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Executive Summary

The National Aeronautics and Space Act of 1958 directs NASA to “provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof.” The recent proliferation of Internet access and widespread information distribution capability allows NASA to more effectively meet this directive. To this end, the Electronic Dissemination of Technical Reports (EDTR) working group was formed by the Office of the Chief Scientist at Langley Research Center in September 1993. The EDTR working group was chartered to establish the capability of electronically disseminating NASA Langley's technical reports to the U.S. aerospace industry.

External Survey

During September 1993, the EDTR working group and employees from the Langley Scientific and Technical Information Division (STID) visited a representative sample of aerospace companies to ascertain their evaluation of NASA STI services and products and, in particular, their reaction to the possibility of electronic dissemination of Langley reports. This group met not only with the library staff but also with the research and engineering staff of each company. The five companies visited were Boeing Aerospace Company, McDonnell Douglas, United Technologies, Texas Instruments, and Bell Helicopter. A conference meeting was also attended by representatives from seven additional companies and two universities in southern California. After evaluating the information obtained during these visits, the working group identified a number of factors for establishing the EDTR system requirements:

1. Because of the reliance of industry researchers on their libraries, the industry library represents a viable target for (and customer of) electronic dissemination.
2. Because of the lack of Internet access by aerospace industry researchers, passively publishing Langley reports on the Internet is insufficient; more proactive approaches are also required, such as electronic current awareness announcements.
3. Because Internet access is increasing and libraries are beginning to deliver electronic products to their customers, interest among industry researchers in on-line products is expected to increase.
4. Because industry systems and network environments differ from Langley's, the EDTR system should not be modeled according to the Langley environment.
5. Any proposed EDTR system must significantly exceed the current capabilities of traditional NASA STI products and services, which typically do not sufficiently reach industry.
6. Electronic access and delivery of Langley reports must include basic printing and searching capabilities.
7. Timeliness must be exploited in the electronic dissemination process.
8. When possible, data files should be included or linked to the electronic report.

Internal Survey

A desired characteristic of any electronic dissemination system is that it be capable of handling documents in the form in which they are produced, that is, without additional staffing requirements for document conversion. An informal survey was therefore performed to determine the standard word processing and graphics packages used by Langley researchers in the preparation of documents for publication. Surveys were sent to researchers in four directorates to identify first the degree to which documents were being prepared electronically and second the principal software packages used. Researchers were also asked about the method used to include graphics and photographs in their documents.

Most reports are already being generated (at least in part) electronically. If an appropriate electronic distribution system is identified, electronic posting of most technical documents may be a realizable near-term goal. However, no standard software package exists at Langley for either word processing or graphics, and manually pasting figures into documents is still prevalent. In addition to differences in software utilization, no standard platform exists for producing the documents. The EDTR group decided that it is neither appropriate nor cost-effective to define a standard set of software and compel all researchers to conform. Rather, a common output format, such as Adobe PostScript, should be sought from among the set of software; the electronic dissemination system would then only need to handle the single common output format.

System Selection

Seven electronic information systems in the Washington, D.C., area were investigated to gain an understanding of the available technologies and approaches used by other national agencies and corporations. This information was used

to formulate a strategy for the development of the EDTR system. Three approaches are used to develop electronic information dissemination systems: (1) custom development, (2) commercial off-the-shelf software, and (3) public domain software. Custom development involves the internal staff developing the system, writing the custom code, and integrating the system. This approach for the EDTR system was considered too costly and not necessary. Most systems are developed with the various commercial off-the-shelf software packages. This approach is cost-effective in terms of the development, integration, and maintenance and also provides optimal functionality. For wide area network access, the site licensing of client software can be costly, but the vendors are willing to negotiate on a case-by-case basis. This approach was seriously considered and evaluated for the EDTR system. Public domain software for information delivery and retrieval over the Internet has proliferated and is widely use by those connected to the Internet. Overall, this approach can be cost-effective for wide access by various clients, but it may be expensive when customization and integration are required to enhance functionality. This approach was selected by the working group for the EDTR system.

Langley Technical Report Server

The Langley Technical Report Server (LTRS), an experimental proof-of-concept system based on World Wide Web (WWW) and Wide Area Information Server (WAIS) protocols, was in operation at the time. WWW and WAIS allow a simple model for indexing and distributing technical reports. The abstracts are indexed with WAIS, and each abstract contains a pointer to the report, which may or may not reside on the same computer as the indexed abstracts. Currently most reports are stored in PostScript format, a de facto standard used for output to printers. Supplying reports in PostScript format provides most users with the ability to download and print. The potential report user can browse the list of abstracts or search the abstracts for key words (such as subject terms, author names, report numbers). When a report of interest is identified, the author can choose the title in the abstract list and the report is downloaded to the user’s workstation for viewing or printing. LTRS currently provides access to over 300 reports. During the first 18 months of operation, this server has delivered over 11,000 copies of these reports.

At Langley 33 volunteers from technical and nontechnical fields evaluated LTRS on three platforms (Macintosh, UNIX, and PC). Most volunteers thought the LTRS home page was clear and easy to understand. Most were satisfied with the searching capability, wanted to be able to search the full text of the report, and valued the browsing capability. Although they wanted to view the abstract before the full text, they liked being able to go directly to the full text of the report. For the most part, they judged the system to be valuable, even though a limited number of reports are currently available. Overall, they believed that the major strength of LTRS is that it allows researchers to access and search Langley publications from their desktop. The volunteers wanted more reports available and wanted missing figures and photographs included to complete the reports. They complained of inconsistent viewing capability. Other problems seemed to result primarily from limitations of the platform rather than LTRS (i.e., speed, memory, and disk space).

Approximately 175 U.S. companies have accessed LTRS. In addition to numerous computer and software companies, 16 aerospace companies and many nonaerospace companies who are candidates for dual use of NASA's aerospace technology have used the LTRS system. Also over 200 universities and government agencies have accessed LTRS. Although LTRS has not made great penetration into the aerospace community, it has demonstrated the capability of disseminating Langley technical reports to the aerospace industry.

Recommendations

Management support and guidance are essential to the success of any electronic distribution system. Thus, the EDTR working group proposed a policy statement that provides guidelines for distribution and storage as well as a framework for managing the electronic distribution system. (See appendix A.) Although it has not been adopted by Langley management, the policy statement has been reviewed for adherence to copyright law and generally conforms to NASA STI publication policy. The EDTR working group recommends a framework for managing the EDTR system based on establishment of a committee to (1) establish electronic publication standards, (2) monitor adherence to policies, (3) maintain structure of the EDTR system, (4) ensure reliability of the system, (5) plan for the future, and (6) promote the use of the EDTR system, particularly among aerospace industry.

The EDTR working group recommends that the proposed policy statement be reviewed and implemented to move EDTR from a proof of concept to an important strategic direction for the Langley STI Program. Also, the open, unrestricted EDTR system must be extended to restricted information to provide a secure way of quickly disseminating our commercially valuable information to NASA's domestic customers. However, a restricted system will entail investment in labor to qualify users and investment in systems to manage the risk of restricted information on-line. Finally the evaluation of LTRS by Langley users clearly indicated areas for improving functionality. A high priority should be enlarging the collection to include most unrestricted technical documents originating from Langley.

Introduction

The National Aeronautics and Space Act of 1958 gives NASA the following directive for disseminating information: "The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof." The recent proliferation of Internet access and widespread information distribution capability allows NASA to more effectively meet this directive. To this end, the Electronic Dissemination of Technical Reports (EDTR) working group was formed by the Office of the Chief Scientist at Langley Research Center in September 1993. The EDTR working group was chartered to establish the capability of electronically disseminating NASA Langley's technical reports to the U.S. aerospace industry.

To accomplish this objective, the working group determined external customer (user) requirements, surveyed technology status, developed a vision for electronic dissemination, determined internal customer (Langley researchers) requirements and capabilities, and defined and implemented a system for electronic dissemination. The primary focus of this working group was the aerospace industry. Based upon the information gathered from external sources and from within Langley, basic and preferred requirements that described a desired report distribution method were derived. Two approaches were considered for developing a system to meet these requirements: (1) use of commercial off-the-shelf software and (2) use of public domain software based on the World Wide Web (WWW) protocols (ref. 1). After evaluating the two approaches in light of the stated requirements, the WWW approach was selected by the group. The Langley Technical Report Server (LTRS), an experimental report distribution system based on WWW protocols (ref. 2), was in operation at the time.

After LTRS was selected as the primary electronic distribution system, an evaluation was held at Langley to determine how to improve the functionality of the LTRS system. This report documents the findings of the EDTR committee, including customer surveys, system analysis and selection process, current system design, LTRS system evaluation, recommended policy statement, and suggestions for future implementations. Appendix A contains the recommended policy statement, appendix B contains LTRS usage statistics, and appendix C contains the LTRS instructions that were used during the evaluations.

External Survey of Industry Electronic Dissemination Usage

During September 1993, the EDTR working group and employees from the Langley Scientific and Technical Information Division (STID) visited a representative sample of aerospace companies to ascertain their evaluation of NASA scientific and technical information (STI) services and products and, in particular, their reaction to the possibility of electronic dissemination of Langley reports. This group met not only with the library staff but also with the research and engineering staff of each company. The companies visited were Boeing Aerospace Company, McDonnell Douglas, United Technologies, Texas Instruments, Loral Vought, Bell Helicopter, and Lockheed Corporation. A conference meeting was also attended by representatives from seven additional companies and two universities in southern California.

Among these companies, library and information services vary from centralized library systems, to several decentralized libraries, to minimal services. In most companies, researchers rely on libraries for searches, current awareness, and document acquisition and delivery. Many libraries provide electronic services, such as online catalogs, technical experts directories, and CD-ROM databases.

In general, aerospace companies are wary of Internet security and therefore provide electronic mail access only, restricted Internet access through a firewall, or no Internet access at all. However, Internet access is increasing. Company systems and network environments resemble Langley's in that multiplatform is the norm. Their systems and network environments differ from Langley's in that Macintosh is not as prevalent, IBM-compatible personal computers (PC's) are much more prevalent, and networks and electronic mail are more heterogeneous and may not be connected to the Internet.

