

**Institute for Advanced Education in Geospatial Sciences Educating the  
Next Generation of Scientists**

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The University of Mississippi  
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## **THE INSTITUTE FOR ADVANCED EDUCATION IN GEOSPATIAL SCIENCES**

The Institute for Advanced Education in Geospatial Science (AEGS) is a project funded by NASA at the University of Mississippi. It seeks to support the NASA Earth Sciences Enterprise efforts to optimize NASA's Earth Science investments for the benefit of the Nation. This presentation describes the basic work of the project, its goals, history and progress to date. The project is in year two funding of a potential five year funding.

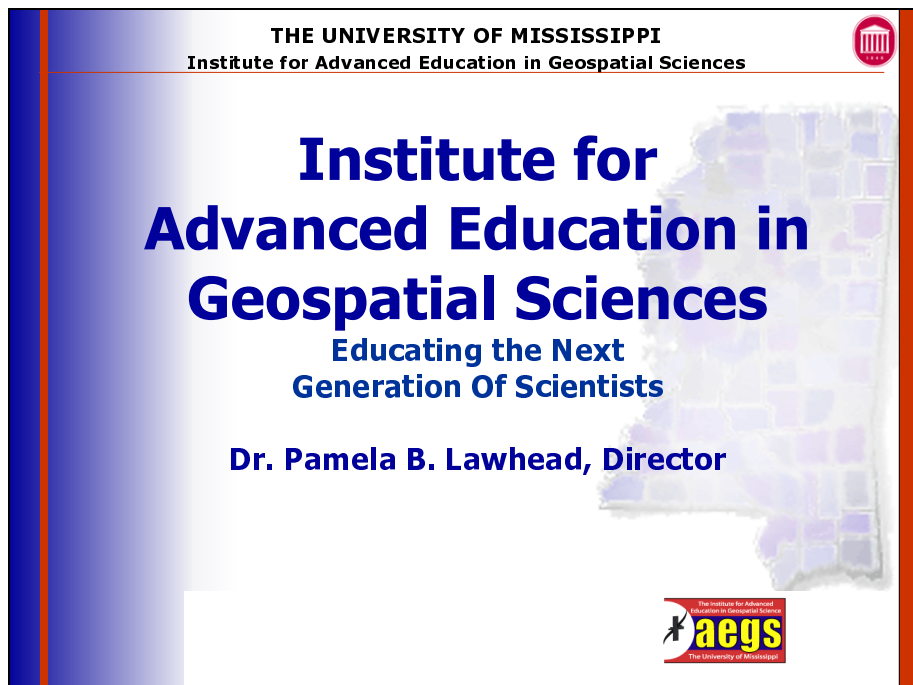


Figure 1

## THE PROJECT

The project, as stated earlier is sponsored by NASA and is located at the University of Mississippi in Oxford, MS. It has two principal investigators with one of them, Pam Lawhead, serving as the Director of the Institute.

The goal of the project is to create fifty online courses in Remote Sensing over the five year life of the project. Each year ten courses are put out for bid and the best ten submissions are accepted. This request for proposals insures that the course creators are content experts. “Equivalence of product” drives the online hosting of the courses. That is, we want the online presentation and delivery of each course to be as multi-media intensive as is effective. The goal is not to replace existing courses but, to provide courses created by content experts to as many colleges and universities as possible. This effort to create and host online courses has as its final goal the creation of a very large college educated workforce prepared to use the vast stores of information gathers by NASA and other remote sensing industries to enhance life on this planet.



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# The Project

- **Sponsored by NASA**
- **Located at the University of Mississippi**
- **Principal Investigators**
  - Pamela B. Lawhead – Computer Science
  - Jay Johnson – Archaeology
- **Courses created by content experts**
- **Multi-media intensive**
- **Goal: 50 courses in Earth System Science over five years**

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Figure 2

## PROJECT GOALS

Historically, little has been done to provide a consistent curriculum in Remote Sensing. This project has as its goal to do that first and then to move forward with its other efforts. To that end, we entered into a partnership with the American Society of Photogrammetry and Remote Sensing (ASPRS) to help us identify Academic and Industrial leaders. Once these individuals were identified, they were brought together to develop a robust, integrated curriculum.

Once the curriculum was identified, courses were prioritized and sets of courses were designated for each year. By following the outline of the committee ten courses were created for each of the first two years of the program. The committee will meet again in October, 2003 to work on year three courses. Following this process either fifty courses or its equivalent will be written and enhanced for online delivery by the end of the funding period.

In order to insure the widest range of acceptance and to provide a true equivalence of product a state-of-the-art course delivery system and creation process has been developed. This process is being tested as this presentation is being written.

