support exploration of network flows. PNNL's Nuance system creates behavioral models of actors on a network, giving analysts a synoptic overview of the communication patterns of each machine and helping them detect potentially malicious activity. Stanford's Isis tool supports exploring the sequence of individual communications in detail. The two systems make a natural pair: analysts can discover suspicious events using Nuance's high-level overviews and drill down to investigate the timeline of those events using Isis.



Stanford's Isis tool enables detailed analysis of suspicious network events.

Collaborating to Make a Difference

During the project's first year, Nuance and Isis will be integrated into an analytic framework and deployed with a small group of analysts at US-CERT for pilot testing. While powerful new analytic techniques will be incorporated into the daily workflow of US-CERT staff, real-world operational considerations will also be fed back into the development of cyber analytics capabilities across the VAC community. This style of collaboration between NVAC and its university partners will also formalize effective ways to bring technology out of the laboratory and into operational environments.

Team Members

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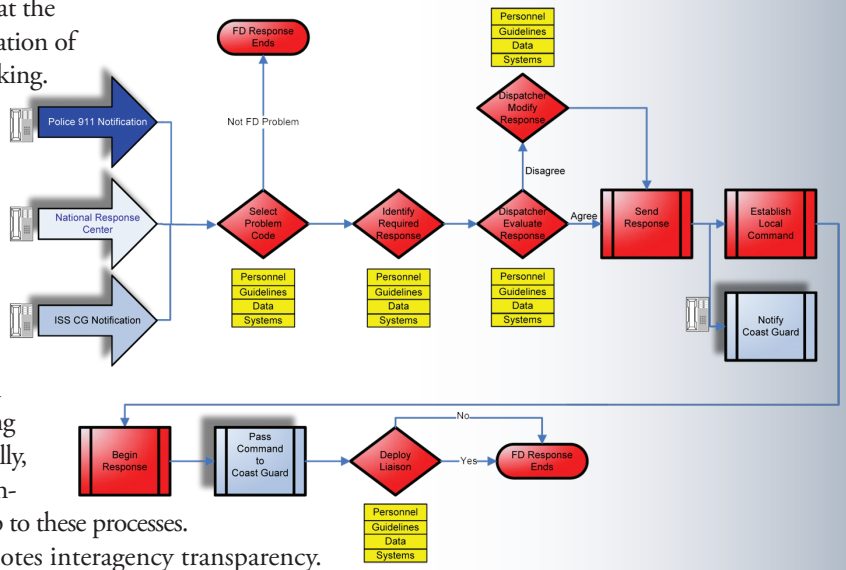
Visual Analytics for Maritime Security

The Pacific Rim Visualization and Analytics Center (PARVAC) at the University of Washington is charged with researching the application of visual analytics to enhance distributed collaborative decision making. A current project, in collaboration with the Puget Sound Area Maritime Security (AMS) Committee, is to map the multi-institutional committee's decision-making and coordination processes for regional maritime crisis response and management.

A Leadership Tool for Interagency Transparency

The researchers are developing 1) a map of the diverse AMS community's sense-making, decision-making, and coordination processes for both non-crisis and crisis situations and 2) an evolving map of technology components that support these processes. Finally, the project will develop a visual representation of how existing technology and possible analytic and coordination enhancements map to these processes.

The ultimate goal is to provide a leadership tool that promotes interagency transparency. As Admiral Thad W. Allen, US Coast Guard, says, "Transparency of information breeds self-correcting behavior." In addition to providing a better understanding of complex information and communication systems, the project will provide an opportunity to open broader discussions about collaborative decision-making within a complex interagency domain.



A sample Fire Alarm Center's oil spill response process. Colors indicate different agencies, shapes indicate different actions, and each decision includes a "drill down." Many of these components are clickable.

A Framework for Collaborative Decision Making

The preliminary focus is constructing a framework for mapping the AMS community's decision-making processes. Researchers can then examine the concepts behind these processes: where interagency interactions occur, where decisions are made, and how an incident progresses through and between agencies. The framework is decision-centric. This lets users drill down through four major layers of each decision: 1) personnel and agencies involved, 2) guidelines and human processes that structure the decision making, 3) data needed to make the decision, and 4) systems that support these decisions. The drill-downs, which will be represented in a dynamic, graphical form, represent the forward-driving forces of a situation response.

Visualizing Maritime Security Response and Management

Tracking and analyzing multi-institutional collaborative decision-making and presenting this in a useful, multi-layered, interconnected, dynamic way are significant challenges. The map also must be designed with consideration toward not only a dynamic process but also a process in which decision-making schema can change drastically upon level of crisis. The visualization component should complement the content. Much of the decision making becomes intuitive; the visualization of these decisions should make sense to the users.

For more information, see http://parvac.washington.edu

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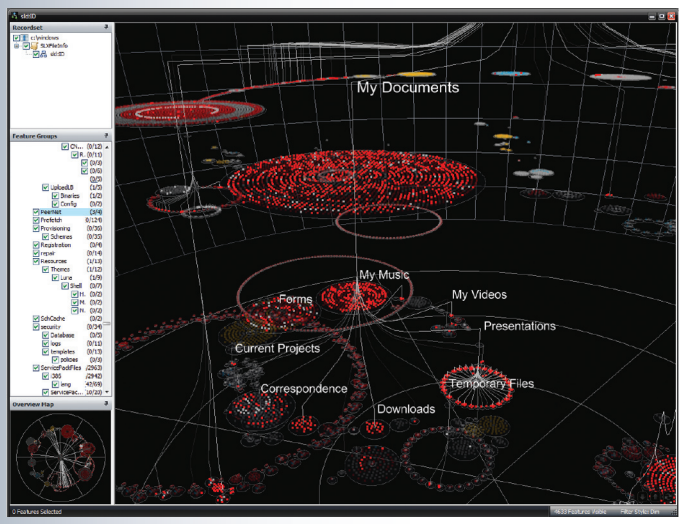
Future Point Systems: The Power of Sensemaking Through Visual Analytics

As the growth rate of digital information and the pace of communications continue to accelerate, businesses, governments, and consumers increasingly face the problem of information overload. They need to turn disparate, complexly related information into actionable understanding. At the cross section of this challenge is the rapidly evolving field of visual analytics and the private, commercial enterprise, Future Point Systems (FPS).

Future Point's Evolution



Starlight's Hierarchy View illustrates ranked, structural relationships, including directories.

FPS was founded in 2006 in partnership with PNNL. As a private company, FPS has been granted exclusive rights to build on over 10 years of successful information visualization research, development, and deployments through PNNL.

