

Geoinformatics Proposal to the LSU Capital IT Initiative

Submitted by:

College of Engineering & the
Center for GeoInformatics

Society has and continues to look to engineers and scientists to provide the infrastructure and technical innovations that will sustain and improve our standard of living and to protect our environment. Information Technology plays an ever expanding and crucial role in accomplishing this mission by providing engineers and scientists the means to investigate, understand and ultimately solve complex problems. Innovations in IT allow us to:

- Realistically model and visualize natural and man-made processes and systems;
- Organize, manage, and analyze massive amounts of diverse data. Because many of the problems with which Society faces occur within a geographical context (e.g., migration of contaminants from a landfill to your water supply), engineers and scientists are increasingly concerned with “**geospatial**” data, i.e., data that includes positional information;
- Communicate and interact as multidisciplinary teams to facilitate problem solving.

With the assistance of IT Initiative funding to add key personnel, equipment and facilities, our group seeks to establish LSU as a national leader in harnessing emerging **geospatial** technologies for innovative research and cutting edge education. Through deep integration of geospatial technologies such as geographical information systems (GIS), the Global Positioning System (GPS), scientific visualization, and remote sensing, we will conduct research and help educate the next generation of engineers and scientists who will craft solutions to world-class problems dealing with civil infrastructure and the environment. This amalgam of science and geospatial technologies is known worldwide as **GeoInformatics**. Harnessing the emerging technologies of geoinformatics has special regional and national significance because it has the potential of providing an unparalleled understanding of many of Louisiana’s most pressing environmental problems such as coastal landloss, air and water pollution, and urbanization.

People and an Institution Poised and Committed to Success

LSU is on the brink of becoming a national leader in the science and applications of the technologies of geoinformatics. Faculty currently utilize the Global Positioning System (GPS), Geographic and Land Information Systems (GIS/LIS), geospatial analysis, statistical/probabilistic analyses, fuzzy logic, parallel/distributed computing, satellite and airborne remote sensing, and advanced visualization in their internationally respected engineering and scientific research. Other groups on campus, however, are poised to apply these technologies to their research but are slowed by the lack of access to training, hardware/software, and know-how.

Our diverse group of scientists and engineers is uniquely positioned to provide leadership in geoinformatics. For example:

- The Center for GeoInformatics is establishing itself as the leader in the Gulf south in GPS applications. The Center will soon house the Louisiana Spatial Reference Center, a NOAA-National Geodetic Survey-LSU partnership whose goal is to set up a dynamic state-wide system of high-precision GPS-based positioning that will be the backbone for all legal surveying in Louisiana, as well as supporting precision farming, navigation, and other geospatial applications.
- The CoE Natural Systems Engineering Laboratory is a leading force in modeling storm surge due to hurricanes, and other large storms. The models meld topographic data, real-time satellite and weather data, knowledge of physical geological processes, land use information, and soil characteristics with hydrodynamics to predict inland flooding of Louisiana’s coastal areas.
- Researchers associated with the Louisiana Water Resources Research Institute are studying new ways to analyze and predict the movement of contaminants through the environment due to point- and non-point source pollution.
- The Center for GeoInformatics, created in Summer 2001 by actions of the LA Board of Regents and the LSU Board of Supervisors has as its mission: “to become a national force in expanding and strengthening

the university, commercial and public-sector geospatial communities within the State of Louisiana and the US. To this end, the Center for GeoInformatics will provide the advanced geospatial information applications, products, training, and commercialization expertise that are required to support economic development and environmental stewardship.”

Our Plan for Utilizing IT Funds

Our Plan calls for \$3.5 M the first year and a recurring budget of \$1.0 M a year for the following four years that will be used to attract high-quality faculty and research associates, acquire IT equipment, and to build state-of-the-art facilities for faculty and students. To show its commitment to this initiative, the CoE will commit ~\$250,000 a year for five years and 5,000 sq. ft. of space.