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## Goals of the Project

- To develop a robust, integrated curriculum to educate the next generation of geospatial information technology specialists.
- To create a library of 50 university-level online courses reflecting a consistent curriculum in Remote Sensing
- To develop a state-of-the-art course delivery system and course creation process that will be self-sustaining.

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Figure 3

## ALIGNMENT WITH NASA EARTH SCIENCE SYSTEM'S NATIONAL APPLICATION AREAS

NASA's Earth Science Enterprise, Applications Program and Applications Directorate have identified three missions:

“To develop a scientific understanding of the Earth system and its response to natural and human-induced changes to enable improved prediction of climate, weather and natural hazards for present and future generations.”

“Expand and accelerate the realization of societal and economic benefits from Earth science, information and technology.”

And finally: “To optimize benefits from NASA's Earth Science investments through systems engineering to advance decision support tools that serve the nation.”

To be consistent with that enormous effort we have made very attempt to be sure that our courses are in alignment with these missions. The following figures demonstrate that alignment by listing the current and future courses that alignment with each of the identified application areas.

The figure below shows the first of these areas and the courses consistent with Agricultural Competitiveness.

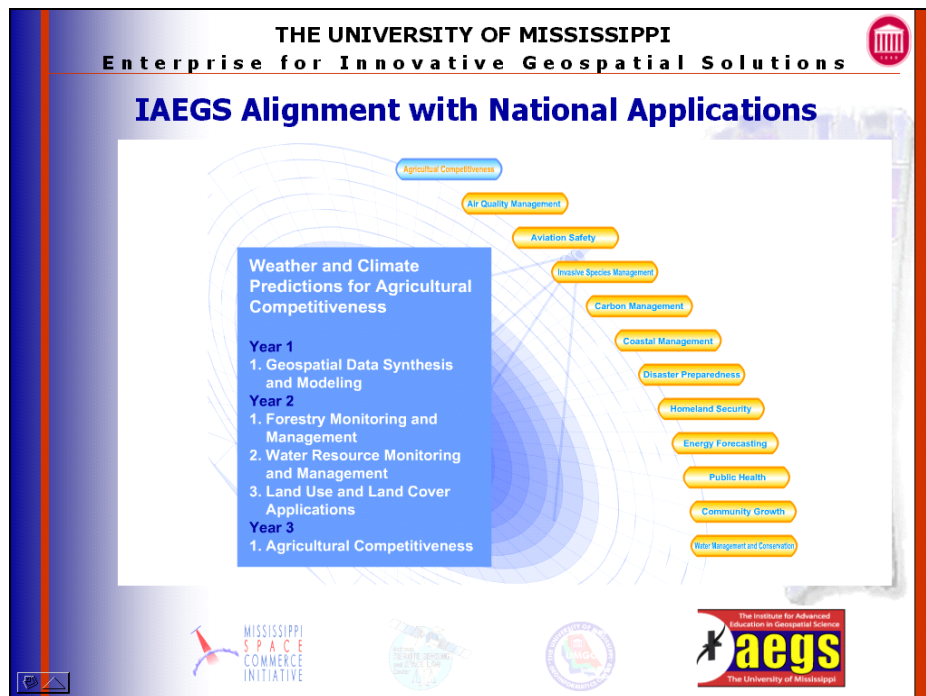


Figure 4

## ALIGNMENT WITH NATIONAL APPLICATIONS AIR QUALITY MANAGEMENT

In year one we have one course that meets this application area, Geospatial Data Synthesis and Modeling/

Year two will have two courses in this area. The authors of the courses Land Use and Land Cover applications and Community Growth will be selected at the June 9<sup>th</sup>-10<sup>th</sup> meeting to be held in Oxford.

Year three will have a course in Air Quality Management. The full description of that course will be written by the members of our National Advisory board in October.



Figure 5

# WEATHER, CLIMATE AND NATURAL HAZARDS PREDICTIONS FOR AVIATION SAFETY

The course that addresses this issue, Aviation Safety will be written in the October meeting and then put out for bids in the spring of next year.