The aerospace companies with viable libraries use a wide range of NASA STI products and services, including subscriptions to NASA reports, current awareness products, and NASA's aerospace database, RECON. The publication *Tech Briefs* was often mentioned. The companies generally considered NASA and NACA documents very valuable resources. However, many of these companies complained about NASA STI products (RECON) and used commercial replacements when available (Dialog and AIAA Aerospace Database). The nonaerospace company and the company with a minimal library had difficulty finding NASA documents and were generally unaware of NASA STI products. In addition, nearly no one understood or was concerned about

Table 1. EDTR System Considerations Inferred from Aerospace Industry Visits

1.	Because of the reliance of industry researchers on their libraries, the industry library represents a viable target for (and customer of) electronic dissemination.
2.	Because of the lack of Internet access by industry researchers, passively publishing Langley reports on the Internet is insufficient; more proactive approaches are also required, such as electronic current awareness announcements.
3.	Because Internet access is increasing and libraries are beginning to deliver electronic products to their customers, interest among industry researchers in on-line products is expected to increase.
4.	Because industry systems and network environments differ from Langley's, the EDTR system should not be modeled according to the Langley environment.
5.	Any proposed EDTR system must significantly exceed the current capabilities of traditional NASA STI products and services, which typically do not sufficiently reach industry, particularly nonaerospace companies.
6.	Electronic access and delivery of Langley reports must include as a minimum basic printing and searching capabilities.
7.	Timeliness must be exploited in the electronic dissemination process.
8.	When possible, data files should be included or linked to the electronic report.

distinctions among the NASA report series (i.e., TP's, TM's, etc.).

Many companies recommended improvements to NASA STI products and services such as RECON and the Center for Aerospace Information (CASI), which is under the auspices of NASA Headquarters. Companies recommended several new products, such as electronic current awareness, technical experts locator, monographs, and state-of-the-art reviews. They also recommended enhancements to our traditional reports, such as more informative abstracts and summaries.

The companies felt that NASA reports are not published and distributed quickly enough. Thus, electronic access to Langley reports is of interest to these companies provided that they can print a hard copy. They also wanted robust searching not only of bibliographic citations but also of full text of a large repository of documents, and they wanted direct electronic access to the data discussed in NASA reports.

After evaluating the information obtained during the industry visits, the working group identified a number of factors for establishing the EDTR system requirements. These system requirements are summarized in table 1.

Internal Survey of Langley Document Preparation Methods

A desired characteristic of any electronic dissemination system is that it be capable of handling documents in the form in which they are produced, that is, without document conversion. The EDTR working group therefore performed an informal survey to determine the word processing and graphics packages used by Langley researchers in the preparation of documents for publication. Surveys were sent to researchers in four directorates to identify first the degree to which documents were being prepared electronically and second the principal software packages used. Researchers were also asked about the method used to include graphics and photographs in their documents. For expediency, the surveys were distributed via electronic mail. Surveys were also sent to branch secretaries so that researchers who do not use electronic mail could have the opportunity to respond.

Over 250 researchers from four directorates responded. Many researchers also provided detailed commentary on the report generation process along with suggestions for process improvement. Because this was an informal poll, no attempt was made to aggregate the responses weighted by directorate size; the results are presented as a proportion of those who chose to respond. Trends resulting from that survey are presented in figures 1 to 4.

The first important observation from the survey results is that most reports are already being generated (at least in part) electronically. Even when handwritten manuscripts are delivered to secretaries for typing (relatively rare among the respondents), the secretaries prepare the documents electronically. Thus, if an appropriate electronic dissemination system is identified, electronic posting of reports may be a realizable near-term goal.

Authors need only be convinced of the desirability of using the skills they already possess or using available publication support services to provide reports in a

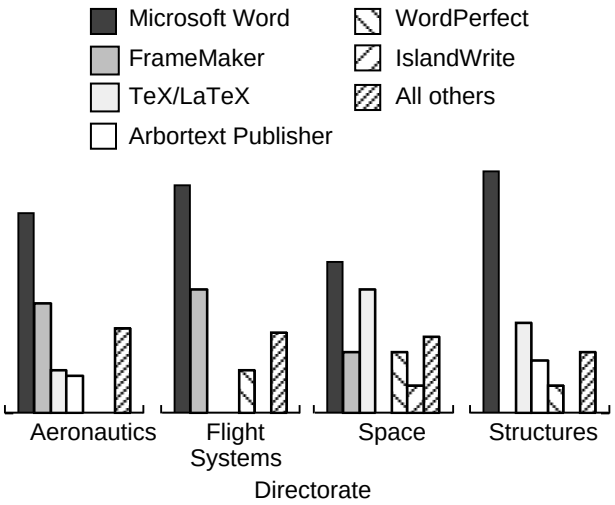

Figure 1. Usage of word processing software.

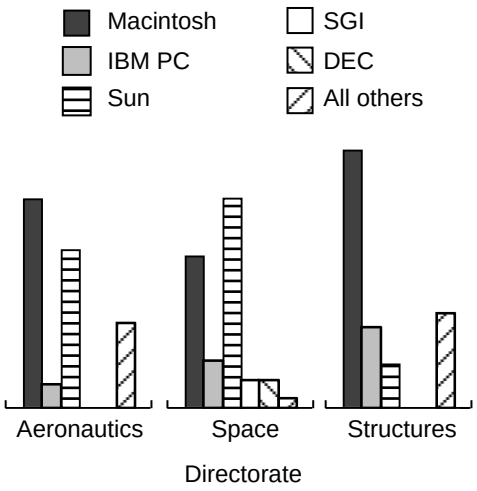

Figure 4. Usage of computer platforms.

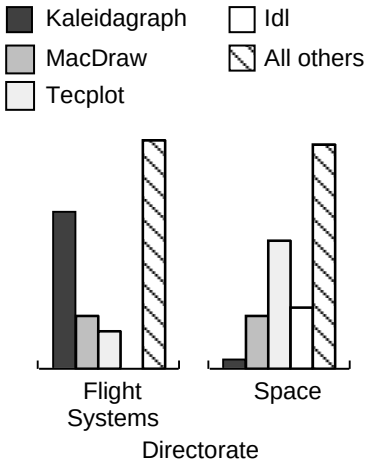

Figure 2. Usage of graphics software.

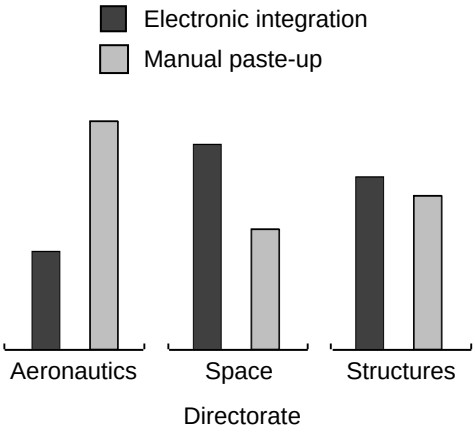

Figure 3. Figures incorporated in reports.

completely electronic format. Because many journals have already imposed such a requirement, the learning curve for the complete production of electronic documents should be short.

The second important observation from the survey is that no standard software package exists for either word processing (fig. 1) or graphics (fig. 2). A large fraction of respondents use individually preferred packages, particularly for graphics. Figure 3 shows that manually pasting figures into documents is still prevalent, especially in the Aeronautics directorate, where researchers commonly paste up photographs in documents. In addition to differences in software utilization, no standard platform exists for producing the documents (fig. 4). Respondents were almost evenly split between UNIX workstations and desktop personal computers.

Researchers at Langley have diverse requirements for appropriately publishing their findings. The EDTR group decided that it is neither appropriate nor cost-effective to define a standard set of software and compel all researchers to conform. Rather, a common output format such as Adobe PostScript should be sought from among the set of software; the electronic dissemination system would then only need to handle the single common output format. The disadvantage of standardizing on output format is that this format might limit the functionality of the system, such as full-text searching and hypertext.

System Capabilities

The EDTR working group used the information from the preliminary meetings with industry and the survey of NASA Langley researchers to compile a set of basic and preferred requirements for the electronic dissemination

Table 2. Basic System Requirements

1.	Compatible with multiple platforms with graphical capability.
2.	Accessible on a TCP/IP Network.
3.	Able to download, view, and print documents and parts of documents including graphics with reasonable speed.
4.	Able to perform interactive searching of bibliographic citation.
5.	Able to view files with sufficient functionality to determine relevance before downloading (e.g., scrolling, zooming, rotating, go to pages).
6.	Easy to use and not require users to be familiar with complex search systems or computer software and hardware integration.
7.	Accommodate delivery of a large repository of documents, including scanned documents as well as electronic documents from various text formatting systems.
8.	Accessible to people working within a restricted access (firewall) system.
9.	Offer minimal cost and labor for NASA and customer implementation, maintenance, and growth of system.

Table 3. Preferred System Requirements

1.	Ability to mark text with users' annotations and bookmarks.
2.	Ability to cut and paste text and graphics.
3.	Allow an optional full-text searching of selected documents.
4.	Ability to navigate through document with hypertext and to create links between documents and files.
5.	Accommodate various information formats including nonprint information such as numeric data files, photographs, video, audio.
6.	Ability to access databases resulting from other electronic publishing projects.
7.	Flexible enough to allow database to be included in future electronic publishing projects.
8.	Accommodate regular announcements containing abstracts of newly released papers grouped by subject or RTOP category
9.	Accommodate access to and transfer of sensitive information.
10.	Inclusion of a technology locator that identifies responsible offices and principal researchers.
11.	Compatible with nongraphical platforms.

system. These requirements are presented in tables 2 and 3, respectively. The EDTR working group deemed the basic requirements to be necessary for a viable EDTR system. The preferred requirements are important but not necessary.

System Selection Process

The system selection process consisted of surveying existing information dissemination systems, evaluating two approaches against the basic and preferred requirements, and deciding which approach would be better for the electronic dissemination of technical reports to the aerospace industry.

Seven electronic information systems in the Washington, D.C., area were investigated to gain an understanding of the available technologies and approaches used by other national agencies and corporations. This information was used to formulate a strategy for the development of the EDTR system. Systems at the following institutions were investigated:

- National Library of Medicine
- Naval Research Laboratory
- Kestrel
- Bell Atlantic Corp.
- Symbiont
- NASA Goddard Space Flight Center
- NASA Headquarters/Info Dynamics

System Development Approaches

Three major approaches are used to develop electronic information dissemination systems. These approaches are (1) custom development, (2) commercial off-the-shelf software, and (3) public domain software.

Custom development involves the internal staff developing the system, writing the custom code, and integrating the system. This approach was used for all systems at the National Library of Medicine. In general, this approach is expensive and is used when a specific application cannot be developed with existing software. In other words, the application may require so many modifications to the existing software that it is not worth the effort, or it may be virtually impossible to adapt a commercial product to work with an existing internal system. At the National Library of Medicine, this approach seems to be used because they have a 30-year-old MEDLINE system, permanent resources allocated to develop all necessary internal systems, and a philosophy that their needs are unique and will always require them to develop their own systems. This approach for the EDTR system was considered too costly and not necessary.

Most systems are developed with various commercial off-the-shelf software packages. The Projects Directorate at the NASA Goddard Space Flight Center, NASA Headquarters, the Naval Research Laboratory Library, and Bell Atlantic Information Systems have used this approach. Of all the systems that were investigated, the most successful ones in terms of meeting the original objectives used this approach. This approach is cost-effective in terms of the development, integration, and maintenance and also provides optimal functionality. For wide area network access, the site licensing of client software can be costly, but the vendors are willing to negotiate on a case-by-case basis. This approach was seriously considered and evaluated for the EDTR system.

