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SCIENTIFIC DATA AND INFORMATION SYSTEMS LABORATORY
ATMOSPHERIC SCIENCE AND REMOTE SENSING LABORATORY
COLLEGE OF SCIENCE
UNIVERSITY OF ALABAMA IN HUNTSVILLE
HUNTSVILLE, ALABAMA

Dr. Sara J. Graves
Principal Investigator

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1. Introduction

The University of Alabama in Huntsville (UAH) has completed the research proposed under contract NAS8-36955. The research addressed the problems of accessing and utilizing the ever increasing volume of Earth System Science information available today and projected for the future. Scientists must be given increased capabilities to rapidly determine the contents of data inventories, browse data sets of potential interest, and select those desired for detailed study to efficiently do science in this environment.

The research reported here was done within the scope of existing, and planned, Earth Science and Applications Division (ESAD) data management resources, and with the particular needs of ESAD scientists in mind. The existing Interactive Data Integration and Management System (IDIMS) was used as the baseline for this work. Extensions were made to allow study of data set selection methods, graphical user's interface techniques and data inventory organization approaches. As a result of this research a new IDIMS prototype, which runs on the ubiquitous UNIX operating system, was begun. The major tasks which made up this effort are summarized in the following sections.

2. Mainframe IDIMS

IDIMS was originally developed on an MSFC institutional IBM 3090 and continues to support the ESAD data inventory there. During the progress of research under this contract the existing capability (Mainframe IDIMS) had to be maintained. Several software changes were incorporated into this system that enabled ESAD scientists to better manage and access their data during the course of this contract. In particular the possibility arose of moving the underlying database management software from the Engineering Analysis and Data System (EADS) 3090 to the MIS 3090. A study was performed to determine the impact of such an action on the Division's day to day operation. Ultimately this led to the decision not to make the proposed move.

3. UNIX/IDIMS

Two major parts of this contract's effort were research into data set selection techniques and visual cueing approaches, and their application to ESAD data management systems. The UNIX IDIMS prototype was the centerpiece of this effort. Progress was made from early planning, to conceptual design and finally to an early prototype.

The original IDIMS system was a text oriented menu system that executed on the EADS IBM 3090 computer system. To investigate graphical approaches for more efficient data set selection, a graphical user's interface (GUI) was desired. The software to support such an interface (UIM/X) ran only on UNIX workstations. Thus, IDIMS was extended to execute on UNIX platforms.

Prior to development of actual GUI screens, sample layouts were produced on paper and presented to division scientists for review. Using the resulting suggestions initial GUI screens were developed on the UNIX workstation and once again presented to division scientists. Through this approach a system of GUI windows was designed and prototyped. The result was a graphical tool which allowed scientists to enter many different search criteria at a single screen, without having to navigate through lots of menu levels. By working closely with the scientists we were able to produce an interface which better matched their desires and would decrease their data set selection time.

Designs were also produced for rectilinear and polar map projections which would allow specification of geographical areas of interest through simple mouse manipulations. This feature will provide scientists with a quick natural technique (drawing a box) for defining an area of interest. UNIX IDIMS will automatically place the latitude and longitude ranges into the data base query. Designs were produced for a zoom function that would enlarge geographic areas so that a more precise selection could be made.

In addition to the graphical user's interface, research was also done on a system to provide a visual display of reduced resolution images. These browse images can give scientists a better feel for the content of a data set before the full resolution data is accessed. This kind of feature will allow scientists to more precisely select data products for research and potentially reduce the amount of time spent in initial investigations since bad data products could be visually isolated and omitted from consideration. Our research concentrated on techniques for displaying the images, including still frames, movie loops containing several frames and functions for manipulating the movie loops. Designs were produced and initial implementation was begun.

The prototype of the UNIX IDIMS system was demonstrated to division scientists, several visiting scientists and representatives from NASA Headquarters.

4. ORACLE Testing

UNIX IDIMS interfaces with a commercial data base management system for the access of data set inventory information. During the period of this research a new version of ORACLE was released. The utility of the new version was investigated to ascertain its impact on, and to identify any new capabilities that could be incorporated into the prototype. Plans were made for the integration of the UNIX IDIMS interface with underlying metadata contained in ORACLE.

5. Planning For Weather Services Incorporated Data Archival

Initial plans were made for an automated archival capability for Weather Services Incorporated (WSI) composite radar data. This data was being ingested into McIDAS on the EADS 3090 computer system. The automated system would transfer the McIDAS images to EADS mass storage files, and inventory the files under IDIMS.

6. Data Inventory Organization

The current data inventory organization, used in mainframe IDIMS, was studied under this contract, in order to suggest expanded metadata and more

efficient database organization for use with UNIX IDIMS. Additional metadata fields suggested for future ESAD inventories include geographic coordinates and data parameter keywords to be associated with the various data files. As part of this study a list of keywords was presented to all ESAD scientists to be used in cataloging data under UNIX IDIMS. Their comments were incorporated and a revised list was formed. The keywords list, which reflects planned data base organization, interrelates data source, sensor and parameter measured. Information was also collected from ESAD scientists describing division data kept in off-line tape libraries. These tape libraries are cataloged in IDIMS and UNIX IDIMS, along with data kept on-line or near-line on the EADS computer system.

The use of the Directory Interchange Format (DIF) for directory metadata provides a consistent organization over a wide range of data sets. DIF information was collected from various division scientists for entry of selected data sets into the international Global Change Master Directory.

7. Conclusions and Recommendations

Due to the short 800 hour period of this contract we were able to study only a few of many options for improving ESAD data management systems. However, the research described above has shown that the use of graphical techniques coupled with visual representations of geographic regions, supported by a common data organization can enhance the productivity of scientists. An equally important factor demonstrated in this effort was the ability to incorporate the comments, ideas and desires of ESAD scientists into the research while it was in progress. This mutual cooperation was vital to the project and ensured that the issues addressed were those of the scientists who will ultimately benefit from this work.

The UNIX IDIMS prototype begun in this study is a vehicle which can be used for continued research in data management. It is only a beginning, however. The issues touched on in this study need further consideration. The capabilities prototyped represent only the first step in a series of actions that ultimately produce quality research data. The data selection methods need to be extended to produce data base queries. Organizational methods for ESAD

data sets need to be studied further and issues related to the production, transmission, storage and display of browse products investigated. We recommend that such research continue into these issues and others so that ESAD scientists can continue to conduct their work in an environment which provides them with the necessary tools and techniques for meeting the challenges of Earth System Science Research.

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Danny M. Hardin
Helen Conover

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The University of Alabama In Huntsville
Computer Science Department
Huntsville, Alabama 35899

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16. Abstract

The research proposed on this contract concerning investigations of existing and planned Earth Science and Applications Division (ESAD) data management systems and research into utilities for the access and display of scientific data products has been completed. A summary of this work is provided in the attached report.

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