Figure 6

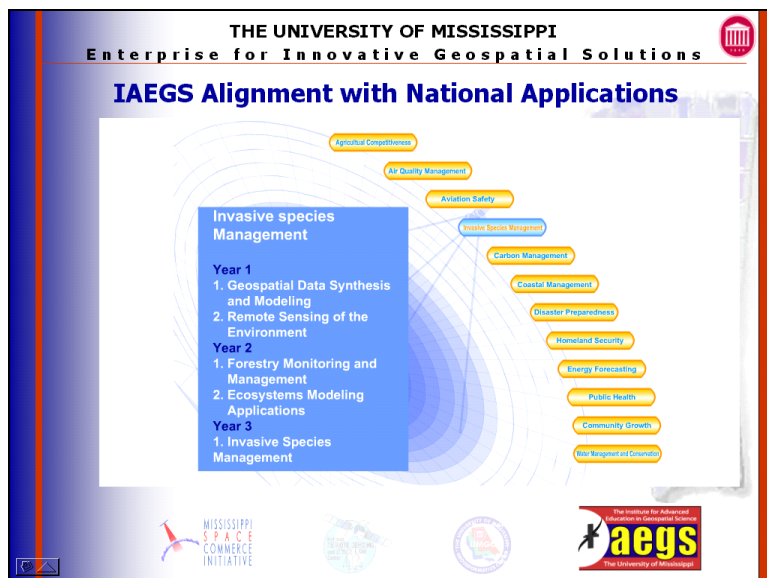


Figure 7



## PROPOSALS

Once the course descriptions were completed a request from proposals was created and published. It was sent to the several professional organizations membership lists; it also appeared on our web site. Thirty proposals were accepted and the authors were invited to participate in a forum where the proposals were formally reviewed. Nine proposals were accepted and their authors were awarded sub-contracts of \$80,000 each.

The authors were then invited to a workshop in August where they were introduced to the course creation process and to their course liaisons.

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# Request for Proposals

- Advertised in Industry Journals
- Sent to professional organization membership lists
- Appeared on our Web Site –  
**geoworkforce.olemiss.edu**
- 30 proposals submitted
- 9 Awards of \$80,000 made

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Figure 8

## THE COURSE FELLOWS

The course fellows and their affiliations are listed below. The Lidar course was not awarded because there was not a strong proposal for it.

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### Course Fellow Awards

**Fellow:**  
Arthur Lembo,  
Cornell University

**Fellow:**  
Rus Congalton,  
University of New Hampshire

**Fellow:**  
Gouguing Zhou,  
Old Dominion University

**Fellows:**  
Karen Seto and Erica Fleishman,  
Stanford University

**Fellow:**  
Lori Bruce,  
Mississippi State University

**Fellow:**  
James Campbell,  
Virginia Tech

**Fellow:**  
Richard Forster,  
University of Utah

**Fellows:**  
Conrad Bielski, JPL  
and Khaled Hasan and Greg Easson, UM

**Fellow:**  
Lynn Usery, University of Georgia

**Fellow:**  
John Jensen,  
University of South Carolina





Figure 9

## THE COURSE CREATION PROCESS

In order to build a course on line the Institute provides graduate students in a technology lab for each course fellow. The fellow is responsible for the course content only. That content may be delivered to the center in any way that the fellow feels comfortable. We have set up an online delivery process but some fellows found it difficult to use or preferred to give us the material in other ways. Once the material is presented to the student liaisons, it is enhanced, broken up into acceptable sizes and hosted online. The student liaisons work very closely with the fellows. We also provide an educational consultant for the fellows. This person is responsible for guiding the fellows in the development of very detailed course concept hierarchy maps.

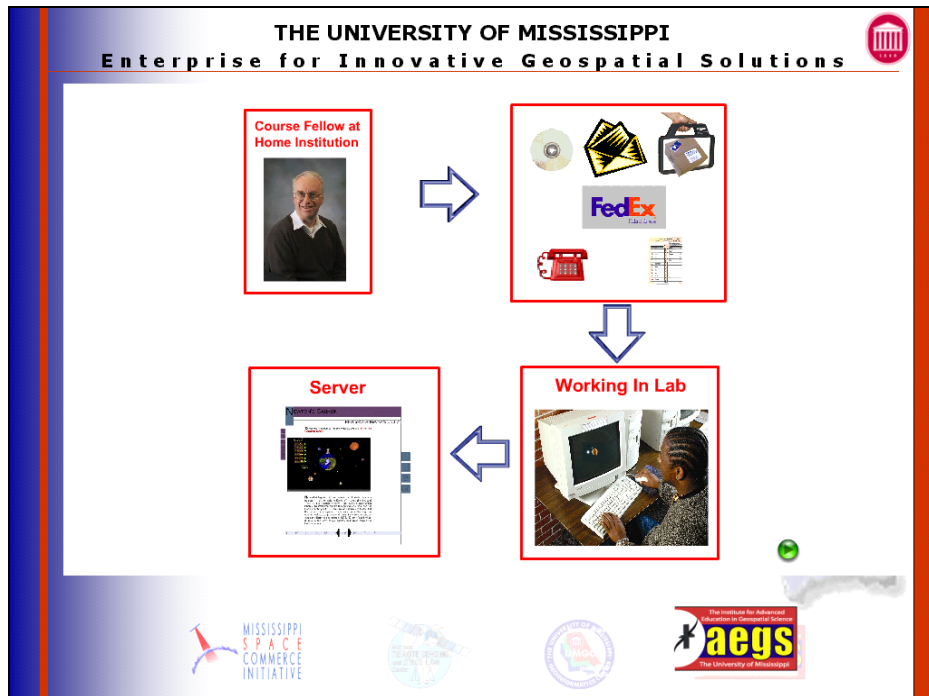


Figure 10

## THE PROGRAM DELIVERY SYSTEM

On the programming side the course delivery system is divided into four parts, the user interface, XML/XSLT templates, publishing framework and the backend database. These are used to produce each course page.