Public domain software for information delivery and retrieval over the Internet have proliferated and are widely used by those connected to the Internet. The Astrophysics Data Facility at the NASA Goddard Space Center developed a prototype system with this approach. This specific implementation did not seem to achieve its intended objectives. The reason seemed to be inexperience with selection and integration of the various hardware and software pieces. The EDTR working group realized that this prototype was not a good implementation and integration of public domain software. Overall, this approach can be effective for wide access by various clients, but it may become expensive when customization and integration are required to enhance functionality. This approach was also seriously considered and evaluated for the EDTR system.

Existing Langley Prototypes

Two efforts were in progress at Langley in the area of electronic dissemination of technical reports: LTRS and FEDS. The LTRS project sponsored by the Information Systems Division and STID is based on the WWW protocols and NCSA Mosaic, a public domain WWW browser (ref. 3). The LTRS project was started as a proof-of-concept service in late 1992 (ref. 4). The other project, a prototype full-text electronic documents system (FEDS), was sponsored by STID and was initiated as a result of a grant from the Director's Discretionary Fund awarded to the Technical Library in September 1993. This project proposes use of Interleaf Worldview and commercial off-the-shelf software for the development of the system. Although both projects shared the common goal of electronic dissemination and retrieval of reports, their approaches, objectives, and developmental cycles differed significantly.

The goal of FEDS was to build a system of full-text NACA/NASA reports that exist in paper and electronic (T_EX) format. Langley researchers would then have desktop access to NACA/NASA reports from all clients (PC, Macintosh, and UNIX) with excellent functionality, an easy-to-use interface, full-text searching, hyperlinks, manipulation, and printing. This project proposed a unified approach for providing access to all NASA reports regardless of their format. It also proposed to integrate full-text searching, viewing, and printing of reports with their original ‘‘look and feel.’’ The emphasis of this project was providing desktop document delivery and retrieval to the Langley community with a high level of functionality. The prototype project was given a year for development with a projected completion date of July 1994.

The goal of LTRS was to disseminate Langley technical reports to a wide audience on the Internet. The report set was initially comprised of Langley formal technical reports from recent years that were archived in electronic (T_EX) format (ref. 5). These reports were converted to Adobe PostScript format, but hypertext reports have since been included and other formats can easily be integrated. Based on WWW protocols, LTRS offers access from numerous platforms, even nongraphical terminals, running WWW client software such as NCSA Mosaic. LTRS offers browsing, searching of bibliographic data and abstracts, full-text viewing, and printing. The emphasis of this project was to quickly disseminate Langley technical information to a wide audience through an Internet-based solution to information

delivery. LTRS has been in operation since January 1993.

Selection of LTRS for EDTR System

The FEDS prototype project, based on commercial off-the-shelf software, and the LTRS proof-of-concept, based on WWW public domain protocols, offered the EDTR working group the opportunity to explore two approaches to decide which approach was more suitable for the electronic dissemination of Langley's technical information. At the time of the EDTR system selection, the FEDS project was at the software selection stage prior to system development, while LTRS was already operational. Therefore, the EDTR working group focused on the functionality and suitability of the software. The group examined Interleaf Worldview and NCSA Mosaic software to determine whether they were fully compliant (FC), partially compliant (PC), or not compliant (NC) with the basic and preferred requirements listed in tables 2 and 3. The results of this evaluation are given in table 4.

Both NCSA Mosaic and Interleaf Worldview were fully compliant with most of the basic requirements and many of the preferred requirements. Thus, the working group resorted to considerations other than the system requirements in selecting a system approach. The WWW public domain approach exemplified by LTRS was selected for the following reasons:

1. System flexibility: LTRS is based on publicly documented open systems and standard protocols that are an intrinsic part of the Internet functionality.

2. Wide dissemination: LTRS is widely used (appendix B) because of availability of public-domain client software running on numerous platforms, access to other NASA and non-NASA information from a single WWW interface, and demonstrated delivery of a wide variety of information.

3. Cost: LTRS imposes no direct cost for software on either NASA or its customers.

Although the commercial off-the-shelf approach had the following advantages, they were believed to be less significant to the charter of the EDTR system presented in the Introduction.

1. Functionality: Commercial software generally provides greater functionality, such as user-friendly search capabilities, full-text searching, hypertext links between search results and text.

Table 4. Evaluation of Interleaf and Mosaic

[FC, fully compliant; PC, partially compliant, NC, not compliant]

Requirement	Interleaf	NCSA Mosaic
Basic		
1	FC	FC
2	FC	FC
3	FC	FC
4	FC	FC
5	FC	PC
6	FC	FC
7	FC	FC
8	PC	PC
9	NC	FC
Preferred		
1	FC	PC
2	FC	PC
3	FC	NC
4	FC	PC
5	FC	FC
6	PC	FC
7	PC	FC
8	FC	FC
9	PC	PC
10	PC	PC
11	FC	FC

2. Software integration: Commercial document delivery systems include fully integrated client software.

3. Access control: Users can usually be categorized with most commercial systems to allow varying levels of access depending on sensitivity of documents.

4. Large collections: Commerical systems have been demonstrated on very large collections.

Evolution of LTRS

Pre-WWW LTRS

LTRS officially began serving reports on January 14, 1993 (ref. 4). The initial stage consisted of only one server, an anonymous FTP (file transfer protocol) server on `techreports.larc.nasa.gov.` The FTP server was the historical model for distributing reports, program codes, and other information on the Internet. Figure 5 shows the file system hierarchy for the FTP server. Initially, the reports that were available were formal technical reports in compressed PostScript format. Abstract lists, which were available in ASCII format, could be browsed or loaded into a text editor for searching.

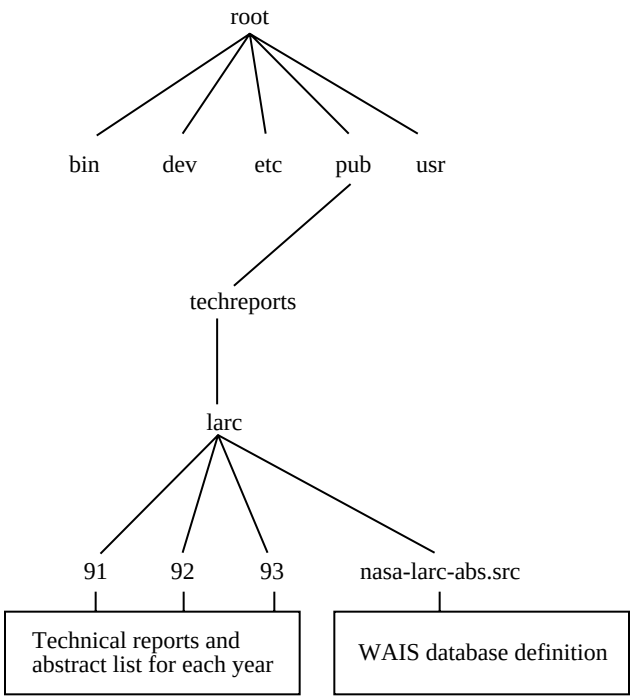

Figure 5. File hierarchy of technical reports on server.

On February 10, 1993, a Wide Area Information Server (WAIS) was added to LTRS, which allowed interactive searching of the abstracts. The FTP server and the ASCII abstract lists were still available. However, searching the abstracts and retrieving the reports were not integrated into a single process.

Many gophers (menu-based systems for exploring Internet resources) soon started to point to the FTP and WAIS servers of LTRS, but before LTRS could be implemented as a gopher server, the developers discovered NCSA Mosaic and the WWW. The gopher implementation was bypassed in favor of WWW.

WWW Version of LTRS

The initial WWW version of LTRS began August 1993. This version consisted only of a WWW wrapper around the existing FTP and WAIS servers. The integration of WWW made the separate services easier to use and collected them into a single location for convenience; however, it did not allow for the integration of searching and retrieving.

The current WWW version of LTRS, described in detail in reference 2, made its debut in October 1993. (See fig. 6.) LTRS is now a collection of servers (HyperText Transfer Protocol (HTTP), FTP, and WAIS), which are combined in a manner transparent to the user (fig. 7). Only functionality choices are presented to the user (search and browse) and the implementation details (FTP and WAIS) are hidden. Perhaps most importantly, the current version of LTRS integrates the search and retrieve functions. Users can now search the citations and abstracts of reports and then retrieve (view or save locally) the report. Also, users can now retrieve the reports directly by browsing abstract lists.

The increasingly seamless integration of new servers does not obviate the previous servers. For example, many users still access the technical reports via anonymous FTP or through a gopher gateway that points to the FTP server. The current version builds upon the prior work of the LTRS project. Even when a user accesses LTRS through WWW, a retrieval ultimately results in an anonymous FTP access to `techreports.larc.nasa.gov` for most of the reports. This orthogonal, building-block approach insures that older systems remain functional even with rapid improvements in information servers.

Although accessing LTRS via the previous methods is still possible, the use of WWW has allowed it to grow beyond the level of just serving reports from one computer. LTRS takes advantage of the distributed nature of WWW to catalog and provide access to reports that were once outside its domain. The compressed PostScript files available via anonymous FTP on `techreports.larc.nasa.gov` now represent only a large subset of the reports that are available.

Current System Design

New Model for Document Distribution

WWW and WAIS allow a simple model for indexing and distributing technical reports. The model is general enough to be used for a variety of applications and well-suited for the distribution of reports in a variety of formats. A small amount of metadata, in this case an abstract, is indexed with WAIS. The abstract itself holds a pointer to the report. Because WWW can point

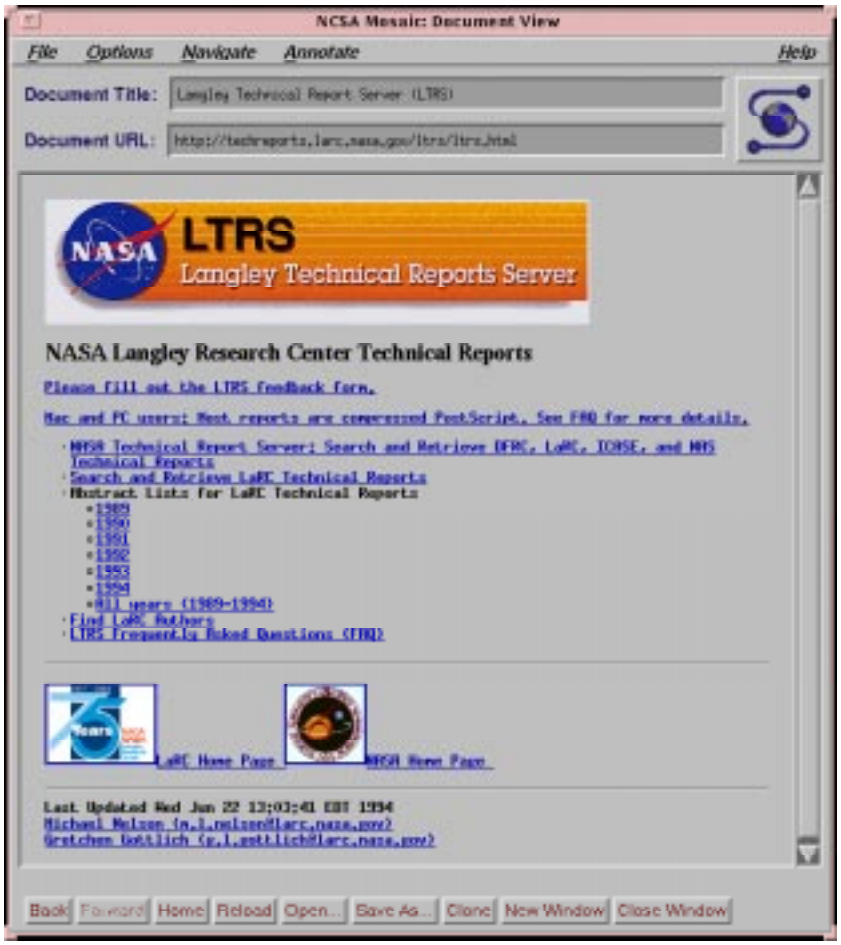

Figure 6. LTRS home page as displayed in NCSA Mosaic.