Since its founding in 2006, FPS has rapidly established itself as a market leader in Visual Information System solutions. FPS provides software for visually managing, understanding, and deriving new knowledge from massive quantities of heterogeneous and complexly related information. The award-winning Starlight™ software is a comprehensive visual analytics platform that tames information overload and enables users to extract new value from data of all types. Starlight is software for *sensemaking*, the process of creating situational awareness and understanding in complex or uncertain situations in order to make decisions. Starlight enables sensemaking by automatically organizing and summarizing large collections of information and then presenting the results in easily interpretable graphical formats.

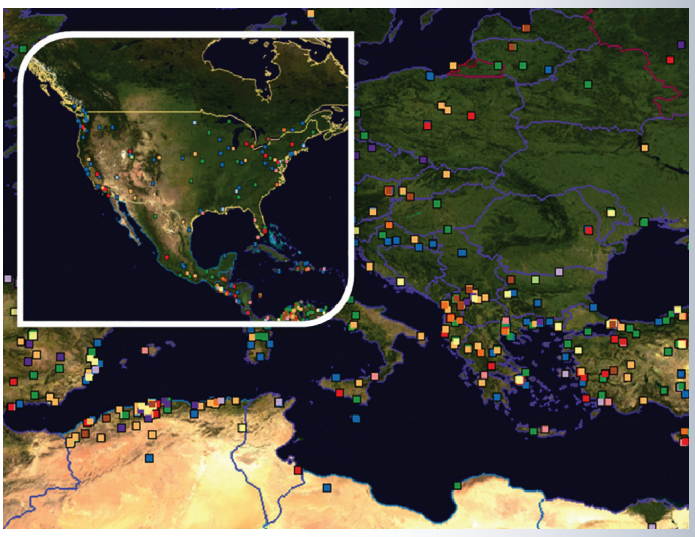
FPS's enterprise-class solutions are mature and proven in the field, capitalizing on years of development and government funding at PNNL. In fact, John Risch, formerly a Chief Scientist at PNNL, has joined the leadership team at FPS as Chief Technology Officer. It was through John's efforts and pioneering research in the field of information visualization that the Starlight software platform was first created. Unlike existing approaches to data analytics and intelligence analysis, Starlight has built a solution for true information fusion. Starlight integrates multiple information types seamlessly, including text documents, database records, web pages, geospatial data, images, video, and more. Starlight also keeps pace with dynamically changing information environments, an essential capability that enables sensemaking as data types and data sources are constantly in flux.

A Little Help from Their Friends: Key FPS Partnerships

As part of its spin-out from PNNL, FPS has signed a key partnership with Battelle, the operating contractor for PNNL. Battelle acts as a valuable evangelist, reseller, and training partner for FPS, while PNNL is uniquely qualified to conduct advanced IT R&D on the Starlight platform on behalf of interested U.S. government organizations. Ben Sommers, FPS Vice President of Sales and Marketing, asserts, "The partnership with Battelle has been invaluable as we've taken the Starlight software solution out from the lab environment at PNNL and into the broader commercial market. Through our work with Battelle and ongoing partnership with PNNL, we've been able to offer the onsite integration and consultative services that many of our clients demand when rolling out the Starlight software platform." In addition to key partnerships with PNNL and Battelle, FPS has also established valuable reseller and integration services relationships with well-known vendors such as SAIC and MicroLink.

Data Clean-Up: A Critical Step in Enabling Sensemaking

Starlight enables users to work with a virtually unlimited variety of data types, ranging from structured, semi-structured, or unstructured information such as database records, message traffic, and open source material, to geospatial and multimedia data. In addition to their flagship software platform, Starlight, FPS has also licensed from PNNL the XML Engineering Environment (XEE), a solution to the significant challenge of engineering, processing, enhancing, and using data from complex information systems. Designed as a companion product to Starlight, XEE enables users to quickly set up complex data processors in a fraction of the time required through traditional scripting or programming methods.



Starlight's Geospatial View illustrates the location of key events or information sources on a customized, interactive map.

Positioning for Continued Success Alongside PNNL

FPS's award-winning information engineering and visual analytics products are used in government and Fortune 500 organizations worldwide. Key implementations include U.S. intelligence and military organizations and commercial clients who seek to make sense of the vast, disparate data sources at hand to enable better decision making. Ben Sommers maintains, "PNNL has been a key partner to help build awareness with both government and commercial clients for our Starlight solution. In fact, Future Point Systems participated in a session at the NVAC summer camp (page 17) hosted at PNNL to showcase the enormous capabilities that visual analytics brings to the government and commercial marketplaces. PNNL has been there to help educate key stakeholders around the world about the value of visual analytics and to provide excellent training and research and development services for FPS."

FPS is headquartered in Mountain View, CA, with offices in Washington, Oregon, and Washington, D.C.

For more information, see http://www.futurepointsystems.com.

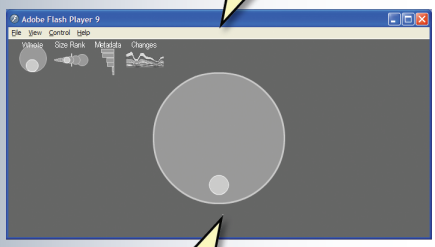
Team Members

Future Point Systems: Paul D'Antilio, Rich Remington, John Risch, Ben Sommers

Point of Contact

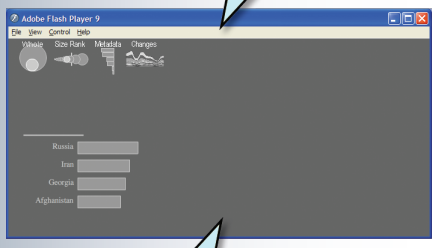
Ben Sommers, Vice President, Sales and Marketing, Future Point Systems, Inc., bsommers@futurepointsystems.com

1 *First Look, "This is your First Look recap for August 19, 2008."*



2 *First Look, "You have 1397 new documents. This update is 8 percent of your total data set size."*

3 *First Look, "It's a larger than normal update."*



4 *First Look, "Here are today's documents broken down by country."*

A Look at First Look

The problem with predicting the future is that it keeps changing into the present. New information—and our understanding of old information—changes and accumulates continuously, forcing those who would like to understand the future to spend a disproportionate amount of their time simply trying to keep up with the recent past, instead of trying to make sense of it.

But what if researchers could give users tools to help them quickly identify what has changed in their information space and what has stayed the same? What if researchers could help them sift through the new information and quickly determine what demands their attention?

A First Look at the News

Faced with these questions, NVAC Director Jim Thomas came up with a simple vision and a challenge to his staff. According to Thomas, "I told the [First Look] project team that I wanted to see a tool that would let the user know, in two minutes or less, what had changed in their information space.

"And I wanted this to be brought to them without any need to learn a new tool. It had to be something that anyone could understand from the very first time they saw the tool."