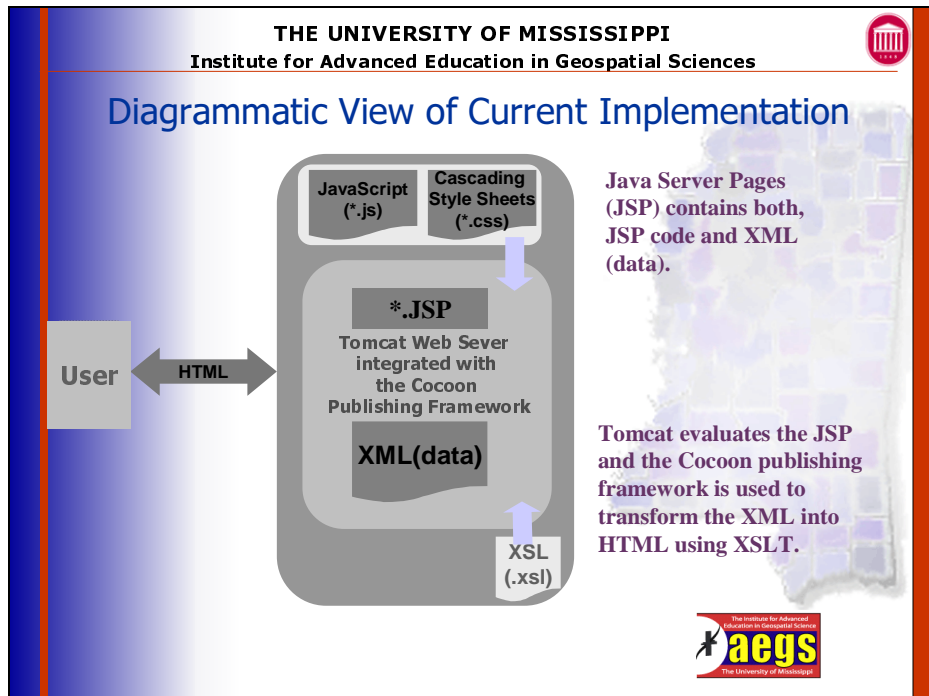
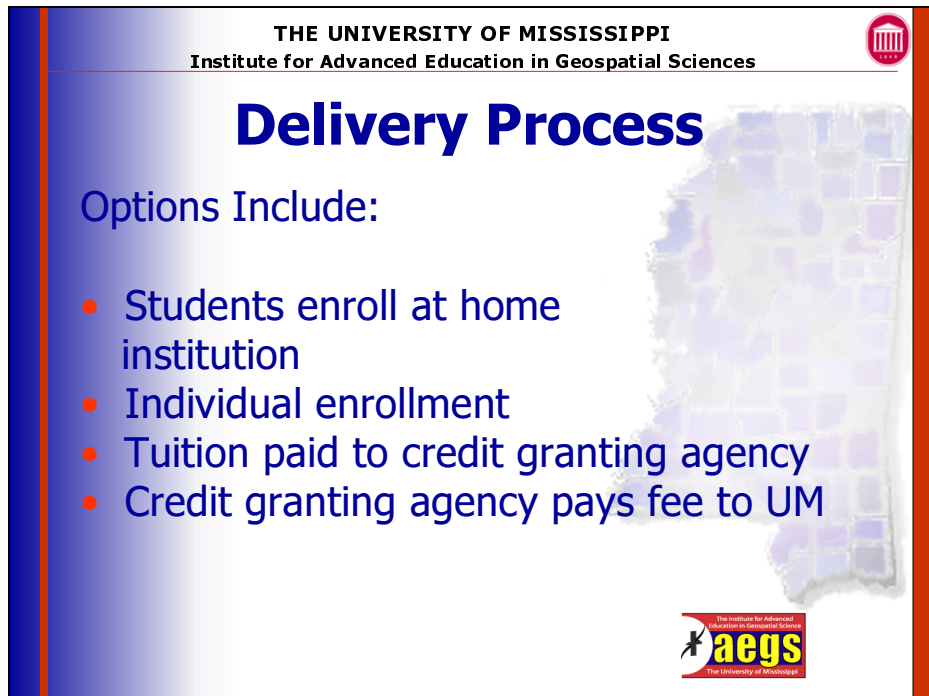


Figure 11

## THE COURSE DELIVERY SYSTEM

The delivery options for each course are varied. A student may enroll at any college our University, anywhere and access the courses. The home institution licenses the courses from the Institute. The home institution awards the credit to the student, gives grades and basically oversees the administration of the course locally.