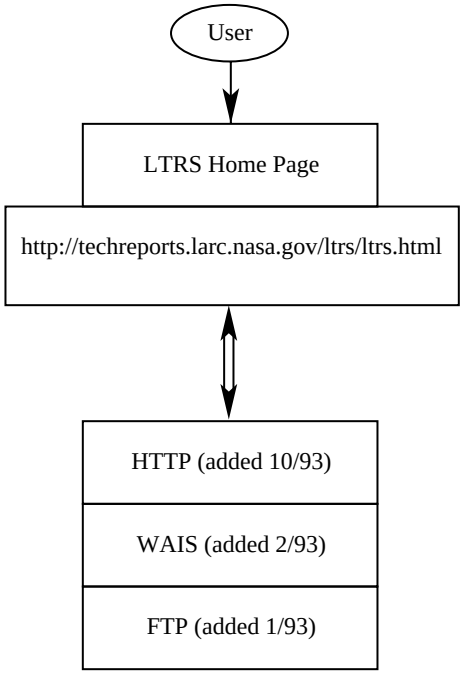

Figure 7. Collection of servers in LTRS system.

anywhere on the network, the abstract can point to a report (or other data object) residing on a different computer, possibly even with a different type of server (HTTP or gopher). Currently, the abstracts in LTRS only point to one copy of the report, but the system could easily be extended so that the abstracts point to reports in multiple formats, related reports, or even supplementary material such as photographs or video. Figure 8 illustrates a simplified view of the data model.

Report Storage in LTRS

Initially, the contents of the single anonymous FTP server defined the contents of LTRS. With the use of WWW, logical content and physical content can now be separated. All abstracts for the reports are stored centrally, and while all the reports appear to be stored centrally, about 5 percent are now stored on other computers at Langley. More distributed storage of reports is anticipated in the future. However, the degree of distributed storage is an issue as yet to be resolved.

Report Indexing Method

A distinction is made between the archival format of the abstracts and the presentation format. Abstracts are accepted in refer format (ref. 6), and a script is used to translate the refer format into hypertext markup language (HTML). (See figs. 9 and 10.) Although refer is a popular bibliographic format, it is generally not preferred by users. HTML (ref. 7) is currently the obvious choice for presentation of the abstracts with pointers to reports. (See sample abstracts in figs. 10 to 12.)

The resulting HTML files are then indexed with WAIS. The WAIS index program was originally unable to index HTML documents. The LTRS developers modified the index program so that it handled HTML documents appropriately. The resulting changes to the WAIS index program have been submitted to the Clearinghouse for Networked Information Discovery and Retrieval (CNIDR), the organization that maintains the free version of WAIS.

Report Collection

Central to wide use of any document delivery system is the quality and extent of the collection. LTRS currently provides access to over 300 unique reports, including NASA reports, journal articles, conference papers, and NASA-sponsored theses. During the first 18 months of operation, LTRS has delivered over 11,000 copies of reports from this database. (See appendix B.)

The initial report set was comprised of unrestricted NASA formal technical reports that the Research Publishing and Printing Branch (RPPB), STID, had archived in native electronic format, that is, in the format of the software used to produce the reports (T_EX). These files were converted to PostScript format, a de facto standard used for output to printers. Supplying reports in the PostScript format provides most users with the ability to download and print.

The RPPB continues to submit new NASA Langley formal reports to the LTRS system. After the manuscripts are approved for printing and hardcopy distribution, the same electronic files are processed into PostScript files for electronic delivery and submitted to LTRS. Because these reports are all produced with the same publishing software and conventions, the abstract and citation in refer format can automatically be extracted from the electronic file. These formal reports continue to be a large subset of the total number of reports available from the system.

Authors may submit their reports directly to LTRS by preparing a citation in refer format and submitting it along with a PostScript file for the report. If the report is already available on-line, the author may simply include the universal resource locator (URL) so that LTRS can point to the report on the author's server. Documents formated with HTML are also accepted.

The most limiting factor to the quality of the LTRS report collection is that not all reports are complete. Often manual processes are still used to produce the report manuscripts; for example, photographs and illustrations may be pasted up instead of electronically inserted. Then, the reports on LTRS do not include the manually inserted material.

Evaluation of LTRS by Langley Users

LTRS was evaluated on three platforms: Macintosh, UNIX, and PC. Instructions illustrating the searching, browsing, viewing, and printing capabilities of the system were written for each platform. (See appendix C.) Thirty-three Langley volunteers from technical and nontechnical fields were asked to follow these instructions and then fill out a two-part evaluation form of Likert scale and free responses.

The volunteers were divided into four sessions so that they could evaluate LTRS on their platform of choice: Macintosh (16), UNIX (11), and PC (7). At each session four Macintosh, three UNIX, and two PC platforms were available. Each platform had the same version of NCSA Mosaic and the appropriate viewing and printing software. The Macintosh and UNIX platforms were connected to a printer. No formal training was given during the scheduled 2-hour sessions; however, EDTR group members were available to answer questions. Most volunteers finished in 1 to 1.5 hours.

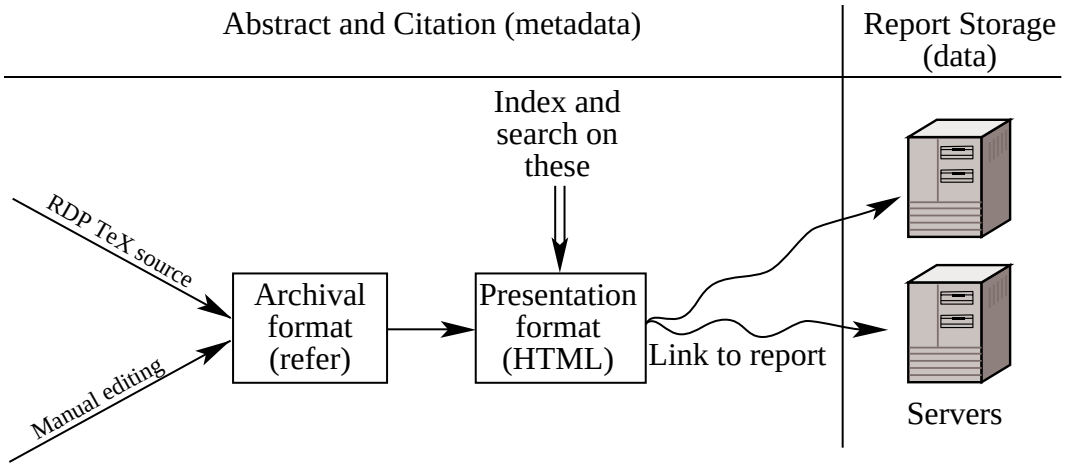

Figure 8. LTRS data model.

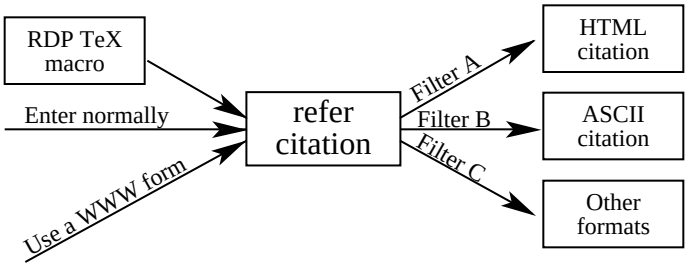

Figure 9. Abstract-generation method.

```
%A Lin C. Hartung
%A Robert A. Mitcheltree
%A Peter A. Gnoffo
%T Stagnation Point Nonequilibrium Radiative Heating and the Influence of Energy Exchange Models
%J Journal of Thermophysics and Heat Transfer
%V 6
%N 3
%D July–September, 1992
%P 412–418
%O Prior version appeared as AIAA Paper 91–0571
%U ftp://techreports.larc.nasa.gov/pub/techreports/larc/92/jtht–6–3–92.ps.Z
%X A nonequilibrium radiative heating prediction method has been used to evaluate several energy exchange
models used in nonequilibrium computational fluid dynamics methods. The radiative heating measurements
from the FIRE~II flight experiment supply an experimental benchmark against which different formulations for
these exchange models can be judged. The models which predict the lowest radiative heating are found to give
the best agreement with the flight data. Examination of the spectral distribution of radiation indicates that despite
close agreement of the of the total rediation, many of the models examined predict excessive molecular radiation.
It is suggested that a study of the nonequilibrium chemical kinetics may lead to a correction for this problem.
```

Figure 10. Sample abstract in refer format.

```
<TITLE>Stagnation Point Nonequilibrium Radiative Heating and the Influence of Energy Exchange Models</TITLE>

<i><A HREF="http://www.larc.nasa.gov/ltrs/ltrs.html">Langley Technical Report Server</A></i><hr>

<OL>

<LI><A NAME="">Lin C. Hartung,
Robert A. Mitcheltree and
Peter A. Gnoffo,
<B> ' ' <A HREF="ftp://techreports.larc.nasa.gov/pub/techreports/larc/92/jtht–6–3–92.ps.Z">Stagnation Point
Nonequilibrium Radiative Heating and the Influence of Energy Exchange Models,</A> ' ' </B>
<I>Journal of Thermophysics and Heat Transfer</I>,
vol. 6, no. 3, July–September, 1992,
pp. 412–418,
Prior version appeared as AIAA Paper 91–0571.
</A>
<P>
<B>Abstract: </B>
A nonequilibrium radiative heating prediction method has been used to evaluate several energy exchange
models used in nonequilibrium computational fluid dynamics methods.  The radiative heating measurements
from the FIRE~II flight experiment supply an experimental benchmark against which different formulations for
these exchange models can be judged.  The models which predict the lowest radiative heating are found to give
the best agreement with the flight data.  Examination of the spectral distribution of radiation indicates that despite
close agreement of the of the total rediation, many of the models examined predict excessive molecular radiation.
It is suggested that a study of the nonequilibrium chemical kinetics may lead to a correction for this problem.<P>
```

Figure 11. Sample abstract in HTML format.