That was in 2007. Since that time, the First Look team has been working on turning this vision into a reality. Building upon PNNL's extensive experience with text signature analysis, the team has built a prototype version of the First Look tool and applied it to a document base of more than 21,000 news stories. The preliminary results are encouraging: the nearly universal reaction to a demonstration of the tool has been, "When can we have it?"

First Look technology provides easily digested multim highlighting key changes in streaming data so users c

A Quick Look at First Look

First Look views the news through the concept of stories—groups of documents that share common topics over a period of time. Essentially, First Look is a quick video summary of how those stories have changed over time—during the past week, since the last time the user viewed them, or over the lifetime of the story. The video consists of short animated "report segments" that present different views of the stories, broken out by topic, by news source, by geography; the team is exploring the options for what sorts of views might be most useful. Each segment depicts how the data have been changing and flags important trends—for example, a change in the frequency of reporting on that topic or a notable change in affect or mix of data sources.

A Laboratory for "Walk-up Analytics"

First Look is one of the earliest examples of what the NVAC team is calling "walk-up analytics"—tools that are simple and intuitive enough to permit users to "walk up" to the tools and begin using them productively immediately. Such tools are intended to change the way that users relate to their information spaces, by encouraging new forms of interaction.

Because the concept of walk-up analytics is still in its infancy, researchers anticipate a lot of experimentation with interface concepts, data visualizations, and multimedia (including sound and animation). The First Look architecture is designed to separate the underlying data analysis from the presentation layer, ultimately allowing users to select from a rich menu of presentation visualizations, or report segments, to build their First Look reports according to their individual cognitive style, tastes, and task orientation.

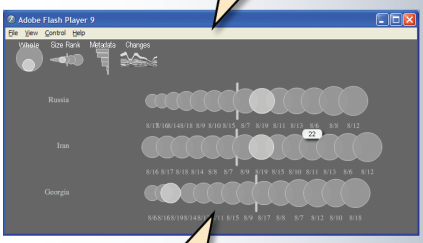
Looking Beyond the News

The initial emphasis in the First Look project has been to demonstrate its application to monitoring news sources. This makes sense because the news provides a continual stream of ever-changing text data, with story threads that come and go in cycles that vary in length from days to months or even years.

But the potential applications of First Look extend to any data source that regularly changes, where the user may want to "examine by difference" the changes in the data source. Email threads, changes to social media (such as blogs and wikis), even the results of database or search engine queries are all examples of data sources that the First Look team has been considering. For instance, imagine being able to store a search in Google and receive a First Look report each day letting you know how the results of that search have changed. Such a capability will enable a new kind of relationship between users and the topics that they are interested in: exactly the result that the First Look team hopes to achieve.

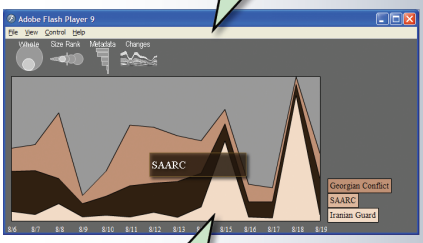
edia summaries of complex information spaces, an focus their analysis where it matters.

5 *First Look, "Russia produced more documents than normal in the past 24 hours. Iran produced more documents than normal in the past 24 hours. Georgia produced fewer documents than normal in the past 24 hours."*



6 *First Look, "6321 documents fall into 3 story categories."*

7 *First Look, "Plotting the recent activity for the top 3 stories for Iranian Guard."*



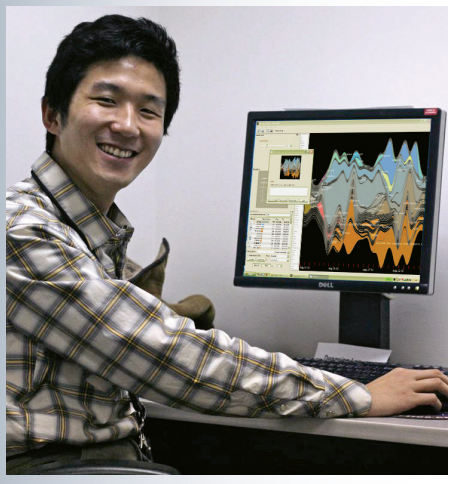
8 *First Look, "This concludes your First Look update. Use the menu above to explore this update..."*

Team Members

Pacific Northwest National Laboratory: Scott Butner, Wendy Cowley, Vern Crow, Michelle Gregory, Eric Marshall, Stuart Rose

Point of Contact

Scott Butner, Research Scientist, PNNL,
scott.butner@pnl.gov



Dongning Luo, Ph.D. Candidate

Standing at the Forefront of Visual Analytics Research

Dongning Luo, University of North Carolina at Charlotte

My internship at NVAC in the winter of 2008 was a collaborative and interactive research experience. Instead of the mode of "do what you are assigned," my PNNL mentors (Shawn Bohn and Bill Pike) and I worked together to develop a research plan; my personal interests and opinions were fully respected. As a member of the SouthEast RVAC, I got the chance to contribute my previous work into NVAC's research projects and integrate my visual analytics techniques into NVAC tools, which will direct and inspire my future work.

Temporal Text Extraction

A major focus of my internship was investigating issues and gaps in the current state of temporal text analysis in the context of real-world analysis problems. This will support the development of novel temporal text extraction techniques to aid high-level visual exploration of text collections.

Temporal text analysis originates from topic detection and tracking research in the information retrieval area; knowledge and sequential pattern discovery in the knowledge discovery area; and, in a broad sense, time series analysis in the statistics area. Temporal text analysis helps analysts understand how themes in data emerge and evolve over time.

In addition to contributing new algorithms to NVAC tools, I investigated current research related to temporal text extraction in the information retrieval and knowledge discovery fields. I identified the complexities involved in identifying intertwined semantic correlations among topics, the episodic evolution of topics, and the lack of organizing structures beyond the granularity of individual articles or messages. Current research places more emphasis on semantic relations among themes in articles than on exploiting and exploring their temporal features. However, my discussions with PNNL analysts revealed that understanding evolutionary patterns is one of their most important issues. Other important issues such as the ranking and tracking of topics and the temporal information embedded in the content also have not been well explored.

A deep understanding of the temporal themes in information is the first step to map them into visual patterns that help users make sense of information. A promising research area for me, and one that will inform my own Ph.D. topic, is creating new ways to integrate user interaction and visualization into the temporal text analysis process.

Other Internship Benefits

I am very grateful that I had the opportunity to work with scientists from different research groups and to learn how to communicate and be a team player in a large project involving many people with different backgrounds. Perhaps the most valuable experience was interacting with real analysts to identify research requirements for real-world problems, letting me see the frontline of visual analytics. This kind of collaboration between NVAC and RVACs promotes communication of the latest research findings.