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# Delivery Process

Options Include:

- Students enroll at home institution
- Individual enrollment
- Tuition paid to credit granting agency
- Credit granting agency pays fee to UM

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Figure 12

## CURRENT STATUS

We have currently hired a staff of four, a director, an associate director, a project coordinator and a network administrator. We have thirty graduate students at work. These students are divided into five teams and within those teams have multiple responsibilities. Some students are members of multiple teams. Student liaisons are responsible for identifying work to be done for each course and then parsing the work out to others. All students are members of the research team and expected to be actively involved in some research topic related to the course creation/ delivery process.

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### Current Status

- Staff of four at work
- Teams in place:
  - Animations
  - Information Technology
  - Course Delivery
  - Public Relations
  - Research

**1.1.1 Geospatial Dimensions**  
The open, user-oriented geospatial presentation have been demonstrated by various researchers and groups of educators at the University of Mississippi and the University of Mississippi, 1997-1998. To specify any geographic reality one must include spatial, temporal, and temporal dimensions with attributes and relationships with the dimension. Table 1.1. This model of geographic phenomena needs to be used in the open context of a geographic information system (GIS) (Lacey, 1997).

Traditional representation of geographic data in geographic information systems (GIS) are often based on the Cartesian coordinate system. The model of figure 1.1) and structure spatial data attributes as being geographic objects such as points, lines, areas, and polygons (Lacey, 1997).

Digital representation is introduced as consisting of general topology with only attribute representation for the field of higher education. These attributes are attached to basic geometric objects.

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Figure 13

## CURRENT STATUS


As discussed earlier, the Advisory Board is an active part of the Institute's work. The technology lab is established with students working actively each day. Two prototype courses are complete. Two other courses are 90 % complete and all others are approximately 60% complete. One short course is in process on Decision Support Systems.

We work very closely with our educational expert in directing the overall design of each course. We have a very large group of graduate students at work and are, for the summer, using some undergraduates.

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### Current Status



- National Advisory Board actively guiding the process
- Course creation lab established
- 2 Prototype courses complete minus quizzes
- 11 Course Fellows under contract
- 1 Short Courses in process
- Consultant on Pedagogy directing course design
- 31 students at work on animations and course delivery process



Figure 14

## STATUS

The Knowledge Engine, described earlier is complete and undergoing testing at this time. The Virtual Portal is being completed, including the Virtual Campus and the browser application.

The course fellows are all under contract, the second round of RFPs will culminate in a conference on June 9<sup>th</sup> of this year. The goal is to have six courses out for testing by the end of this summer.

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### Current Status

- Knowledge Engine Design Complete
- Virtual Campus delivery expected May 2003
- Browser with Renderware® successfully built
- Course Liaisons in place
- 1<sup>st</sup> Set of Course Contracts in place
- Concept Maps, first milestone delivered
- Mid year course evaluations complete
- 2 courses complete
- RFP for 2<sup>nd</sup> round of courses finished
- Memorandum of Agreement signed with Boeing

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Figure 15



## RESEARCH RESULTS

The articles listed below are evidence of the effectiveness of the work of the research team. This is the status as of April, 2003. There are many more papers under construction at this time. It should be noted here that, because of our successful International work we have had a name change. In the research papers our name appears and the Center for Geospatial Workforce Development (GWD) we are now the Institute for Advanced Education in Geospatial Sciences.



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**Current Publications By The Institute**

**Liang Feng, Application of Database Technologies in the GWD Online Course Creation Project**, Conference Name: The 2003 International Conference on Information and Knowledge Engineering (IKE'03) Feb.17, 2003

**Hong Zhou, Naive Bayesian Classifier for Microarray Data.** International Joint Conference on Neural Networks, July, 2003

**Jun Liu Three-Dimensional Effects Created by Macromedia Flash MX**, The 2003 International Multi-conference in Computer Science and Computer Engineering Draft Due: Feb 17,2003.

**Jie Tang Follow the Line: using vision in an autonomous mobile robot**, The 4th British Conference "Towards Intelligent Autonomous Robots" (TIMR '03) Draft Due: 4/25/03

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Figure 16

## MORE RESEARCH PAPERS

These paper topics indicate the scope of the work being done. The paper by Bhatt explores the work of using Virtual Reality to provide online laboratories in GeoSpatial Sciences. The others all have to do with technical issues regarding the delivery of the online courses or the creation process itself.