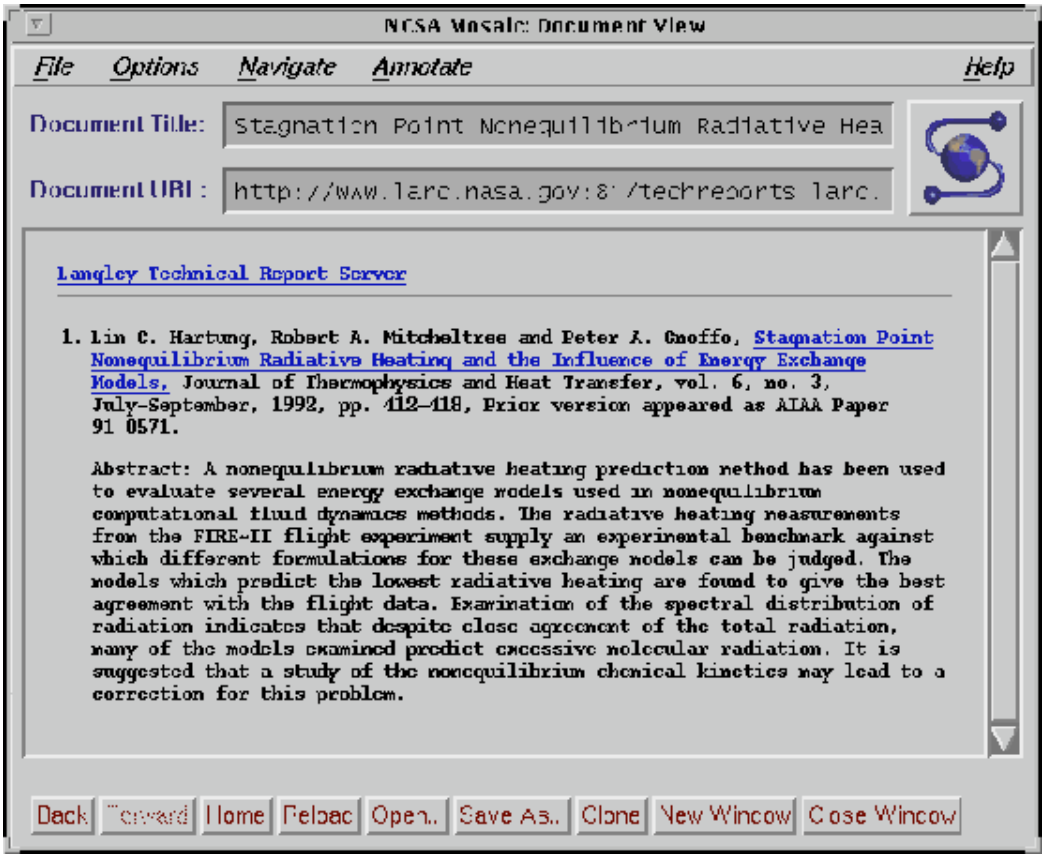

Figure 12. Sample abstract displayed in NCSA Mosaic.

The results of this evaluation are summarized in this section.

Evaluation Results: Likert Responses

In section I of the evaluation, the volunteers were asked for their level of experience with their chosen platform, the Internet, and NCSA Mosaic. Most considered themselves very experienced on the platform tested (fig. 13), not as experienced with the Internet (fig. 14), and even less familiar with NCSA Mosaic (fig. 15).

Section I of the evaluation form also contained 25 statements about LTRS. The volunteers were asked to what extent they agreed with the statement on a Likert scale of 1 (do not agree) to 5 (strongly agree). These statements can be grouped into the following five categories: instructions (statements 1,14,15), searching (statements 3 to 7, and 21), report viewing (statements 8 to 12), printing (statements 13 and 22), and report types (statements 16 to 20, 24, and 25). Each statement as it appeared on the evaluation form is presented along with the response in table 5.

Most volunteers thought that the instructions and the LTRS home page were clear and easy to understand. However, one commented that the LTRS instructions needed to be taken ‘‘slowly.’’ Most volunteers were satisfied with the searching capability, wanted to be able to search the full text of the report, found the browsing capability valuable, and were in strong agreement that they wanted to view the abstract before the full text. For the most part, they liked having the capability to go directly to the full text of the report.

In response to statements 8 and 9, one volunteer commented that what one would view depended on what one knew about the report. Most would use the system to preview the paper before printing. One volunteer commented that, for the most part, the procedure for viewing the paper on the screen was straightforward. Another felt the instructions were good but the procedure itself was not easy to use. Most wanted the document to be legible on the screen and felt the procedure for printing was straightforward. Either training or written instruction was deemed necessary for the experienced computer user and even more so for the inexperienced user.

Even though LTRS currently provides access to over 300 reports, they judged LTRS to be a valuable system. They would like to see the full text of classic NACA and NASA reports. In particular, one volunteer suggested immediate inclusion of some NACA reports, while another suggested expanding LTRS slowly to include past reports. Even though they thought figures and photos currently unavailable electronically should be added to the reports, they indicated that LTRS was still a

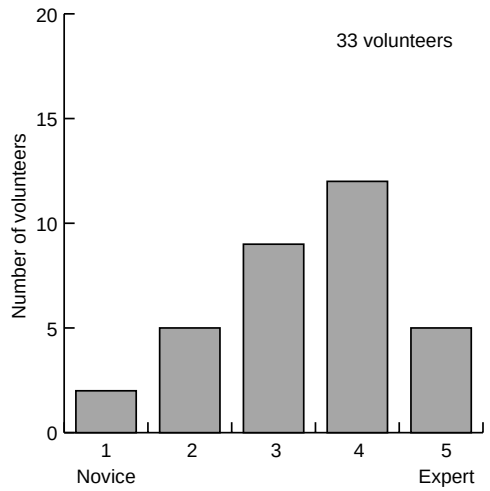

Figure 13. Level of experience on platform.

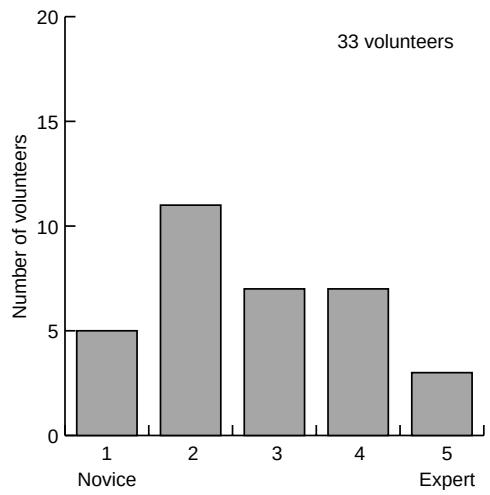

Figure 14. Level of experience with Internet.

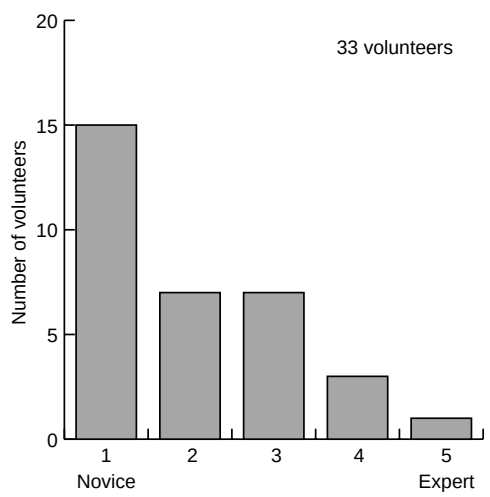

Figure 15. Level of experience with NCSA Mosaic.

Table 5. Responses to LTRS Survey Questions

[Response of 1 or 2 on Likert scale = Do not agree; response of 4 or 5 on Likert scale = Agree]

Survey	Mean	Do not agree, percent	Agree, percent
1. The written instructions explaining how to use the LTRS system are clear and easy to understand	3.91	3	76
2. The LTRS home page is clear and easy to understand.	4.18	0	85
3. Searching LTRS for a specific author or word is intuitive and user friendly.	4.09	3	76
4. The search results screen is clear and easy to understand.	3.76	6	61
5. I am satisfied with the current search capability provided by LTRS which allows for retrieval from the bibliographic description (author, title, report number, date, etc.) and abstract.	3.80	6	73
6. I want the capability to search the full text of the report or paper.	3.82	6	61
7. The LTRS system provides browsing capability for bibliographic descriptions (title, author, report number, date, etc.) and abstracts which is both easy to use and valuable to me as a researcher.	4.00	3	76
8. I want to view the bibliographic description and abstract of the paper before deciding to view the full text of the report.	4.55	0	94
9. I want the capability to navigate directly to the full text of the report or paper without having to first view the bibliographic description and abstract.	3.30	27	42
10. I would use the system to preview the text before printing the complete report or paper.	4.42	3	91
11. The procedure for viewing and reading the full text of the report or paper on the screen is easy, simple, and straightforward.	3.55	15	45
12. I require the full text of the report or paper to be fully legible on the screen.	3.79	9	61
13. The procedure for printing the full text of the report is easy, simple, and straightforward.	3.48	12	48
14. Written instructions and/or training on how to use LTRS is not necessary for the experienced computer user since the system is very intuitive and easy to use.	2.61	52	24
15. Written instructions or training on how to use LTRS is not necessary for even the inexperienced computer user since the system is very intuitive and easy to use.	1.67	85	3
16. With only selected reports and papers from 1989 to the present, LTRS's material content is still valuable.	4.03	9	73
17. LTRS should include the electronic full-text version of classic NACA and NASA reports issued prior to 1989.	4.30	3	82
18. For LTRS to be a valuable research tool, the missing figures and photographs must be added to the system.	3.55	18	55
19. In spite of the missing figures and photographs, LTRS is still a valuable research tool.	3.88	3	73
20. The LTRS reports which are available in hypertext format are easier to work with and provide greater research value than those which are in PostScript format.	3.45	12	45
21. Response time for searching and browsing is acceptable.	3.56	15	67
22. The response time for printing is acceptable.	3.58	9	55
23. Overall, the LTRS system is an easy to use, effective, and valuable research tool.	4.12	3	85
24. In the future, the electronic full text of Langley reports and papers should be stored in a permanent and routinely accessible distribution system available on the Internet.	4.58	0	88
25. I would be willing to contribute my own reports and papers for electronic distribution via LTRS.	4.64	0	94

valuable research tool. In addition, most liked to view hypertext format reports better than PostScript reports.

Most agreed that the response time for searching and browsing was acceptable; however, one commented that the PC response time was slow. (Exact times were not measured; thus, reaction to response time is extremely subjective.) The 25 who tried printing found the response to be acceptable. Most believed that Langley reports should be available on the Internet, and one wanted Langley researchers to also have access to foreign reports. Most were strongly agreeable to adding their reports to LTRS.