An Intern's Experience

"I supported multiple information analyses by generating and assessing high-dimensional visual datasets. I also collaborated with numerous analytical teams to test IN-SPIRE statistical tools and capabilities in support of future software releases. Engaging in these complex projects has allowed me to acquire many skills necessary to succeed in future career opportunities. This educational and gratifying internship experience was made possible by NVAC's diligent, dedicated and experienced scientific leadership."

Michael Gilligan,
North Carolina State University,
NVAC Summer Intern 2008

Inaugural Visual Analytics Summer Camp a Success

The National Visualization and Analytics Center hosted a two-week educational workshop sponsored by the Department of Homeland Security. Attendees were immersed in training from July 14-25, 2008 at the Pacific Northwest National Laboratory in Richland, Washington. The workshop was an enormous success, with comments ranging from "the agenda had a great mix of fascinating topics" to "this workshop was very valuable and worth every minute."

NVAC Director, Jim Thomas, interacts with Alexander Endert of the College of Charleston.

Attendees engaged in a training session.

In-Depth Curriculum

The 17 hand-selected participants were all early in their visual analytics career and represented a variety of backgrounds, including government and industry. Attendees came from the National Air and Space Intelligence Center, Mercyhurst College, Simon Fraser University, Middlesex University, and other institutions.

The 10-day curriculum of in-depth training included panel sessions, an analytic writing assignment, an evaluation session, a Watch and Warn analyst training session, and hands-on experience with tools, such as Jigsaw, IN-SPIRE, Analyst's Notebook, and Starlight. Participants also had ample time for networking through planned social activities and one-on-one lunches with PNNL researchers.

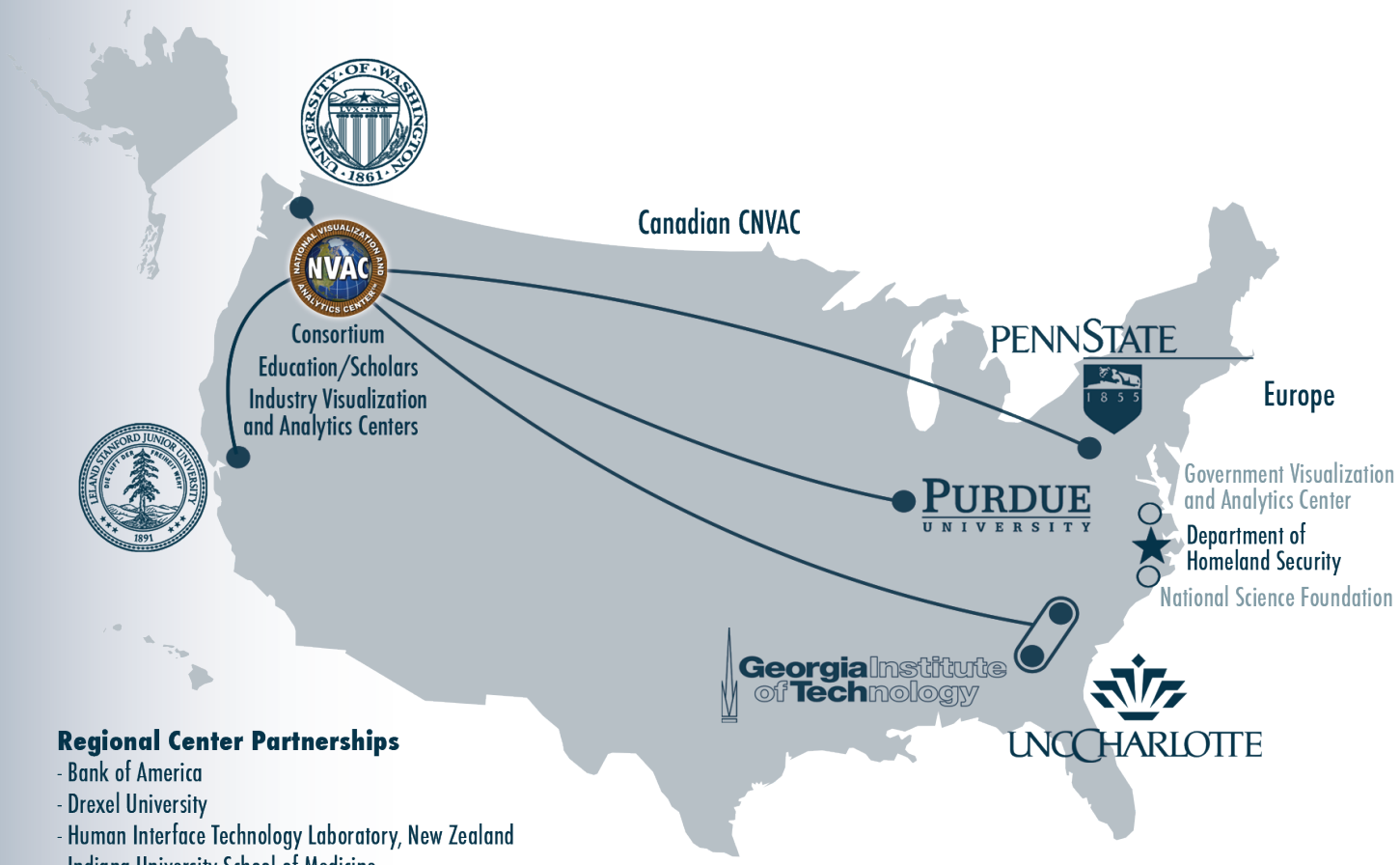
Relationships were formed that will lead to future partnerships.

Point of Contact

Carrie Almquist, Specialist,
PNNL, carrie.almquist@pnl.gov

Summer camp attendees enjoy a barbecue on the Columbia River.

A Partnership with Academia, Industry and Government



Regional Center Partnerships
- Bank of America
- Drexel University
- Human Interface Technology Laboratory, New Zealand
- Indiana University School of Medicine
- NY/NJ Port Authority

Consortium Members – Provider Level

Microsoft Research
BOEING
tableau SOFTWARE
FUTURE POINT Systems, Inc.
Quantum4D®

Program Representatives

Joseph K. Kielman
Department of Homeland Security

John Hoyt
Department of Homeland Security

James J. Thomas
National Visualization and Analytics Center

What Is VAC?

The Visualization and Analytics Centers are a national and international resource, fulfilling a fundamental need to provide advanced analytical tools to address the U.S. government's critical challenges in identifying and preventing attacks on U.S. soil.

In 2004, the Department of Homeland Security chartered the National Visualization and Analytics Center at the Pacific Northwest National Laboratory to define a long-term research and development agenda for visual analytics. NVAC established the family of VACs through academic, government and industrial partnerships.