The hiring of five new tenure-track faculty in critical enabling and complementary technology areas is the primary element of our plan. Three junior hires will be added to provide critical breadth to existing faculty clusters, whereas two senior faculty will be brought on board to provide leadership in the development of two emerging areas. The proposed areas are geodesy/GPS, Land Information Systems, advanced statistics, advanced topographic engineering technologies (e.g., LiDAR, Laser Interferometry, Detection and Ranging), high performance computing and visualization, and wireless applications systems engineering. A total of \$1.0 M is requested to fund four of these new positions and the associated start-up costs. The CoE commits its own funds for one of the junior positions. Funds are also requested for four postdoctoral research associates with specialties in the areas mentioned above in order to provide an immediate infusion of needed expertise. A systems technician is requested to manage the visualization and student laboratories. The CoE will also provide four PhD fellowships to complement this new initiative. The addition of these new faculty and research staff to the CoE will accelerate development of innovative undergraduate and graduate academic programs in IT-related areas that are grounded in engineering concepts and skills (e.g., geodetic engineering and surveying).

We also request \$2.5 for infrastructure mainly during Year 1 to fortify our current information technology infrastructure through substantial improvements in the network and facilities. These include:

- Renovation of space to house the newly LA Board of Regents-approved *Center for Geoinformatics*.
- Improvement of network capabilities between CoE computer laboratories: *Engineers require high bandwidth because the processes and systems they model are complex and databases they build are large. For example, researchers in the Natural Systems Engineering Laboratory are modeling storm surge due to hurricanes, and other large storms. The models meld topographic data, real-time weather data, knowledge of physical geological processes, land use information, and soil characteristics to predict inland flooding of Louisiana’s coastal areas.*
- Improvement of network capabilities between CEBA, F. Frey, College of Basic Sciences, and School of the Coast and the Environment: *The main reason is collaboration. Engineers and their research partners in the School of the Coast and Basic Sciences must have a high quality network connecting each other to share data and resources. For example, researchers in the Natural Systems Engineering Laboratory require the latest satellite imagery and real-time rainfall data collected at the EarthScan Lab and the Regional Climate Center, respectively, to model real-time flooding in south Louisiana. These external research facilities are located cross-campus in the Howe-Russell Geosciences Complex. Similar connectivity is required by the LSU Hurricane Center in CEBA.*
- Expansion of the CoE’s current LINUX-based computer cluster to ~500 processors: *Our current cluster consists of 112 linked processors that together achieve a fairly high level of performance in computations. The system is heavily used by the Natural Systems Engineering Laboratory for storm surge modeling and Mechanical Engineering for materials modeling. The current system limits us, however, to modeling small areas or systems composed of a relatively small number of complex intertwined processes. With the expanded cluster we will be able to, for example, build more realistic mechanical and materials simulations and to help emergency preparedness personnel to issue accurate coastal flooding warnings in timely manner. We will naturally link the computational cluster to the tools of the visualization center.*
- Creation of an Immersive Visualization Center (i.e., CAVE™) for use by all faculty. *Because of their orientation towards process, computation, and simulation, engineers and scientists have tremendous needs for computer-aided visualization. For example, engineers at LSU design chemical plants, drill deep into the Earth looking for oil and gas, build bridges and buildings, develop models to simulate natural processes for coastal*

restoration, and simulate the behavior of materials inside a jet engine. To this end, the Geoinformatics IT Plan includes the establishment of a high performance, visualization laboratory to support the following functions:

- ◆ An arena for multidisciplinary collaboration and “brainstorming” between engineers and scientists.
- ◆ A business/technology showcase to aid non-specialists in understanding CoE research products and activities.
- Provide universal access to cutting edge geospatial software for students and Faculty at LSU: *The Center for GeoInformatics will acquire and distribute without additional charge all software needed by LSU Students and Faculty. This will include GIS, LIS, and image processing software as determined by the LSU GIS Council.*
- Creation of an electronic classroom and visualization laboratory for students: *Facilities to educate students in GIS and remote sensing are inadequate to meet the needs of the campus. We propose to establish an electronic classroom in CEBA in space dedicated by CoE. Here, we will provide devices such as 3-D glasses, a small immersion screen, and appropriate tools that will allow students and teams of collaborating students to interact with their data.*

Anticipated Outcomes

Although the success of the Geoinformatics IT Plan will be apparent in several tangible ways, it ultimately should be judged by the amount of national academic prestige accrued and how this translates into improving the lives of Louisiana’s citizens. It should also be measured by the quality and quantity of the contribution the initiative makes towards achieving state and national scientific, environmental, and educational goals. We also consider the growth and maturity of a commercial sector in the State of Louisiana, and how well this sector serves the state, region, nation and international community to be measures of our success.