Evaluation Results: Free Responses

In section II of the evaluation, the volunteers were asked to list (1) what they felt were the strengths of the LTRS system, (2) what features needed to be added or enhanced in the system, (3) what specific problems they encountered during the evaluation session, and (4) any thoughts they had about the collection of reports and papers available on LTRS. This section summarizes those comments, which were consistent with those indicated numerically in section I of the evaluation.

In response to question 1 concerning the strengths of the LTRS system, the comments ranged from “the basic idea is there but it needs work” to “the system has great potential.” Overall, the volunteers believed that the major strength of LTRS is that it allows researchers to access and search Langley publications from their desktop. They thought that having access to Langley reports would make literature searches easier and would reduce the turnaround time for needed information. This theme of on-line access to reports (instant availability of reports) occurred repeatedly in the volunteers' comments. They liked having the full text available so that they could preview the report or abstract before printing. They also liked the quick searching techniques and the ease of use.

In response to question 2 concerning what features needed to be added or enhanced, two comments were prevalent: The volunteers wanted to have more reports available in the collection, and they wanted missing figures and photographs included to complete the reports. One volunteer wanted to see NACA as well as NASA reports prior to 1989 added to the collection. In addition, the volunteer wanted the collection to include reports currently processed through STID.

One volunteer suggested that the system include an abbreviated browsing capability of abstracts by year and the ability to browse abstracts by subject. The capability to view the documents was not consistent; that is, some reports were encountered that could not be viewed past the first page. The volunteers would like the viewing capability to be consistent and enhanced so that the reports are clearer on the screen. Another suggested that the abstracts include the total size of the compressed file so that users could determine whether their local machine has sufficient disk space to download and decompress the file.

In response to question 3 concerning problems encountered using LTRS, the comments seemed to deal primarily with the limitations of the platform rather than LTRS (i.e., speed, memory, and disk space) or viewing software (i.e., MacGS or Ghostview). One problem seemed to be not knowing when the file was compressed PostScript and when it was uncompressed and not knowing what software was needed with which version.

In response to question 4 concerning the collection of reports and papers available on LTRS, almost every respondant thought that the LTRS database should be expanded to include University grantees' reports; all NASA TM, TP, and journal articles; and JIAFS articles. One volunteer suggested that the report date be added to alphabetic and subject lists. One volunteer wanted to know how to contribute reports. Another hoped more people would take advantage of the system and increase the collection of reports.

The volunteers also offered some suggestions concerning the LTRS instructions used for the evaluation. As a result, the instructions in appendix C will be modified to incorporate their suggestions.

Use of LTRS by U.S. Industry

As previously discussed, aerospace companies are wary of Internet access and generally provide restricted access or none at all. In contrast, such disciplines as astronomy, physics, and computer science seem to have enthusiastically embraced publication over the Internet.

Appendix B lists organizations that have accessed LTRS. From the list of 173 companies, 16 aerospace companies can be identified, including Gulfstream, Lockheed, Loral, Martin Marietta, McDonnell Douglas, Pratt & Whitney, Rockwell, TRW, Boeing, and United Technologies. In addition to numerous computer and software companies, many nonaerospace companies who would be candidates for dual use of NASA’s aerospace technology are listed. For example, ARCO Oil and Gas, Allied-Signal, Dupont, Eastman Kodak, Exxon, Ford, General Motors, Monsanto, and Pacific Gas and Electric have used the LTRS system. Also over 200 universities and government agencies have accessed LTRS.

Although LTRS has not made great penetration into the aerospace community, it has demonstrated the

capability of disseminating Langley technical reports to the aerospace industry.

Implementation of EDTR System

Management support and guidance are essential to the success of any electronic distribution system. Thus, the EDTR working group devised a policy statement that provides guidelines for distribution and storage as well as a framework for managing the electronic distribution system. The policy statement proposed by this group is given in appendix A. Note that Langley management has not adopted this policy. However, it has been reviewed for adherence to copyright law and generally conforms to NASA STI publication policy.

The proposed policy statement has two major impacts on the publishing strategy of NASA Langley. First, approval of the policy statement amounts to a mandate to all Langley authors to provide technical documents for electronic dissemination: "Therefore, in any instance where NASA has the legal right to do so, publications shall be made available electronically via Internet to NASA customers." (See appendix A.) Such a mandate leads to the second impact: an electronic server for Langley technical documents must be supported as part of the Langley publication infrastructure. Such support includes technical support for the server system, support for producing the on-line information, managing the information to ensure responsible and reliable dissemination, strategic planning, and promoting use of the system among aerospace and nonaerospace customers.

To ensure the success of the electronic distribution system, the EDTR working group outlined a framework for managing the system. This framework is based upon the establishment of a committee responsible for establishing publication standards for electronic documents, monitoring adherence to the EDTR policy, and maintaining the structure of the electronic distribution system. The goals of the committee are as follows:

1. Establishing electronic publication standards: The possibility of electronic dissemination immediately raises policy and quality issues. Should restricted documents be available on Internet? Should electronic versions with illustrative material missing be on-line? Should documents submitted to external publishers (e.g., journals) be on-line? The future will hold a new set of issues. On-line dynamic documents (bibliographies, computer documentation, data sets) will be up-to-date, while their hard copy counterparts become obsolete. Multimedia or hypermedia documents will exist on-line, while no hard copy counterpart will be possible. The committee will provide a forum for resolving these issues with STI Program management.
2. Monitoring adherence to policies: The disadvantage of a distributed LTRS system is the difficulty of coordinating and communicating policy. Communication of policy is the primary goal of the committee. In general, the Langley community is very responsible when STI policy (e.g., copyright and management approval) is clearly communicated.
3. Maintaining structure of LTRS system: A technical interface among server administrators, publication policy makers, and information professionals will ensure that a well-designed state-of-the-art system is maintained that adheres to NASA management requirements and meets NASA information customer needs.
4. Ensuring reliability of the system: Any quality information system must display dependability and integrity. Information including bibliographic information, should be reliable in content and availability.
5. Strategic planning: Electronic publishing technology is in its infancy. As this technology matures, we must bring new developments to bear on deficiencies in the current LTRS system.
6. Promoting use of LTRS system: While some technical disciplines such as astronomy, physics, and computer science are well-connected and proficient in use of Internet for EDTR, the aerospace community is not. To capitalize on the cost benefits and efficiency of electronic information transfer, we must market EDTR.

Reference 8 suggests that management of electronic delivery requires a balance of ‘‘the reality of decentralized, dispersed, user-oriented agency automation with the need for some measure of centralized, yet flexible, policy direction and oversight.’’ The concept of an LTRS Committee proposes to do just that, to capitalize on the decentralized, dispersed, user-oriented WWW servers coming on-line under auspices of branches and divisions, while providing central, flexible policy direction and information management services (e.g., indexing and browsing capabilities).

Concluding Remarks

Approval and Implementation of Policy Statement

Because of the wide impact of EDTR on Langley and its significance in support of technology transfer, the working group recommends that the Langley Senior Staff endorse the policy statement for implementation by the Langley STI Program through the Langley Technical Report Server (LTRS) Committee described in the policy statement.

The use of electronic on-line publishing is an important strategic direction with impacts not only on the publishing research community but also on the Langley institution, in particular, the Langley STI Program. Langley and NASA are embracing the World Wide Web (WWW) technology at the "grass roots" level, as are many of our customers. WWW is rapidly becoming a de facto standard technology for electronic dissemination not only within NASA but also within the electronic publishing community in general. Any EDTR effort should conform to WWW standards; however, several electronic document delivery projects not based on WWW are in various stages within NASA. With endorsement by Langley management of the policy statement, EDTR will no longer be a grass roots experiment at Langley; it will become a strategic direction for the STI Program management.

Enhancements to LTRS

The open, unrestricted LTRS system must be extended to restricted information to provide a secure way of quickly disseminating our commercially valuable information to NASA's domestic customers. The current unrestricted system will provide a catalyst for the restricted system. Users who like LTRS will be willing to accept inconveniences of accessing a separate, similar restricted system. However, a restricted system will entail investment in labor to qualify users and in systems to manage the risk of restricted information on-line.

The evaluation of LTRS by Langley users clearly indicated areas for improving functionality: for example, providing full-text searching, producing hypertext documents, and adding missing illustrations and photographs. A high priority should be enlarging the collection of documents to include current informal reports, meeting papers, and articles as well as NACA and pre-1989 NASA reports. In addition to the functionality and content of the server, client configuration presents issues such as auxiliary software for viewing and printing, available disk space, training, and instructions. Although many of these problems represent technological challenges, some can be solved or minimized by system design and process improvements. For example, the LTRS collection can certainly be rapidly enlarged by instituting a process making electronic dissemination routine.

The Langley technical publications program is at a critical juncture. EDTR has been demonstrated to be feasible with no direct cost for software imposed on NASA or its customers. Should Center management endorse EDTR as the strategic direction for disseminating Langley STI, Langley is ready to face the challenges of developing, designing, and managing an electronic dissemination system.

NASA Langley Research Center
Hampton, VA 23681-0001
December 15, 1994

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8. Making Government Work—Electronic Delivery of Federal Services Office of Technology Assessment, OTA-TCT-579, September 1993.

Appendix A

Proposed Policy

Policy Statement Introduction

For the United States to remain an international leader in aerospace research and development, NASA must not only perform state-of-the-art research relevant to U.S. industry but must also make the results of that research available in the fastest, most cost-effective manner. Technology currently exists to make NASA's products (formal and informal publications, data sets, etc.) available electronically.

Responsibility for maintenance and technical support of an electronic document dissemination system shall lie with the LTRS committee, under the direct supervision of the head of the Research Publishing and Printing Branch (RPPB). This committee, comprised of representatives from each division at Langley, shall have responsibility for establishing publication standards for electronic documents (including proper copyright notations), monitoring adherence to this policy statement, updating this policy statement, and maintaining the structure of the electronic distribution system. The committee shall further be responsible for promotion of the use of the electronic distribution system as a means of technology transfer to aerospace and nonaerospace customers.

This policy statement covers the following aspects of the electronic dissemination of unclassified, unlimited technical reports: (1) copyright, (2) distribution, (3) electronic document storage, (4) preliminary release of formal reports, (5) approval for posting informal reports to distributed servers, and (6) publication standards for electronic documents.

Copyright

All NASA publications that are cleared for public release (unclassified, unlimited TP's, low-numbered TM's, high-numbered TM's, conference papers, journal articles, etc.) should be posted to an electronic server accessible worldwide via the Internet to assist the customer in rapidly obtaining NASA research. If NASA produced the research, then it is by definition a work of and property of the United States government. Even in cases of journal publications, NASA retains a license to use the work in any manner deemed in the interest of the U.S. government. Therefore, in any instance where NASA has the legal right to do so, publications shall be made available electronically via Internet to NASA customers. In instances where copyright agreements exist with external publishers, the copyright statement must be included in the electronic version of the document.

