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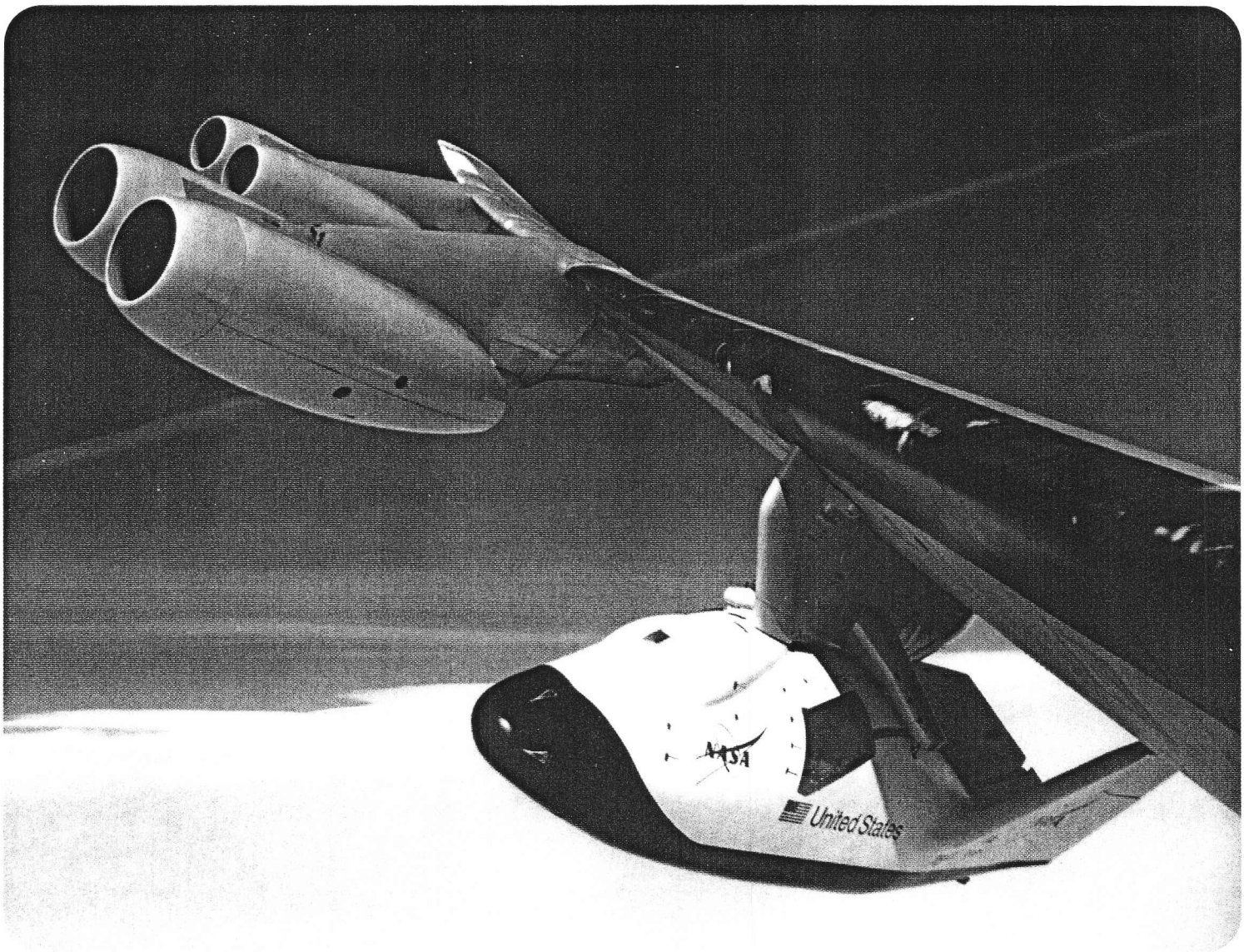
National Aeronautics and Space Administration
Office of Equal Opportunity Programs
Minority University Research and Education Division

Research and Technology Report



Summer 2000 and Academic Year 2000-2001

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High Performance Database Management with Applications to Earth Sciences

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INTRODUCTION

The purpose of the High Performance Database Management with Application to Earth Sciences project is to develop a highly parallel database system based on the semantic/object-oriented approach. The research aims to significantly improve the usability and efficiency of highly parallel database computers and system clusters (tightly networked groups of systems). Florida International University (FIU) is developing algorithms and a database management system that will have substantial advantages over current database systems. The object-oriented system is based on the semantic binary model of databases.