Vision

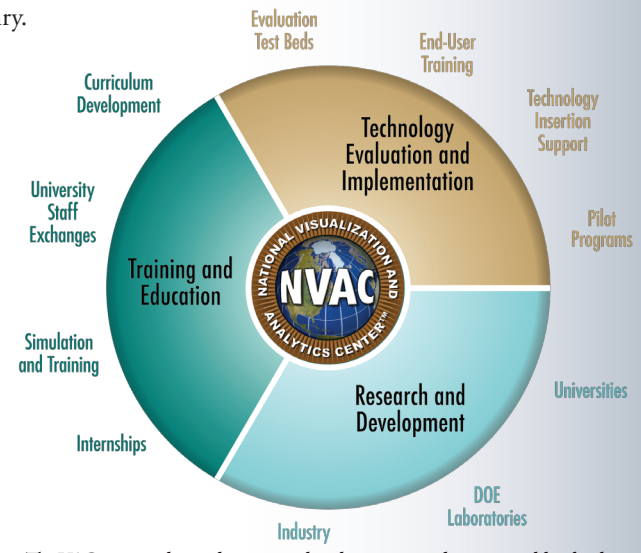
VACs will provide high throughput, accessible visual analytics, enabling anticipation and prediction of, preparedness for, and response to man-made and natural disasters and terrorist incidents and ensuring the security and resilience of our nation's infrastructures and citizenry.

VAC Approach

VACs are more than research and development. They foster a culture that brings together the resources necessary to advance the state of visual analytics.

The VAC charter includes four major missions:

- **Research and Development Leadership:** Provide stewardship for the visual analytics R&D agenda, ensuring that a continual stream of advanced analytical tools are developed and implemented for stakeholders.
- **Technology Evaluation and Implementation:** Evaluate new methods and support the adoption of new tools for analysts and emergency responders.
- **Training and Education:** Build the intellectual capital and workforce capacity at all levels for research, education and training.
- **Coordination and Integration:** Bring together the best researchers from government, academia, industry and national laboratories to create visual analytics tools.



The VAC approach involves research, education, evaluation and leadership.

VAC Partnerships

The unique partnerships created under VACs among universities, industry and government agencies represent an ongoing commitment to collaboration in the discipline of visual analytics.

Regional Visualization and Analytics Centers

Each university-led RVAC conducts research in one or more of the areas described in the R&D agenda for visual analytics. The RVACs' research concepts and prototypes are evaluated in the context of user needs and priorities. RVACs also develop curricula in visual analytics.

Government Visualization and Analytics Centers

GVACs, which are led by non-DHS government agencies, aim to create the best possible visual analytics tools for government missions.

Industrial Visualization and Analytics Centers

IVACs support the research in elements of the R&D agenda or fund integrated technology demonstrations that join new capabilities to address an important problem.

Other Partnerships

Other less formal partnerships have been formed (for example, through University Affiliate Centers), and NVAC has a year-round internship program for both students and professors. The twice-yearly VAC Consortium meeting brings together all the partners to promote dialog, understanding and education. NVAC is also enabling increased collaborative research with international partners. Meaningful collaboration helps ensure the success of the VACs by industry implementation of the best solutions from research with continual input from the user community.

Visualization and Analytics Centers

Visualization and Analytics Centers fulfill a fundamental need to provide advanced analytical tools to make progress in understanding and addressing critical challenges in identifying and preventing terrorist attacks in the United States and around the globe. The following listing provides brief descriptions of the Centers, the Centers' individual projects, and related and jointly funded projects. The primary points of contact for each Center are also provided for further information.

NVAC – Contact: Jim Thomas, jim.thomas@pnl.gov

The National Visualization and Analytics Center provides leadership and coordination among the academic community, industry and government to create and deploy visual analytics technologies to ensure the security and resilience of our nation's infrastructure.

Leadership & Coordination

Visualization and Analytics Center Consortium

The VAC Consortium provides a forum where industry and university leaders and government specialists collaborate to achieve the best solutions to protect the nation.

VAC Participation in Conferences and Workshops

Participation and collaboration through conferences, workshops and other forums ensures that VAC-developed technology is deployable and has real-world impact.

National Science Foundation: Partnering to Advance Visual Analytics

A formal partnership between DHS and the National Science Foundation results in the establishment of the NSFVAC.

Educating the Next Generation

Internships for students and professors at NVAC, visual analytics curricula at universities, and workshops at conferences and other venues are just a few of the ways the VACs are educating the next generation of researchers.

Research

Scalable Reasoning System: Lightweight Visual Analysis and Dissemination

SRS is a prototype suite of analytical capabilities that can be deployed over the web. Its visual interfaces offer intuitive ways to explore information collections.

Visual Analytics for Law Enforcement

The Law Enforcement Information Framework, based on SRS, links mobile and office law enforcement personnel with real-time information analysis and notification tools. Web-based and PDA interfaces enable investigators to find patterns in data and disseminate findings to colleagues.

Threat Stream Generator

TSG creates realistic data sets that are becoming the test data sets of choice by commercial tool developers, government analysts, and university technology developers.

Evaluation of Visual Analysis Environments

This project is helping RVACs develop their own evaluation metrics based on their needs and working with potential end users to develop task descriptions, work environment constraints and metrics.

Visualizing Semantic Graphs

Have Green is a suite of visual analytics technologies that supports analysis of large semantic graphs.

Analyzing the U.S. Electric Power Grids

GreenGrid, a visual analytics prototype, identifies vulnerabilities in U.S. power grids.

The Assessment Wall: Usable Visualization for Streaming Data

The Assessment Wall has linked visualizations for streaming text documents on a high-resolution touch-screen interface to help users find the latest on topics of interest and to discover unexpected and emergent themes.

Text/Data Analytics Integration

This effort explores approaches that will leverage analysis techniques used for both unstructured text analysis and structured data analysis.

Active Products: Composition and Dissemination of Smart Analytic Reports

Active Products are a new kind of "smart report" that support both rapid authoring and new modes of presentation.

Information Synthesis and Fusion

This research intends to develop mathematical models and methodologies that merge information with different conceptual representations into a common semantic space.

Rapid User-Guided Analytics: Reducing the Time to Productive Analysis

RUGA is developing ways for users to rapidly assess an entire information space in a personalized context.

ProSPECT: Proactive Scenario Production, Evidence Collection and Testing

ProSPECT is a visual interactive environment for event, entity, and relationship analytics that integrate knowledge discovery, discourse analysis and visualization capabilities to scenario manipulation and generation.