Distribution

Proper handling of restricted information necessarily requires that some level of difficulty be imposed (for proper user validation) in obtaining the data. The unfortunate effect is a delay to eligible users. The electronic distribution system is patterned after the current paper system to preclude foreign access to restricted information. Currently, within the open Internet environment, this means that restricted (classified, limited, ITAR, FEDD, etc.) information is *not* included for electronic dissemination.

Electronic Document Storage

Because of the large volume of documents published within NASA annually, a distributed document storage environment is necessary. (Additionally, the disk space required to store a compressed PostScript document that includes figures is approximately 1 MB.) As previously noted, the LTRS committee shall have responsibility for maintenance and technical support of this distributed-storage electronic dissemination system, as well as responsibility for promotion of the use of the electronic distribution system within the aerospace community.

All formal NASA publications shall be maintained centrally, under the control of the chair of this committee, and representatives from each Langley division to this committee will have responsibility for maintaining their own division repository of informal documents (conference papers, journal publications, etc.). The electronic dissemination system (known as LTRS) will index and point to these informal report servers via NCSA Mosaic. (NCSA Mosaic is a well-documented public-domain software for browsing and searching the world-wide web, available for PC, Macintosh, and most UNIX platforms via anonymous FTP. Thus, the burden of obtaining and integrating NCSA Mosaic and associated tools shall lie with the end user.) To insure continuity and availability of papers within the system, division representatives shall offer the committee electronic versions of any documents prior to removal of such documents from the distributed servers.

Preliminary Release of Formal Reports

Upon completion of the technical changes required by the editorial committee for NASA formal publications, the author shall have the option of seeking division approval for electronic release of the preliminary document. If approval is granted, the document shall be clearly marked that it is a preliminary draft, cleared for

release with respect to its technical content, but not yet meeting NASA's editorial requirements. The document shall also bear the date of that release with an estimate of when the final draft will be available. Once prepared and cleared for release, the final draft will replace the preliminary draft on the file server. It shall be the responsibility of the customer to retrieve the updated copy of the report.

Approval for Posting Informal Reports to Distributed Servers

Approval for posting new informal reports to distributed servers shall be obtained from the author's division office. Determination of document restrictions shall continue to be made at the division level. Once the document has been approved, responsibility for updating and maintaining the division's report server and for providing LTRS with the appropriate indexing information shall lie with the division's representative to the LTRS committee.

Publication Standards for Electronic Documents

The LTRS committee shall define standards for electronic versions of NASA documents. In the interest of making NASA publications rapidly available, electronic documents generated prior to the definition of such standards will be accepted for posting to the report server provided that they are significantly complete, that is, full text with sufficient figures and tables to be useful. The documents must be marked such that the absence of any data, photographs, figures, or tables is obvious. Responsibility for assessing the desirability and cost effectiveness of completing electronic versions of existing documents (e.g., via scanning photographs, figures, etc.) shall lie jointly with the author and the head of RPPB.

Appendix B

LTRS Usage Statistics

Reports Accessed by Internet Hostnames

Domain	No.
.com	1282
.edu	3120
foreign	3781
.gov	207
.larc.nasa.gov	1358
.mil	287
.nasa.gov	750
.net	19
unknown	213
.org	51

Reports Accessed by Foreigners

Country	No.
Austria	219
Australia	208
Canada	451
Switzerland	105
Germany	423
Finland	69
France	466
Italy	58
Japan	383
The Netherlands	185
Norway	99
Sweden	70
Singapore	60
Taiwan	392
United Kindgom	335
Others	258

Organizations That Have Accessed LTRS

Companies

3Com Corporation
ARCO Oil and Gas
ASK/Ingres Products Division
AT&T Bell Laboratories
AT&T Global Information Solutions
Adobe Systems Inc.
Adroit Systems, Inc.
Advance Geophysical Corp.
Advanced Decision Systems
Advantis
Alcatel Network Systems
Allied-Signal, Inc.
Anasazi, Inc.
Apple Computer Corporation
Asea Brown Boveri
Aware, Inc.
BP
Bailey Controls Company
Ball Aerospace, Inc.
Beckman Instruments, Inc.
Bob Gustwick & Associates, Inc.
Bolt Beranek and Newman Inc.
Box Hill Systems Corporation
Bull HN Information Systems Inc.
Byte Information Exchange
CAE-Link Corporation
CFD Research Corporation
CLAM Associates
Calspan Advanced Technology Center
Centerline Software
Centric Engineering Systems
Charles Stark Draper Laboratories
Chevron Information Technology Co.
Chicago Title & Trust
Cisco Systems, Incorporated
Compaq Computer Corporation

Computervision Corp
Concurrent Computer Corporation
Concurrent Technologies Corporation
Connected, Inc.
Convergent Technologies, Inc.
Convex Computer Corporation
Cray Research, Inc.
DHL Systems, Inc.
Data General Corporation
Dell Computer Corporation
Delmarva Power and Light Company
Delphi Internet Service Corporation
Digital Equipment Corporation
Dupont Experimental Station
EUTeC
Eastman Kodak
Electric Power Research Institute
Electronic Data Systems
Electronic Data Systems
Enterprise Integration Technologies Corp.
Epoch Systems Inc.
Exa Corporation
Exxon Research and Engineering
Fluent, Inc.
Ford Motor Company
GTE Government Systems Corporation
General Dynamics / Computer Sciences Corp.
General Motors Research Laboratory
General Research Corp.
Gulfstream Aerospace Corporation
Hal Computer Systems, Inc.
Harris Corporation
Hewlett-Packard
Hibbett, Karlson, and Sorensen Inc.
Honeywell, Inc.
Horizon Research Inc.
Hughes Aircraft Company
Hughes Information Technology Company
IDT/CCTT
Informix Software, Inc.
Insignia Solutions Inc
Intel Corporation
Intergraph Corporation
Intermetrics, Inc.
International Business Machines
Internet Direct, Inc.
JP Morgan
James Spottiswoode & Assoc.
Kendall Square Research Corporation
Kofax Image Products
LSI Logic Corporation
Landmark Graphics Corporation
Lockheed Information Technology Company
Locus Computer Corporation
Loral Corporation
MRJ Inc.
Malin Space Science Systems
Martin Marietta Astronautics Group
McDonnell Douglas Corporation
Mead Data Central
Merck and Co., Inc.
Micrognosis
Microsoft Corporation
Mirador Computing Systems
Monsanto Company
Motorola Inc.
NETCOM
NYNEX Science and Technology
Ncube
Network Equipment Technologies, Inc.
Networx, Inc
Niagara Mohawk Power Corp.
North American Philips Corporation
Northern Telecom Ltd.
Oracle Corporation
PARAMAX SYSTEMS CORPORATION
PIXAR
Pacer Software, Inc.
Pacific Bell
Pacific Gas and Electric Company
Panasonic Technologies, Inc.
Panix Public Access Unix of New York
Performance Systems International Inc.
PictureTel Corporation

Portal Communications Company
Pratt & Whitney
Process Software Corporation
Pyramid Technology Corporation
Qualcomm Inc.
Radius Inc.
Rational Systems, Inc.
Real/Time Communications
Rocket Research Company
Rockwell International
SAIC
SAS Institute, Inc.
SCUBED Corporation
SPARTA, Inc.
SRI International
SSDS, Inc.
Schlumberger Limited
Sequent Computer Systems, Inc.
Silicon Graphics, Inc.
Software Tool & Die
Solbourne Computer Inc.
Southwestern Bell Corporation
Sterling Software
Stratus Computer, Inc.
Structural Dynamics Research Corporation
Sun Microsystems Inc.
Sun Tech Journal
TRW Inc.
Tandem Computers, Inc.
Tekelec, Inc.
Teknekron Communications Systems, Inc.
Telebit Corporation
Texas Instruments
The Analytic Sciences Corporation
The Boeing Company
The MathWorks, Inc.
The Wollongong Group
Thinking Machines Corporation
Titan, Inc.
Transarc Corporation
Unison Software, Inc.
Unisys Corporation
United Technologies Corporation
Varian Associates, Inc.
Visidyne Inc.
Warner Lambert / Parke-Davis
Western Digital Corporation
Westinghouse Electric Corporation
Wyvern Technologies, Inc.
XMission
Xerox Palo Alto Research Center
Zycad Corporation

Universities

Appalachian State University
Arizona State University
Auburn University
Baylor College of Medicine
Baylor University
Boston University
Bowling Green State University
Brandeis University
Brown University
Bucknell University
Cal Poly State University
California Institute of Technology
California State University, Chico
Carnegie-Mellon University
Case Western Reserve University
City University of New York
Clarkson University
Clemson University
College of William and Mary
Colorado State University
Columbia University
Cornell University
Drake University
Drexel University
Duke University
Embry-Riddle Aeronautical University
Emory University
Florida Institute of Technology
Florida State University ACNS
George Mason University

George Washington University
Georgia Institute of Technology
Hampton University
Hartford Graduate Center
Harvard University
Indiana University
Institute for Computer Applications in Science and Engineering
Iowa State University
Johns Hopkins Applied Physics Laboratory
Johns Hopkins University
Kent State University
Lehigh University
Louisiana State University
Louisiana Tech University
Loyola College
Marquette University
Massachusetts Institute of Technology
Mayo Foundation
McGill University Internet
Merit Computer Network
Miami University
Michigan State University
Michigan Technological University
Minnesota State University System
Minnesota Supercomputer Center
Mississippi State University
Monmouth College
Montana State University
Muskingum College
National Center for Atmospheric Research
National Technology Transfer Center
New Jersey Institute of Technology
New Mexico State University
New York University
North Carolina Agricultural and Technical State University
North Carolina State University
Northeast Missouri State University
Northeastern University
Northwestern State University
Northwestern University
Nova University
Ohio Northern University
Ohio State University
Ohio University
Oklahoma State University
Old Dominion University
Oregon Graduate Institute
Oregon State University
Pennsylvania State University
Pittsburgh Supercomputer Center
Polytechnic University
Prairie View A&M University
Princeton University
Purdue University
Rensselaer Polytechnic Institute
Rice University
Rochester Institute of Technology
Rockefeller University
Rutgers University
SUNY College of Technology
SUNY at Buffalo
San Diego State University
San Diego Supercomputer Center
Santa Clara University
Seattle University
Southern College of Technology
Southern Illinois University
Southern Illinois University at Edwardsville
St. Louis University
St. Mary's College of Maryland
Stanford University
State University of New York at Stony Brook
Syracuse University
Temple University
Texas A&M University
Texas A&M University - Corpus Christi
Texas Education Agency
The Institute for Advanced Study
The Wichita State University
University of Akron
University of Alabama
University of Alabama in Huntsville