The semantic database system will have better logical properties than relational databases. It is friendlier and has more intelligent user interfaces based on the stored meaning of the data. Additionally, it has comprehensive enforcement of integrity constraints, greater flexibility, and substantially shorter application programs. The semantic database system can handle both spatial data and scientific data. It will also provide higher efficiency for both small and large numbers of processors and better exploitation of parallelism for data storage and processing.

Research has been conducted on such theoretical and applied issues as database design methodology, database design tools, information analysis, multimedia databases, distributed databases, database languages, data compression, data visualization, and spatial databases.

RESEARCH ACCOMPLISHMENTS

TerraFly

A major research accomplishment in data visualization is the development of TerraFly, a Web-enabled system designed to aid in the visualization of spatial and remotely sensed imagery, which can be accessed at *http://www.terrafly.fiu.edu/*. Designed for users of all levels, TerraFly is an interactive vehicle for "flying" over Earth's surface and exploring spatial data such as aerial photography, satellite imagery, street maps, and locale information. This system's features include an integration of spatial, textual, and multimedia data, which can be viewed and manipulated using any standard browser. Thus, a user need not install any additional software or be an expert in remote sensing to use TerraFly. TerraFly allows quick and efficient place identification, as well as multiple sensor manipulation to create any color composite image the user may desire.

A main benefit of this system is TerraFly's ease of use. All functions are GUI-based and can easily be executed with a mouse. Using any standard Web browser such as Netscape or Internet Explorer, a user can go to our Web site, *http://www.TerraFly.fiu.edu*, to peruse information about TerraFly and launch the TerraFly application.

When a user elects to take a flight, the main TerraFly applet is launched and several additional windows open. Data is automatically loaded into the flight windows. Flying over the data is easily accomplished using the mouse, using the compass tool found in the Fly Control window or by clicking on the image in one of the FlyFrames. Users can open multiple "flight" windows, and "flying" occurs over all open windows in sync.

Users need a point of reference while "flying" over the imagery. This information is provided in a variety of ways. First, the geographic coordinates of the center point of the data are displayed in the Flight Control window. As users fly over the data, these coordinates are continuously updated. Users can also view corresponding maps and additional data types at varying resolutions and retrieve information regarding a specific point. Users can change resolution of data and/or map information by using the "Resolution" drop-down menu in the corresponding FlyFrame window. Users can retrieve text and data for points and areas by clicking (ctrl-left click) on the image.

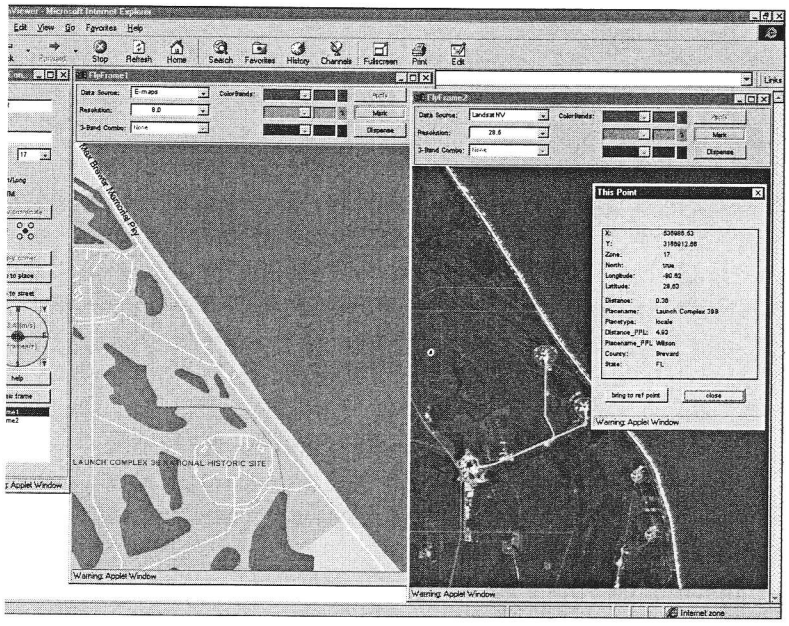

Figure 1. A screenshot of FIU's TerraFly application. In this screen capture, a user is flying over NASA Kennedy Space Flight Center using a map and Landsat 5 imagery. The small pop-up window describes a point of interest that the user chose.