Audio Categorization

This project is developing the capability to compare audio and text features based on the linguistic and emotional content of a conversation recording and combining the analytical results into one coherent, comprehensive analysis.

IN-SPIRE

IN-SPIRE is text analysis and visualization software that can quickly reveal important information from large collections of unformatted text documents and accelerate subsequent investigation and discovery.

Universal Parsing Agent

UPA, an R&D 100 award winner, accepts multiple data sets or streams of information, discovers and extracts information needed by users and delivers results in their most useful form.

The Pennsylvania State University –
Contact: Alan MacEachren, maceachren@psu.edu

The North-East Visualization and Analytics Center, operated by Penn State, is one of five regional centers coordinated by the National Visualization and Analytics Center and supported by the U.S. Department of Homeland Security. NEVAC is developing knowledge-enabled, geographically aware visual analytics.

Thrust 1: Information Retrieval, Extraction and Contextualization

A fundamental challenge for homeland security is to quickly find among massive volumes of data the information essential for threat and situation assessment and decision making. This thrust addresses the challenge through fundamental research linked to development, implementation, testing and deployment of visual analytics tools.

FactXtractor: Automated Named Entities and Entity Relationship Extraction from Text Documents

FactXtractor is an information extraction web service that provides core technologies to support textual data analysis.

FEMARepViz: Automatic Information Extraction for Geo-temporal Visualization

FEMARepViz supports nationwide and regional crisis situation assessment by visualizing FEMA situation updates geographically. It automatically extracts place and event information from reports and plots them on web-based maps that make it easy to see the distribution of events and to drill down to relevant details.

Context Discovery Application

CDA supports knowledge-enabled retrieval of news stories and other documents relevant to user-specified issues and places.

TexPlorer: An Integrated System for Text Analysis and Visualization

TexPlorer enables information analysts to find entities and connections in text documents.

Geographic Information Retrieval

Geographic Information Retrieval methods and tools address the challenge of retrieving documents that are relevant to a task in terms of both document theme and geographic focus.

Health GeoJunction

Health GeoJunction is an interactive visual analytic web portal for tracking the science and public health indicators of infectious disease threats.

Thrust 2: Visual-Computational Methods

NEVAC is developing new visual and computational methods that support rapid sifting and analysis of complex information sources. The approach combines modular tool architectures that support interconnection of independently developed components with general visual analytics strategies that adapt easily to many problem contexts and support complex querying of realistically large data sets.

Improvise Application: KEDS

The Kansas Event Data System tool provides analysts, policy advisors, journalists, and social scientists with a highly interactive visual interface for probing geographic and temporal patterns in political relationships between groups of international actors.

Improvise: Highly Coordinated Multiple View Visualization

Improvise provides tool developers with an environment for rapidly prototyping and implementing applications that support highly interactive visual exploration and analysis of high-dimensional, multi-source information.

The GeoViz Toolkit: Insight into Spatial Data

The GeoViz Toolkit supports systematic analysis of spatial, temporal and attribute data sets and allows analysts to discover previously hidden patterns in data.

CiteSpace: Detecting and Tracking Trends and Transformative Changes

CiteSpace facilitates visual analysis of trends, patterns and critical changes in a volatile information environment.

Semantic Network Structure Analysis

SemanticNetSA will help analysts assess the evidentiary value of data stored in graph or network form.

Thrust 3: Knowledge Representation and Management

In this thrust area, NEVAC's focus is on integrating technologies from three areas: concept mapping and knowledge visualization; ontology management; and text browsing and analyzing.

ConceptVista: A Visual Environment for Ontology Development and Analysis

ConceptVISTA supports the representation, management, and exploration of knowledge and the connection of knowledge with data. It enables analysts to quickly encode tacit knowledge and link artifacts to existing knowledge structures that support computational reasoning.

Thrust 4: Supporting Analysis and Decision-Making in Group Work

NEVAC research in group work is identifying impediments to successful distributed and collaborative, visually enabled work in the domains of crisis management and threat assessment and developing specific geo-visual analytics technologies to support collaborative tasks in these domains.

NeoCITIES Geo-Tools

NeoCITIES Geo-tools is an update and extension of the NeoCITIES scaled-world simulation developed based on knowledge elicited from crisis management experts. NeoCITIES is a resource allocation problem involving police, fire and hazardous materials teams designed to mimic emergent situations that comprise real-life emergencies and to measure decision-related outputs.

Purdue University – Contact: David Ebert, ebertd@purdue.edu

Purdue University Regional Visualization and Analytics Center is dedicated to supporting the National Visualization and Analytics Center and the U.S. Department of Homeland Security in confronting the challenges of safeguarding our nation against natural and human-induced catastrophic events.

Data Integration

PURVAC is taking a multipronged approach to solve challenges inherent to the critical problem of data integration.

Privacy and Visual Analytics: Effective Analysis of Anonymized Data

PURVAC is evaluating and comparing privacy protection methodologies and their impact on analytical methods and plans to analyze the performance of de-identified data relative to original data to see when privacy and utility coexist.

Visual Analytics for the Disaster Response Life Cycle

The visual analytics disaster response life cycle defines the key challenges facing first responders. By implementing systems based on this framework, tools for improved coordination, delivery, detection and response in large-scale disaster management will be greatly enhanced.

Mobile Analytics for Command & Control in Real-World Testbeds

PURVAC is exploring the potential of mobile analytic techniques using several applications as test beds: wireless network/sensor mobile analytics for the eStadium project; first responder mobile analytics using the Muscatatuck Urban Training Center; and first responder mobile analytics using a decommissioned elementary school.

Integrating Personnel Tracking and Video Capture For Emergency Response

This research focuses on creating an affordable, mobile, state-of-the-art emergency response training capability and real-world testbed through the integration of low-cost, commercially available products.

In-field Visual Analytics

PURVAC has developed three systems that address the challenges in creating compact, interactive visualizations supported by limited mobile hardware on devices ranging from TabletPCs to cell phones.

Mobile Analytics for Emergency Response and Training

PURVAC's mobile visual analytics system provides a flexible, interactive prototype for emergency response and training by allowing first responders to better carry out rapid and actionable on-site analysis and decision making.

Sensor-Driven Video Analytics: Next Generation Surveillance System

PURVAC is investigating a new approach to the development of sensor-driven surveillance systems that monitor security conditions, identify events of interest and coordinate emergency response operations.

Smart Video Surveillance

Object-tracking tools have been tested on video sequences with moving objects including humans and vehicles. These tools can be deployed in many applications such as visual surveillance, road traffic control, human-computer interface and video compression.

Social Networks: Applications to First Responder Scenarios

PURVAC is examining social networks in the context of first responders. The main issue is how to coordinate resources and first responders in an emergency. To answer this question, PURVAC is harnessing key ideas drawn from social networks: presence and status, messaging and coordination.