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**Parishweta Bhatt** **Virtual Laboratories Using Interactive 3-D Simulations for Remote Sensing Education** ASPRS: May 2003

**Pushpa Grandhi** **Software Verification Tool for Ensuring Accurate Animation Delivery** ASE(The IEEE International Conference on Automated Software Engineering) Submitted May 6, 2003

**Krishna Sajja** **Providing Streaming Capabilities to Online Applications** CRIWG 2003, 9th Int'l Workshop on Groupware, 28 Sept.- 2 Oct. 2003

**Manirupa Das** **Information Storage and Management in Large Web-based Applications using XML** CCSC - MidSouth Conference, Memphis, Presentation: March 28, 2003

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Figure 17

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**Jianrong Yu** **Data Mining with Neural Networks Under a High Volume Noisy Environment** Target Journal: Journal of Neural Computing and Applications, Submission Date: June, 2003

**Brenteria Travis** **Evaluation of Load Testing Software Packages** Target Conference: International Conference on Software Testing and Analysis. Abstract Deadline: May 26, 2003

**Eric Windham** **Shockwave vs. VRML**, ACM Symposium on Virtual Reality Software and Technology 2003 Draft Due: May 31, 2003

**Raju Vuppala** **Random Generation of Questions based on Navigational History** Target Conference: Conference on Information Technology, Submission Date: June 20, 2003

**Ravi Darbhamulla** **Proxy Expert – Using the Student Support Monitoring Tool** Conference: ITICSE 2003

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Figure 18

## PUBLICATIONS CONTINUED

This list continues the papers written by members of the research team. The list goes from policy issues to Adaptive Learning. Again, it is important to note that these papers are a reflection of the issues that we work on at the Institute and are critical to the success of the projects.

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**Manirupa Das** **Emulating the Real - World Expert for Online Course Delivery using Student Status Monitoring**, Innovation and Technology in Computer Science Education ITICSE – 2003,

**Keyur Patel** **Technical and Policy issues for Online Reserve Material**

**Anchuri Pratap** **Secure Data Presentation** 6th Information Security Conference (ISC'03) Submission Deadline May 1, 2003

**Jim Zhu** **Pricing for Web Services** The 2003 International Workshop on Mobile Systems, E-commerce and Agent Technology (MSEAT'2003) Submission Deadline May 15, 2003

**Shrinivas Chappidi** **Random Algorithms for Quiz Generation** (In Progress)

**Marcus Golden** **Adaptive Learning in an Online Environment** (in progress)

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Figure 19

## RESEARCH CONTINUED

Mr. Paris is the team lead on the Virtual Portal, he also is doing significant work on data compression both for course image delivery but for compression used in other areas as well.

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**Luis Paris**

- 1) An empirical study of variable-length codes for efficient storage of data**, To be published in the "ACM Computing Surveys" journal
- 2) Data compression methods for online delivery applications**  
Submitted: "ACM Computing Surveys" journal
- 3) Hosting a Virtual World in an online environment** To be presented in the CRIWG (International Workshop on Groupware), France, Sept 28 - Oct 02, 2003
- 4) Introducing interleaved start-step codes for fast variable-length coding**, To be presented in the DCC (Data Compression Conference) 2004 Utah, March, 25 - 27, 2004

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Figure 20

## COURSE LIST

The list below is the set of courses that are currently under construction. We expect to have courses, 3, 4, 5, 7 and 10 ready for delivery by the beginning of the Fall semester.

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### Courses for Year One

1. Introduction to Geospatial Information Technology
2. Sensors and Platforms
3. Photogrammetry
4. Remote Sensing of the Environment
5. Digital Image Processing
6. Advanced Digital Image Processing
7. Aerial Photographic Interpretation
8. Information Extraction using Microwave Data
9. Information Extraction using Multispectral, Hyperspectral and Ultraspectral Data
10. Orbital Mechanics
11. Geospatial Data Synthesis and Modeling

Image Acquisition via Space-based Sensor

Corresponding row of pixels with amplitude displayed as a shade of gray

Space-based Airborne

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Figure 21

## YEAR TWO COURSES

The descriptions and the RFP for the courses listed here can be found at the Institute's web site: <http://geoworkforce.olemiss.edu>.

The meeting to determine the authors for each of these courses will be held on June 9, 2003. The fellows will then return to the campus for a workshop in August to begin the course creation process.



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### Courses for Year Two

1. Advanced Sensor Systems and Data Collection
2. Advanced Photogrammetry
3. Information Extraction using Thermal Infrared Data
4. Land Use and Land Cover Applications
5. Smart Growth and Urban Regional Planning Applications
6. Ecosystems Modeling Applications (GAP, biodiversity, fish/wildlife)
7. Water Resources Applications
8. Forestry Applications
9. Mapping (Topographic)
10. Business Geographics (industrial site location, banking, real estate, simulation and video games and individual)

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Figure 22

## INTERNATIONAL EFFORTS

Round one of the course selection process had applications from Greece and Canada. This was only the beginning of our International effort. We spoke to the ISPRS Council and Commission heads in December where we received their endorsement. We are in the earliest stages of working with CEOS in an effort to achieve a global market.