TerraFly includes many additional features, such as goto-place and goto-street, which allow a user to find a specific location easily. Additionally, a user can select different band combinations of multispectral data and apply filters to better interpret the data. TerraFly also allows multiple data sets to be overlaid, and vector data to be overlaid on the raster imagery.

RELEVANCE TO NASA STRATEGIC ENTERPRISES

The Goddard Space Flight Center's research that is conducted by FIU aims to support NASA's need for efficient access to the vast quantities of data that are collected by satellites. The LandSat data, mentioned above, is an example of the type of data access FIU's system will enable.

NASA Goddard Space Flight Center (GSFC) and FIU have established a Regional Applications Center (RAC) at FIU. This collaborative effort is expanding the practical applications of NASA satellite sensor readings, combined with other physical or logical data, to the benefit of the southeast region of the United States and beyond. This program will also strengthen the bond between NASA and FIU's High Performance Database Research Center (HPDRC) for the purpose of developing and implementing advanced new database technology. The mission of the RAC at FIU is to collaborate with GSFC to serve public and business needs for remote-sensing data obtained by NASA, primarily from orbiting satellites, as well as from other local and global sources.

BENEFITS TO SOCIETY

This research indirectly benefits the average citizen by allowing researchers to perform their work more efficiently. In the future, the database and data visualization technology that is under development at our Center will provide more efficient information access for everyone.

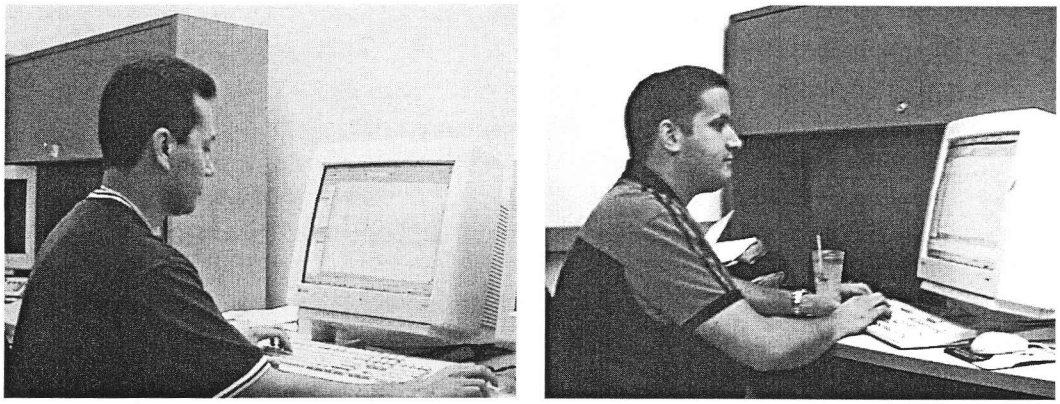

Figure 2. Alejandro Mendoza (left), who received his bachelor's degree from FIU with NASA support in the summer of 2000, and Daniel Mendez (right), who received his bachelor's degree from FIU with NASA support in the spring of 2001, are both pursuing their master's degrees with NASA support at FIU. They are studying better ways to store, serve, and visualize remotely sensed data.

STUDENT ACHIEVEMENTS

Since the granting of this award, 35 NASA-supported undergraduate students have received bachelor's degrees from FIU. Sixteen NASA-supported students received master's degrees, and one NASA-supported student received a Ph.D. These students have either gone to work in the industry or have chosen to remain at FIU to pursue higher degrees. Some supported students have continued to coauthor and present papers at conferences. In addition to university students, there were many high school students who worked on this project for school credit.