Investment in this plan from existing and anticipated projects will provide the LSU IT Initiative with both early and long-term successes.

- By providing funds to improve facilities for the new Center for GeoInformatics, the IT Initiative can rightfully claim that significant research dollars were successfully leveraged. These funds are forthcoming from federal and State sources:
 - ~\$800,000 US Army Corps of Engineers (\$150,000 is in hand; balance will come from FY2002 funds);
 - ~\$2.5M from the NOAA to establish the **Louisiana Spatial Reference Center** (currently under consideration by the US Congress).
- We will immediately be able to provide at no-charge the primary software packages used by researchers and students across campus (i.e., ArcView, ArcInfo, and Imagine).

The long-term outcomes we seek are also clearly defined:

- well-trained graduates that are highly prized by all sectors of Society;
- heightened academic prestige for LSU;
- an inventory of intellectual property that can be commercialized; and
- a Louisiana-based private sector that benefits in one of the following ways:
 - ✓ access to a highly trained workforce;
 - ✓ existing businesses that will grow because they will become more competitive due to increased access to cutting edge technology;
 - ✓ access to new LSU intellectual property developed through research that can be the basis for new businesses.
- an expanded base of external support that will allow CoE and the University to thrive. Areas of current College of Engineering faculty and University research that would directly benefit from IT funds include:

- ✓ LA coastal issues, including coastal restoration and hazards management (CoE, School of the Coast and the Environment, LSU Hurricane Center, College of Arts and Sciences);
- ✓ Transportation (CoE, Louisiana Transportation Research Center);
- ✓ Materials (CoE, BASC, CAMD);
- ✓ Environmental and resources management, including agriculture (Department of Civil & Environmental Engineering, School of the Coast and Environment, A&M College);
- ✓ Civil infrastructure (Department of Civil & Environmental Engineering; and
- ✓ Petroleum reservoir characterization and simulation (Department of Petroleum Engineering).

Because the technology and facilities funded through this initiative will be state-of-the-art, the CoE is committed to serving state and local governmental agencies by providing products, application tools, services, and training.

- This commitment fosters Louisiana-based start-up IT industries in the areas of technical support for engineering and enhanced competitiveness as well as support for established industries.
- These facilities will be available to state industries and organizations interested in developing and utilizing spatial information technologies in collaboration with our faculty and research staff.

In the area of intellectual property, it is our goal to create a vertically integrated science-engineering enterprise, beginning with basic research and ending with commercialization of intellectual property in the form of patents, licenses, and copyrighted materials. The Center for GeoInformatics will partner with the Louisiana Business and Technology Center (Mr. Charles D'Agostino, Director) of the College of Business to make this happen. LSU will become a leading university force in the southeastern U.S. in geospatial technologies and in the commercialization of intellectual property.

The CoE IT Plan and Louisiana: Vision 2020

In order to create a better Louisiana and to guide the State's economic renewal and diversification, the Louisiana Economic Development Council and its ten task forces have drafted a bold plan entitled, *Louisiana: Vision 2020*. In pursuit of *Louisiana: Vision 2020*, the plan identified three goals as primary architectural elements. The CoE IT Plan will have a positive impact on all three of these major goals.

Goal One:

"To be a Learning Enterprise in which all Louisiana businesses, institutions, and citizens are actively engaged in the pursuit of knowledge, and where that knowledge is deployed to improve the competitiveness of businesses, the efficiency of governmental institutions, and the quality of life of citizens."

This goal describes the very essence of the Geoinformatics IT Plan.

Goal Two:

"To have an economy driven by a diverse and thriving set of technology-intensive industries that actively utilize Louisiana's colleges and universities as a source of well-educated graduates as employees, a source of expertise for problem-solving, and a source of technology for commercialization."

The Center for GeoInformatics is currently partnered with the Louisiana Business and Technology Center of the College of Business and will become the leading university force in the State in geospatial technologies and in the commercialization of intellectual property.

Goal Three:

"To have a standard of living among the top ten states in America and safe, healthy communities where rich natural and cultural assets continue to make Louisiana a unique place to live, work, visit, and do business."

We believe that research and training in the technologies of geoinformatics will have a major influence in accomplishing this goal through the commercialization of intellectual property. We are confident that geoinformatics research will lead to new businesses, improvement of existing businesses, and the creation of new, high-tech jobs in the State of Louisiana.