Year three will be very involved in “internationalizing” the curriculum to insure that it has as large an audience as possible.

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### International Efforts

- Round one applicants from Greece and Canada
- Invited to present to ISPRS Council and Commission Heads
- Received endorsement from ISPRS in December
- AEGS became ISPRS's response to CEOS educational initiative
- International Advisory Board to meet in Fall to assure "internationalization" of Model Curriculum
- Second Round RFP to be delivered internationally through ISPRS Commission Heads

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Figure 23

## OUTSTANDING CHALLENGES

The Institute still faces many challenges, none insurmountable but all are there before us. We are in the process of completing the licensing process. This requires a formal document which must be acceptable to our own institution as well as the subscriber institutions. It is being reviewed as this is being written.

Web deliverable 3-D has a significant overhead that must be dealt with if the speed is to be acceptable. We are working on this on many fronts. We are working to reduce the files size, to compress and decompress the files, to use streaming and caching techniques.

We are testing the delivery process on many levels, not just the speed but also the understandability of the interface as well.

It is our hope that the second version will be filled with existing learning style technology.

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# Outstanding Challenges

**Technical**

- Licensing Process
- Web Deliverable 3-D Overhead
- Testing of Delivery Process
- Addition of Learning Style Technology

**Non Technical**

- Increasing Participation in RFP Response
- Internationalization of Course Offerings
- Establish Formal Relationship with CEOS

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Figure 24



## THE VIRTUAL PORTAL

The virtual portal is nearing completion. We have the Portal sending information to the Browser but we must complete the loop and have the information flow in both directions. This is simply a programming issue and it is being solved.

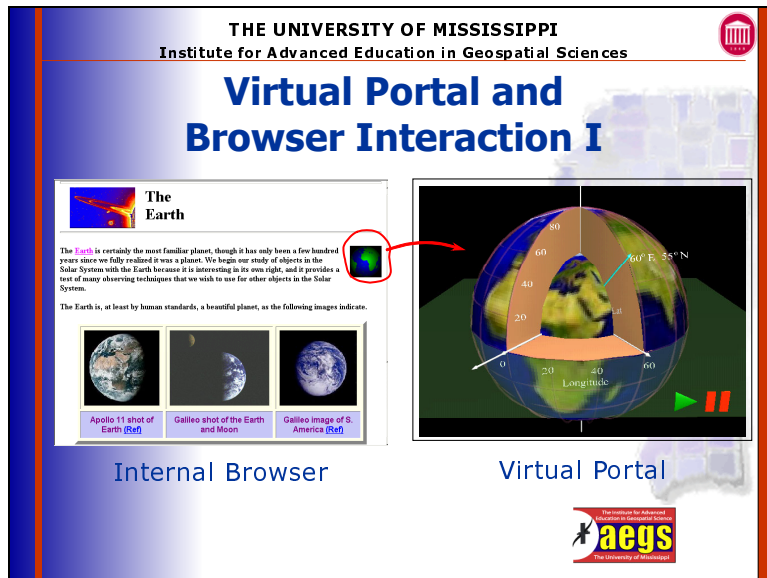


Figure 25

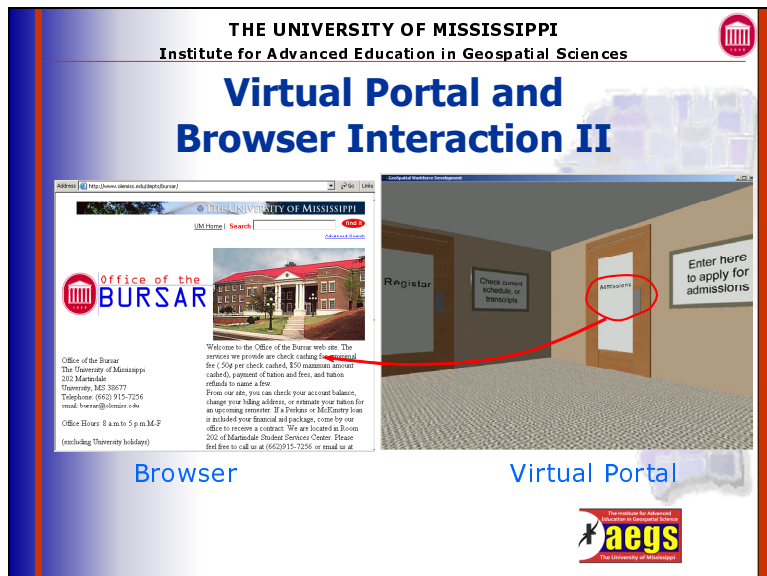


Figure 26

# THE FINAL PRODUCT

The image below reflects the final project. In it there is a standard browser, a video chat space, a white board, the 3-D virtual portal, a note pad and a list of who is online as the student is logged on. This will be the space used by the students.

