Pacific Northwest
NATIONAL LABORATORY

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Visual Analytics
at Pacific Northwest National Laboratory

The Pacific Northwest National Laboratory (PNNL) has a long history of information visualization research leading to high-impact tools for its customers. The success of PNNL's information visualization software and publications in top visualization journals and conference proceedings are the results of PNNL researchers' dedication to helping people make sense of massive amounts of complex data.

A MULTI-DISCIPLINARY, COLLABORATIVE APPROACH

Visual analytics draws from information visualization and scientific visualization with a focus on analytical reasoning facilitated by interactive visual interfaces. PNNL's visual analytics team makes big, complex data useful through skillful visual design, compelling interaction, sound analytic methods, and solid engineering. This team of researchers, user experience specialists, software developers, and subject matter experts invents new visual metaphors, creates analysis algorithms, and delivers software products that put powerful visual analytics capabilities into users' hands. The team collaborates with experts across the laboratory and around the world—including statisticians, machine vision experts, modelers, and domain scientists—to solve its customers' hardest analysis challenges.

PNNL VISUAL ANALYTICS RESEARCH AND TECHNOLOGIES

PNNL creates interactive analytical environments that address dynamically changing data, allowing users to explore, discover, and learn; subset the data; run queries; perform time sequence studies; create categories and correlations of data types; and more.

PNNL has deployed visual analytics technologies in domains such as threat detection for national security, cyber analytics, intellectual property portfolio analysis, energy grid reliability, environmental safety, training, and law enforcement, amongst others.

FOCUS AREAS

PNNL's visual analytics research and development activities focus on five main areas:

Analytical Insights – PNNL's visual analytics team creates mathematical signatures that summarize key features in large, complex, heterogeneous data sets. Signatures are created from text, multimedia, and sensor data, with a focus on performance and scalability.

User Experience – Underlying all of the team's work is the ultimate goal: helping people work with information. The team's user-centered design approach includes collaborating closely with users to understand their problems, test solutions, and deliver usable and useful software products.

Visualization Development – The team develops new ways to tell stories with data through visual representations that are reduced to practice through interactive prototypes. Appealing depictions of complex patterns and relationships visually summarize the output of information signatures.

Analytic Methods – The team designs software and methods that guide users in exploring and gaining valuable insight from visual representations. Through these visualizations, users can create and test hypotheses, communicate results, and challenge assumptions.

Natural User Interactions – In addition to creating new interactive visual environments for the web, mobile devices, and desktop applications, the team explores emerging techniques and hardware for gesture and touch interfaces that brings users closer to their data than ever before.

EXAMPLE TECHNOLOGIES

Text and Multimedia Analytics – Text analytics extracts information from narrative documents and social discoveries, then generates themes and identifies relationships. Researchers continue to advance text analytics innovations and are extending this foundational work to multimedia data as well. For example, the Canopy software suite supports analysis and discovery in mixed-media data, including text, image, video, and audio.

Cyber Analytics – Cyber analytics applies interactive visual analysis to computer networks and related transactional data. For instance, PNNL's CLIQUE models events in large amounts of streaming computer network traffic, helping analysts spot anomalous behavior quickly.

Graph Analytics – Graph analytics addresses information that is represented as networks of nodes and links. PNNL has developed new algorithms for topological and content signatures and new visualizations for understanding complex graphs. Representative PNNL technologies include GreenGrid, a tool that allows visual exploration of the Western U.S. power grid and GreenSketch, which generates synthetic graph data for testing and benchmarking.

Lightweight Analytics – The Scalable Reasoning System provides users with easy access to information and visual analytics tools via the web. Precision Information Environments provides users with easy access to information and visual analytics tools via the web.

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