



Elevating Louisiana's Future Research and Development Enterprise

Louisiana's Experimental Program to Stimulate
Competitive Research (EPSCoR) Committee

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The State of Louisiana's Experimental Program to Stimulate Competitive Research (EPSCoR) Committee recently submitted its most comprehensive Research Infrastructure Improvement Proposal to date.

The plan will capitalize on the State's recent investments in cyberinfrastructure—which have created an extraordinary environment for computing and network development—to further strengthen and accelerate its science and engineering capabilities. It will allow Louisiana to develop new tools for high-performance computing, advanced networking, and data management, and to use these tools for hypothesis-driven, interdisciplinary research. This approach would better position Louisiana to realize its goal of securing a national, federally funded center of excellence.

Through this plan, Louisiana researchers will develop CyberTools, a set of critical Work Packages to enable utilization of the State's advanced cyberinfrastructure. CyberTools will provide an array of services, including data management, scheduling, information services, visualization and application services. Researchers at all Louisiana research universities will use them to conduct research and experiments in major scientific areas through the connectivity made available through the Louisiana Optical Network Initiative (LONI).

The science projects and CyberTools will be developed in tandem by close-knit teams comprised of representatives from each of the research institutions participating in the State's Research Infrastructure Improvement EPSCoR proposal.

This project will transform the State's research base by strongly aligning Louisiana with the National Science Foundation's strategic plan for cyberinfrastructure and creating a more competitive and dynamic environment for conducting research.

The State's EPSCoR leadership strongly believes that this comprehensive, ambitious project will serve as the catalyst through which Louisiana can regain and elevate the trajectory of its research and development enterprise.



CyberTools



The CyberTools component of the proposal will enable the State's researchers to take full advantage of the Louisiana Optical Network Initiative (LONI), a high-speed, fiber optic network that connects supercomputers at the state's major universities and research centers. LONI's hardware and associated infrastructure—representing a \$50M state investment over 10 years—links Louisiana to the National Lambda Rail with one of the most advanced grid-based, distributed network and computing infrastructures in the nation. CyberTools will be deployed across

LONI to create advanced information processing services, data management and a storage environment that can support the entire state's research base. Building on these significant investments, and a cadre of talented research faculty, this research infrastructure improvement will enable us to develop the modern cyberinfrastructure that will accelerate scientific advances.

Work Package Components

Through the CyberTools component, researchers will develop four modular Work Packages (WP):

- WP 1: Scheduling and Data Services
- WP 2: Information Services and Portals
- WP 3: Visualization Services
- WP 4: Application Services and Toolkits

These Work Packages will provide researchers better access to and facilitate the use of the cyberinfrastructure available through LONI. The four Work Packages will:

- Enable scheduling to share computational, network, data and visualization resources
- Allow better data management
- Ease development of complex simulation codes
- Improve visualization
- Mine data

CyberTools will allow advanced research and collaboration in key application areas of science and engineering.

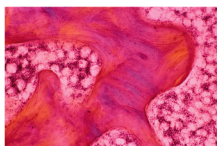
Scientific Applications

The CyberTools component of the proposal will provide the means by which Louisiana's advanced cyberinfrastructure can be brought to bear on the study of key science and engineering problems.

With the aid of the data storage, networking and high-performance computing available through LONI and the CyberTools package, researchers will perform advanced work in two key areas—(1) biosensing and (2) transport processes—that would otherwise not be possible.

The biosensing research will develop better geno/immuno sensors and more effective small molecule sensors. Research will be carried out by collaborative teams of chemists, biochemists, engineers and computational scientists and will address basic and applied questions, with the goal of developing new and innovative systems that can advance sensor and molecular analysis technologies.

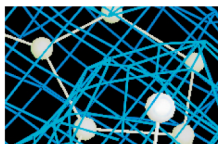
Geno/immuno sensors



These are low-cost, easily deployable platforms that can be used for disease diagnosis, population screening and environmental monitoring. These sensors provide information about the presence of biological or chemical agents in a particular area, which make them a valuable detection tool in the country's efforts

to counteract bioterrorism. However, such sensors can only detect agents of high molecular weight. Researchers will work toward developing biosensors that can detect potential hazards at lower molecular weights, making them more effective counter-terrorism tools. Design of these sensors and optimization of the necessary molecular interactions require computational modeling and simulation that will be facilitated by the development of the Work Packages. Simulation approaches will minimize tedious and costly experimental trial and error.

