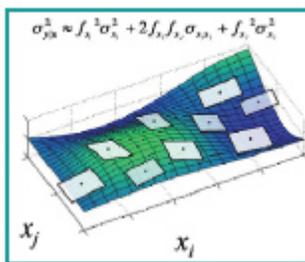


Science.

Technology.

Innovation.



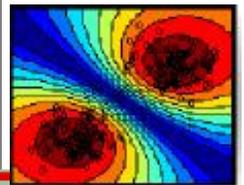
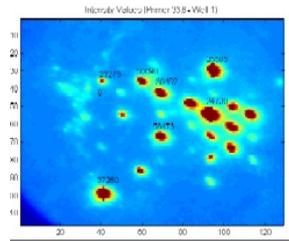
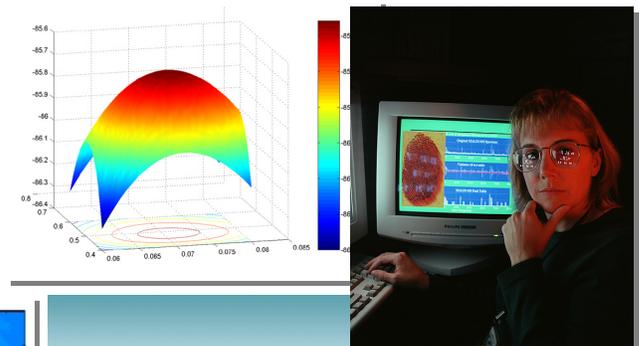
*Tangent Hyperplanes
Modeling provides efficient
approximation to response
and uncertainty in large-
scale simulations*

- ▶ Discovery
- ▶ Uncertainty Management
- ▶ Scientifically Defensible Decisions
- ▶ Mathematical Modeling

Statistical and Mathematical Sciences

Scientific research and development is a process of gaining a fundamental understanding of physical, chemical, and biological principles through computational modeling, experimentation, and data evaluation. The mathematical underpinnings provide a common thread for modeling across disciplinary boundaries and multi-scale systems. Regardless of the application, some level of uncertainty exists and statistical science provides approaches for quantifying and controlling uncertainty while extracting the nuggets that further scientific discovery.

PNNL is a leader in innovative applied statistics and mathematics research. We develop novel data analytic methods to *extract hidden features, anomalies, and signatures* from *high dimensional, large volume, multimedia data* in support of *discovery and confident decision making*. Complex *mathematical and stochastic models* are developed to represent physical, chemical, biological, and nuclear phenomena. We *design experiments and sampling campaigns* to ensure confident decisions and explicitly *manage and quantify uncertainty*.



**Pacific Northwest
National Laboratory**
Operated by Battelle for the
U.S. Department of Energy



Capability Profile

The capabilities within SMS are diverse and often delivered in the form of Methods, Algorithms, Custom Analysis Software, and Analytical Support. These capabilities represent a significant component of the Computational and Mathematical Sciences Division:

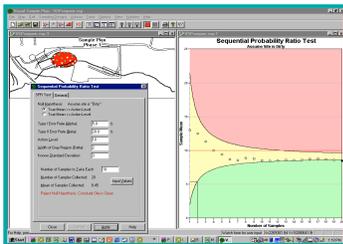
- ▶ Data Mining and Feature Extraction
- ▶ Scientific Modeling: Stochastic/Deterministic
- ▶ Bioinformatics and Chemometrics
- ▶ Simulation and Uncertainty Management
- ▶ Analysis of Non-Traditional Data (text, video, audio, spectral, images ...)
- ▶ Systematic Planning and Sampling Design
- ▶ Experimental Design and Engineering Statistics
- ▶ Anomaly Detection and Forecasting
- ▶ Decision Science and Operations Research
- ▶ Mathematical Modeling and Differential Equations
- ▶ Performance Enhancement/Assessment for High Performance Computing

National Impact

Statistical and Mathematical research has far-reaching effects impacting many issues of national significance. Our work is leading to a safer, healthier society.

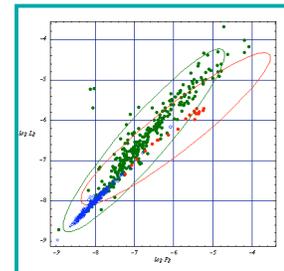
Environmental and Waste Management

- Ensuring environmental characterization data meets requirements for confident decisions through Visual Sample Plan (VSP) sampling design toolkit.
- Optimizing nuclear waste glass formulation properties for long-term storage.
- Modeling cloud properties to evaluate global climate concerns.

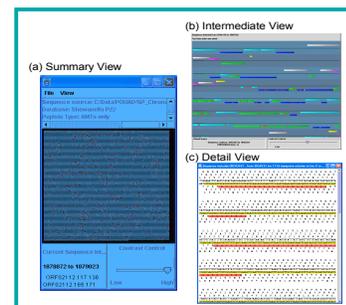


National Security and Defense

- Nonproliferation of nuclear weapons through event discrimination analysis.
- Chemical/biological pathogen detection and identification to protect fighters and first responders.
- Cybersecurity protection through detection of anomalies and intrusions.

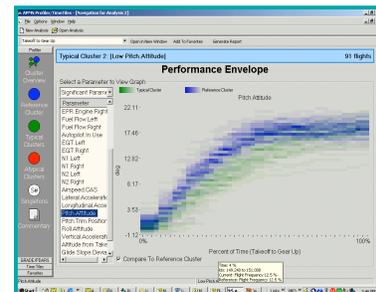


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Human Health and Biological Processes

- Peptide permutation and protein prediction using Bayesian computational system.
- Quality control of complex protein analysis process.



Transportation Safety

- Morning report summary of daily aviation safety onboard instrumentation that identifies potential safety anomalies.
- Text analysis from flight safety incident reports to discover patterns and safety issues.