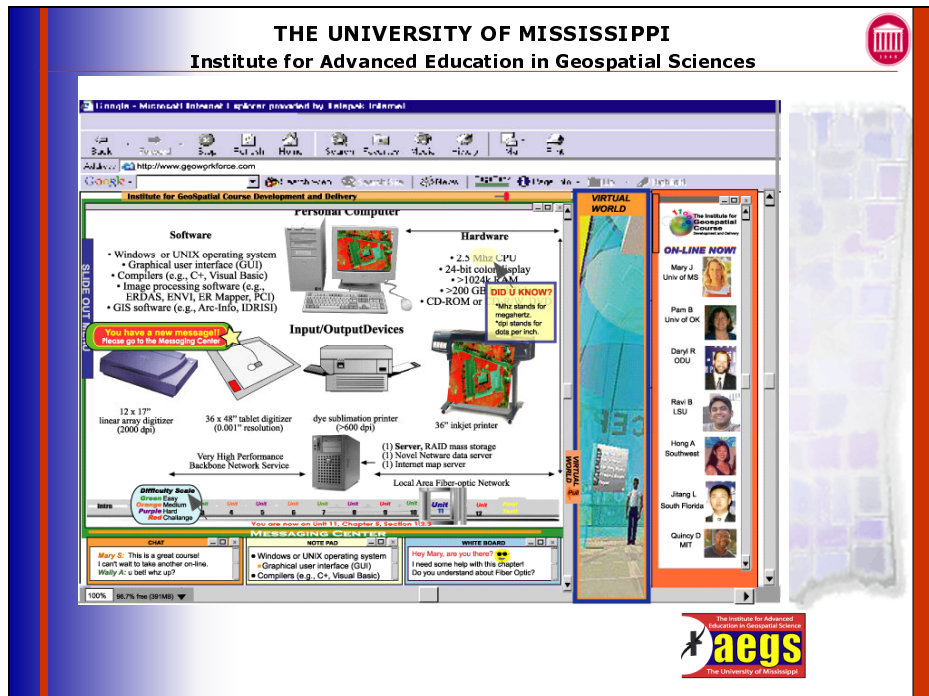


Figure 27

# THE WEB PAGE

This is a snapshot of our web page which can be viewed at <http://geoworkforce.olemiss.edu>

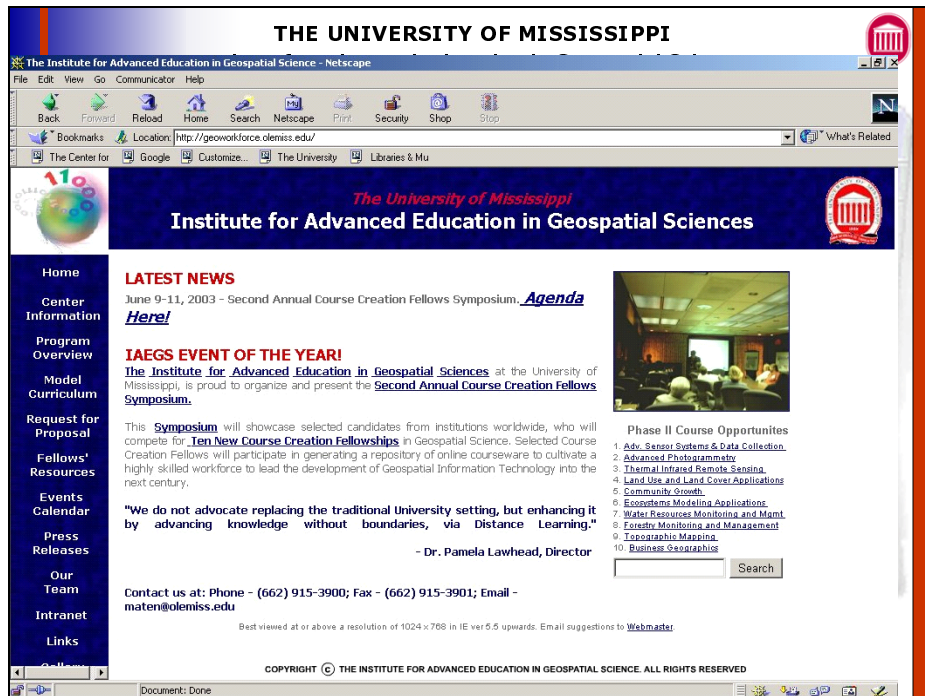


Figure 28