Small molecule sensors



The researchers will develop a LONI work environment that allows researchers better access to high-throughput screening.

This is an advanced research tool used primarily in biological and chemical sciences that allows a researcher to conduct millions of biochemical, genetic or pharmacological tests in a

short period of time and in a more effective manner with better results than traditional screening techniques. Because current limitations in accessibility prevent most scientists from effectively using high-throughput screening, EPSCoR researchers will develop a process that enables more scientists to access this technique by farming the screenings out through the LONI network.

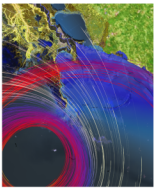
Transport Processes:

Bio Transport



Scientists will work together to develop necessary infrastructure to effectively study biotransport phenomena using the geno/immuno sensor and small molecule sensor. Examples include molecular dynamic simulations and computational fluid mechanics of transport processes in living tissues. The tools, developed in conjunction with biotransport research, also can be used to enable breakthroughs in biosensor development.

Hurricane and Storm Surge Modeling



Louisiana's low-lying coastal areas are one of the world's most vulnerable, and environmentally damaged, ecosystems. Although Katrina heavily damaged the State's shoreline, massive erosion of the state's wetlands already was occurring.

Many isolated models are available that use principles of computational fluid dynamics to study the region. However, for effective modeling, researchers need to link different models together and combine different modeling elements.

Through this application, researchers will use an emerging data field called Dynamic Data-Driven Application Systems (DDDAS) to implement new hurricane and coastal modeling methods. These advanced models will allow researchers to better plan restoration strategies, improve ecological forecasting, determine better placement of future sensors, control water diversion for salinity and predict/control harmful algal blooms.

CyberTools will archive historic and real-time data to be used in modeling the coast. Using this data, researchers will automate creation of multi-layer visualizations that combine multiple elements (e.g., storm surge, sediment deposit, salinity of the water.) Created across the LONI network, these visualizations can be used for many different applications.

Through the LONI network, scientists can use these advanced tools to focus on the urgent problem of emergency storm-surge forecasting during approaching hurricanes.

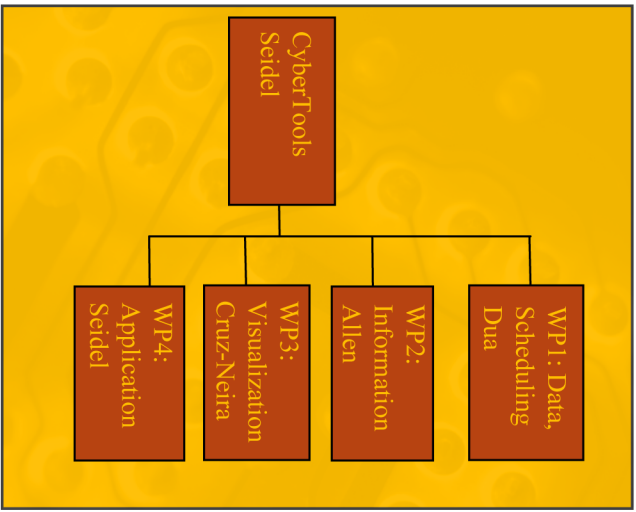
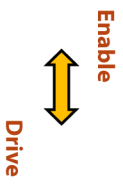
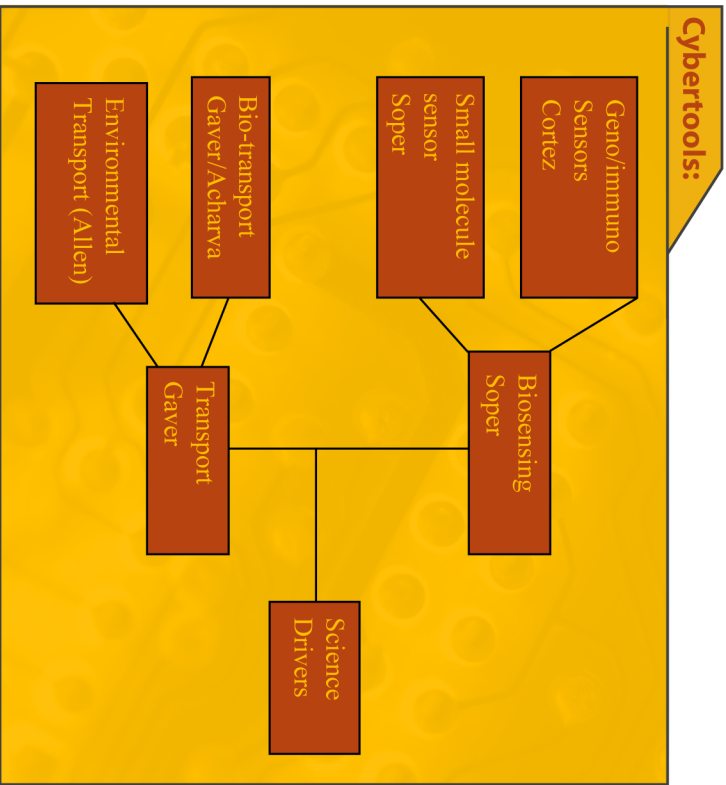
Education and Outreach:

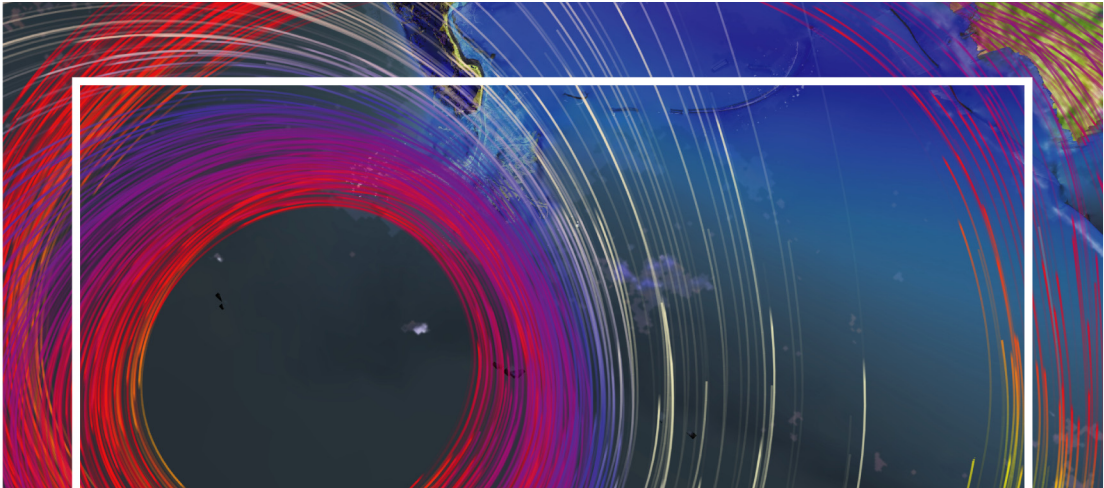


In addition to conducting research at the university level, Louisiana EPSCoR will implement education and outreach activities to assist in developing the knowledge, skill-sets, and careers of a wide spectrum of individuals, ranging from post-doctoral fellows to junior faculty, from undergraduates to graduate students and into the K-12 environment and the public at large.

A diverse group of students from a variety of institutions will benefit from a research-oriented undergraduate, graduate and postdoctoral education that ties science applications to CyberTool development.

The outreach program will introduce computational and analytical concepts in exciting and suitable ways to stimulate K-12 students to advance their science, technology, engineering and mathematics education, to educate and impact the general public and to provide opportunities for faculty throughout the state to be engaged in advancement activities.





The universities and research institutions involved in this proposal through the Louisiana Experimental Program to Stimulate Competitive Research (EPSCoR) are:

**Louisiana State University
Tulane University
Tulane University Health Sciences Center
University of Louisiana – Lafayette
LSU Health Sciences Center – New Orleans
Louisiana Tech University
University of New Orleans
Southern University Baton Rouge
Xavier University**