Visual Analytics for Analysis, Management and Containment of Zoonotic Disease Spread

PURVAC has developed a suite of analytic tools aimed at improving disease control on local farms, as well as providing analysis of larger scale zoonotic disease occurrences.

LAHVA: Linked Animal-Human Health Visual Analytics

LAHVA technology provides public health officials with a suite of visual analytic tools for spatio-temporal exploration of multivariate healthcare data sets in linked statistical and geospatial-temporal views.

Time-Space Modeling and Analysis for Disease Surveillance

Advanced statistical models provide healthcare professionals with tools for measuring and predicting disease spread, allowing for rapid detection and response to outbreaks.

Network Security: Flow Monitoring and Forensics

PURVAC is collaborating with the Stanford RVAC to develop novel techniques to analyze traffic flows on computer networks to distinguish normal user activity from attacks to prevent humans and machines from gaining illegal entries.

K-12 Education Initiative

PURVAC and the Purdue Homeland Security Institute are working on educational outreach initiatives to inform PK-12 students and teachers about the broad range of topics related to visual analytics and homeland security.

Stanford University – Contact: Pat Hanrahan, hanrahan@cs.stanford.edu

The Stanford RVAC performs basic research on the technology behind visual analytics with an emphasis on applications drawn from transactional analytics.

Scalable Visual Analysis for Temporal Databases

The goal of this research is to develop technologies that enable scalable and interactive visual analysis over large temporal data sets.

Isis: Visual Analytics for Network Security Investigations

This project contributes new interactive visualization techniques for analyzing, organizing and presenting network event data at multiple levels of detail for the purpose of forensic analysis—tracking down causal sequences of importance.

Visualizing Heterogeneous Information Spaces

The Stanford RVAC is developing techniques for automatically creating visualizations from heterogeneous graphs of relations. The system automatically searches for and ranks paths from objects to the attributes needed to visualize the objects.

The Perceptual Efficiency of Information Visualization

This project is conducting basic research in visual analytics using eye tracking. The purpose is to improve the understanding of established visualization display and interaction techniques by analyzing interaction at the level of moment-to-moment visual attention and cognitive load.

University of North Carolina-Charlotte and Georgia Tech – Contacts: William Ribarsky, ribarsky@uncc.edu; John Stasko, stasko@cc.gatech@edu.com

The SouthEast Regional Visualization & Analytics Center (SRVAC) is a closely integrated collaboration between the University of North Carolina at Charlotte and the Georgia Institute of Technology. The main objective of SRVAC is to attack challenging problems in evidence gathering, investigative analysis, hypothesis building and testing, and decision making using analytical reasoning capabilities within the visual analytics context.

RESIN: Resource-bounded Decision Making

RESIN is a mixed-initiative reasoning agent that helps investigative analysts perform multi-view point predictive analysis.

Global Terrorism Data Visualization

GTD contains a broad range of visual analytic tools to support the exploration and investigation of patterns in international terrorist activity.

Automated Intelligent Multimedia Analysis

These tools provide investigators a complete, annotated organization of very large collections of images, broadcast video, multimedia web pages and more.

Image and Video Visual Analysis

Semantic Image Browser integrates automatic semantic image classification techniques with novel visualization techniques to let analysts browse and search large image databases. Broadcast News Video Browser integrates automatic news video analysis and temporal analysis techniques with visualization techniques to help analysts detect major news events, access related stories and retrieve stories from large video streams.

Jigsaw: Visualization for Investigative Analysis

Jigsaw provides investigative analysts with a "visual index" onto a document collection and helps them track down connections between entities, thus facilitating the discovery of embedded plots and threats.

Financial Visual Analysis

WireVis facilitates the marriage between the art of analysis with the science of visualization and allows the analyst to systematically discover suspicious financial activities in a reproducible manner.

ResultMaps: Understanding Search Spaces and Search Results

ResultMaps use existing hierarchical structures (e.g., subject classifications) to provide a visual representation of how search results are distributed over a data set.

Visual Analytics Digital Library

VADL provides an organized and readily accessible collection of educational material designed to help teachers develop VA courses and to help students more quickly develop competence as VA practitioners and developers.

University of Washington – Contact: Mark Haselkorn, markh@u.washington.edu

The University of Washington manages the Pacific Rim Visualization and Analytics Center. PARVAC's mission is to advance distributed cognition and visual analytics to enhance decision making for public safety and security around and across the Pacific Rim. PARVAC also serves as a resource for regional research on communication and collaboration among public safety and security agencies in Puget Sound.

RimSim

RimSim is designed to integrate relevant critical infrastructure data and interaction methods into a role-playing testbed for synchronous and asynchronous collaboration during simulated emergency scenarios.

Just-In-Time C3

The JITC3 visualization system uses GIS data to generate a cohesive geo-spatial representation of an urban environment that can be navigated and manipulated using Augmented Reality. JITC3 has an intuitive, tangible interface to navigate and view location-specific perspectives.

Geospatial Optimization of Strategic Resources

The GOSR project develops optimization models for the location and allocation of medical supplies to be used in emergencies in the Seattle region, an area vulnerable to critical infrastructure damage due to earthquakes. These optimization models are an important component of the "analytics" in visual analytics systems.

Moving Visual Analytics Research into Practice

This project aims to improve the way new technology for enhanced visual analytics is developed, introduced and maintained within the environments of regional safety and security communities.

University of Illinois at Urbana-Champaign – Contact: Dan Roth or Robin B. King, contact@mias.uiuc.edu

The Multimodel Information Access and Synthesis Center

The MIAS Center is part of a nationwide network of Department of Homeland Security Centers of Excellence that perform research on advanced methods for information analysis and decision science.

New Search Paradigms for Meaning-based Information Retrieval

The goal of this project is to develop natural-language processing capabilities and associated search protocols that improve search capabilities.

Cornerstone Technologies for Automated Text Analysis (part one)

MIAS is developing a suite of efficient, precise and domain-adaptable tools that improve information extraction, synthesis and visualization by making relevant concepts in natural-language text easily accessible to analysts.

Cornerstone Technologies for Automated Text Analysis (part two)

MIAS is developing general probabilistic models and new algorithms for discovering and analyzing various contextual patterns from text.

Contextual Text Analysis with Probabilistic Topic Models

This project is developing general probabilistic models and new algorithms for discovering and analyzing various contextual patterns from text.

MetaQuerier: Exploring and Integrating the Deep Web

This research aims to enable effective access to structured information sources on the internet.

Complex Data Analysis: Knowledge Discovery from Massive Data Sets

This effort reveals hidden correlations or structural events; analyzing such hidden networks will have a strong impact on identifying hidden themes as well as analysis of social (and anti-social) networks and other sub-communities.

Learning the Meaning of Pictures

Words that appear next to images are correlated. We use this information to train correlated word predictors and discover scene types, improving analysts' ability to derive useful information from images and text.

Cimple: Monitoring People and Events for Online Communities

The Cimple Project is developing a software platform that can be rapidly deployed and customized to manage data-rich online communities.

Data Science Summer Institute

The MIAS Center has a unique summer program that teaches information analytics and retrieval methods from a vast number of potential sources.

University of Pittsburgh – Contact: Jan Wiebe, wiebe@cs.pitt.edu

CERATOPS: Center for Extraction and Summarization of Events and Opinions in Text

CERATOPS is developing new capabilities for information extraction from unstructured text that will allow information analysts to automatically identify entities, facts, and relations from text-based information sources. The emphasis of this work is on accuracy, robustness and rapidly re-trainable deployment.

Detecting Opinion and Sentiment Types to Improve Question Answering and Information Extraction

Expressions of opinion are ubiquitous on message boards, discussion forums, blogs etc. Being able to automatically extract these opinions in a timely manner enables one to take the pulse of public opinion.

Extraction and Summarization of Fine-grained Opinion Frames

This project tackles the problem of automating fine-grained interpretation of opinion expressions at the phrase-level or clause-level.

Exploiting Semantics in Information Extraction

This project has developed several new methods for extracting factual information from unstructured text. These techniques have achieved good results in the domains of Latin American terrorism and infectious disease outbreaks.

Rutgers University – Contact: Fred Roberts, froberts@diamacs.rutgers.edu

DyDAn Is a University Affiliate Center of the Institute for Discrete Sciences

The Center for Dynamic Data Analysis (DyDAn) is one of four Department of Homeland Security Centers of Excellence performing research on advanced methods for information analysis.

Analysis of Large, Dynamic Virtual Communities

This project is developing methods for understanding and analyzing large dynamic multi-graphs arising in virtual communities.

Universal Information Graphs

Universal Information Graphs are a tool for analysts that are the result of fusing a collection of graphs on separate vertex sets. This project is developing the algorithmic and computational infrastructure to support analysis of dynamic, and sometimes massive, networks.

Optimization and Learning for Decision-making under Uncertainty

This project is developing logic for optimally collecting information and for detecting fundamental changes in streams of data. These methods are applicable to a broad range of detection problems, such as determining when a nuclear detector has failed or when a new pattern of activity emerges.

Enhancing Law Enforcement Using Data and Visual Analytics

DyDAn is joining with the Port Authority of New York and New Jersey, Pacific Northwest National Laboratory, Intuidex and the National Consortium for the Study of Terrorism and Responses to Terrorism to develop cutting-edge data analytic and visualization tools for immediate use by Port Authority law enforcement personnel.

Laboratory for Port Security

The Laboratory for Port Security is building systems to help understand and mitigate the impact of events at ports.

Optimizing Port of Entry Inspection

This project is providing strategies for inspecting cargo containers at sea ports, balancing costs of inspection with detection rate to achieve the best possible detection rate given practical limitations.

Sensor Management Problems of Nuclear Detection

This project is addressing sensor management for nuclear threat detection by formulating the related problems using precise mathematical language and then developing tools of the mathematical sciences to solve them.

Privacy-Preserving Model Selection

This project studies privacy-preserving model selection. Initial work assumes a kind of vertical partitioning in which one party holds all the data except the class label and a second party holds all the class labels. The project demonstrates how to perform model selection using cross validation in a privacy-preserving manner without revealing the parties' data to each other.

Using Entropy for Biosurveillance

This project, initiated as part of the DHS Summer Research Team Program for Minority Serving Institutions, examines the potential for using information theoretic measures of entropy in biosurveillance.

Adding Semantics to and Interconnecting Semantic Graphs

This project is investigating augmenting shallow representations of information in semantic graphs or networks with richer information, expressed as ontologies in formal representation languages (such as OWL).

Outreach Across New Jersey

DyDAn members are joining with state and local agencies to help keep New Jersey safe.

DyDAn K-12 Education Programs

DyDAn is committed to building pioneering educational programs that nurture the homeland security workforce of the future. Aware that individuals can help develop homeland security solutions well before college, DyDAn is developing K-12 programs to help teachers introduce homeland security topics in their classrooms.

DyDAn Research Experiences for Undergraduates

The intensive 8-week DyDAn Research Experiences for Undergraduates summer program pairs undergraduates with DyDAn faculty mentors to conduct research on important problems in homeland security.

Summer Reconnect Conference

Annual DyDAn Summer Reconnect Conferences allow faculty and government and industry professionals to explore research questions in a new area of the mathematical sciences relevant to homeland security. This program seeks to "reconnect" to the research enterprise faculty and researchers who don't have the time to keep up with research developments or who would like an immersive introduction to a new research area.

Promoting Homeland Security Research

DyDAn is building awareness of the importance of data analysis in homeland security. DyDAn hosts research workshops, seminars and tutorials to help connect the research community with the homeland security enterprise.

University of Southern California – Contact: Eduard Hovy, hovy@isi.edu

CKID: The Center for Large-Scale Strategic Knowledge Integration and Discovery from Multiple Media

To contextualize and visualize various media in the most appropriate form and discover trends and patterns, CKID is building technology to extract and save the data into a standardized form for each medium.

Geospatial Visualization of Multiple Media for Large-Scale Strategic Knowledge Discovery

This research is building a comprehensive geospatial knowledge base by exploiting a variety geospatial sources and using the knowledge base to search the various media to link them to specific locations.

Large-Scale Discovery of Patterns from Textual Information

This project is developing algorithms to allow automated discovery of trends and patterns over large amounts of textual information.

A Federated Store for Extracted Information and Semantic Graphs

This project provides a store for extracted and ontological information to facilitate effective retrieval by analysts and provide the basis for analysis methods and learning techniques to be applied to a massive amount of source information.

Context-Based Information Trust Analysis for Threat Detection

CONITA filters and presents the most relevant information for the analyst to enhance threat detection. The Content Relevance of the information (e.g., documents) presented to a user in response to an information request is measured based on the semantics of the request and the interests of the analyst.

Learning about Organization Structure and Personnel from Email

This project investigates what can be learned about individuals in an organization from their email messages.

KOJAK Link Discovery Tools

KOJAK UNICORN uses anomaly detection to find anomalous entities in large, complex data sets that are best represented by semantic graphs. KOJAK Simplifier applies normalization and abstraction operators to simplify large semantic graphs, allowing analysts to focus on and visualize only the important parts of the data.

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Lynn Brewer, Crime Analyst Supervisor, Newport News Police Department

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