University of Arizona
University of Arkansas Little Rock
University of California
University of California at Berkeley
University of California at Irvine
University of California at Los Angeles
University of California at Riverside
University of California at San Diego
University of California at San Francisco
University of California at Santa Barbara
University of Central Oklahoma
University of Chicago
University of Cincinnati
University of Colorado
University of Connecticut
University of Dayton
University of Delaware
University of Denver
University of Florida
University of Houston
University of Illinois at Chicago
University of Illinois at Urbana-Champaign
University of Iowa
University of Kansas
University of Kentucky
University of Maine
University of Maryland
University of Maryland Baltimore County
University of Massachusetts
University of Michigan -- Computing Center
University of Minnesota
University of Missouri-Rolla
University of Nebraska at Lincoln
University of Nevada at Las Vegas
University of New Hampshire
University of New Mexico
University of North Carolina at Chapel Hill
University of North Carolina at Charlotte
University of North Florida
University of Oklahoma
University of Oregon
University of Pennsylvania
University of Pittsburgh
University of Pittsburgh Medical Center
University of Rochester
University of Southern California
University of Southern California
University of Tennessee
University of Tennessee at Chattanooga
University of Texas at Arlington
University of Texas at Austin
University of Texas at Dallas
University of Texas at San Antonio
University of Toledo
University of Toronto
University of Tulsa
University of Utah
University of Virginia
University of Washington
University of Wisconsin
University of Wisconsin, Milwaukee
Vanderbilt University
Villanova University
Vincennes University
Virginia Commonwealth University
Virginia Institute of Marine Science
Virginia Tech
Wake Forest University
Walla Walla College
Washington University
Wayne State University
West Virginia Network for Educational Telecomputing
West Virginia University
Western Washington University
Worcester Polytechnic Institute
Yale University

Government Agencies

Ames Laboratory
Argonne National Laboratory
Battelle Pacific Northwest Laboratory
Continuous Electronic Beam Acceleator Facility
Department of Energy Richland
Fermi National Accelerator Laboratory

Idaho National Engineering Laboratory
Lawrence Berkeley Laboratory
Lawrence Livermore National Laboratory
Los Alamos National Laboratory
National Energy Research Supercomputer Center
National Institute of Standards and Technology
National Institute of Standards and Technology
National Institutes of Health
National Oceanic and Atmospheric Administration
Oak Ridge National Laboratory
Sandia National Laboratories
Super Conducting Super Collider Laboratory
U.S. Department of Energy
U.S. Department of the Interior
USDA Forest Service- Pacific Southwest Research Station
USDA National Agricultural Library
United States Geological Survey
Westinghouse Savannah River Company
Military Institutions
Air Force Institute of Technology
Army Armament Research Development and Engineering Center
David Taylor Research Center
Defense Information Systems Agency
Defense Logistics Agency
Defense Technical Information Center
Eglin Air Force Base
Human Systems Division
National Computer Security Center
Naval Air Test Center
Naval Air Test Center
Naval Air Weapons Station
Naval Civil Engineering Laboratory
Naval Ocean Systems Center
Naval Postgraduate School
Naval Research Laboratory
Naval Ship Systems Engineering Station
Naval Surface Warfare Center
Naval Undersea Warfare Center
Naval Weapons Center
Naval Weapons Center
Rome Laboratory
U.S Army Corps of Engineers
U.S. Army Research Laboratory
United States Air Force Academy
Wright Patterson Air Force Base

Network Organizations

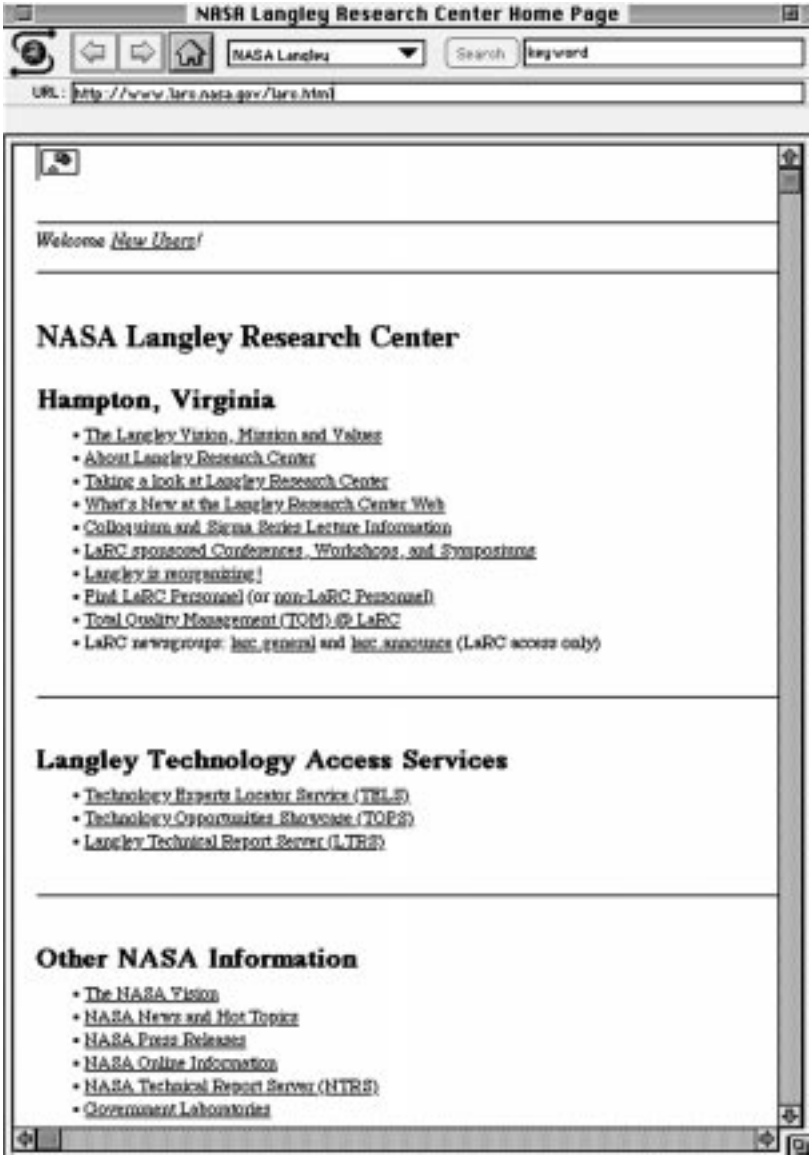
Communications for North Carolina Education, Research, and Technology
Digital Express Group, Inc.
EUnet Ltd
Geschaeftsbereich XLINK
Hong Kong Supernet
Information Access Technologies, Inc.
InteleCom Data Systems
MountainNet, Inc.
NirvCentre
Shadow Information Services
Stichting NLnet
The Internet Access Company
Other Organizations
American Mathematical Society
Capital Area Central Texas Unix Society
Chemical Abstracts Services
Commission of the European Communities
Cooperative Library Agency For Systems and Services
European Southern Observatory
IDA/Supercomputing Research Center
Industrial Technology Institute
Institute for Defense Analyses
International Internet Association
Logistics Management Institute
MITRE Corporation
Microelectronics Center of North Carolina
North Carolina Supercomputing Center
Online Computer Library Center, Inc.
Open Software Foundation
Research Triangle Institute
Software Productivity Consortium
The Information Network of Kansas
The Rand Corporation

Appendix C

LTRS Instructions

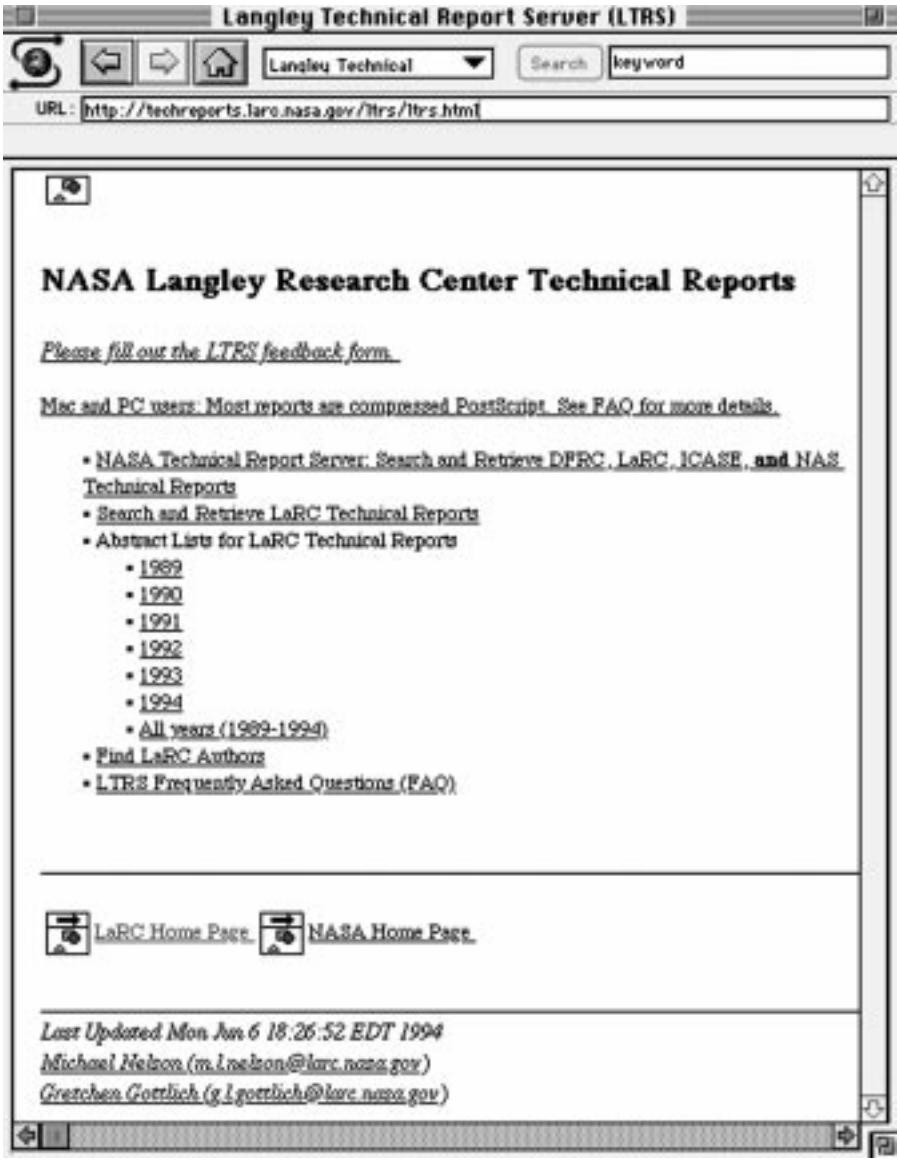
Instructions for Using LTRS on the Mac

STEP 1. Open Mosaic folder. Double click on NCSA Mosaic 1.0.3. If you have the NASA Langley Home Page as your default the following appears on your screen



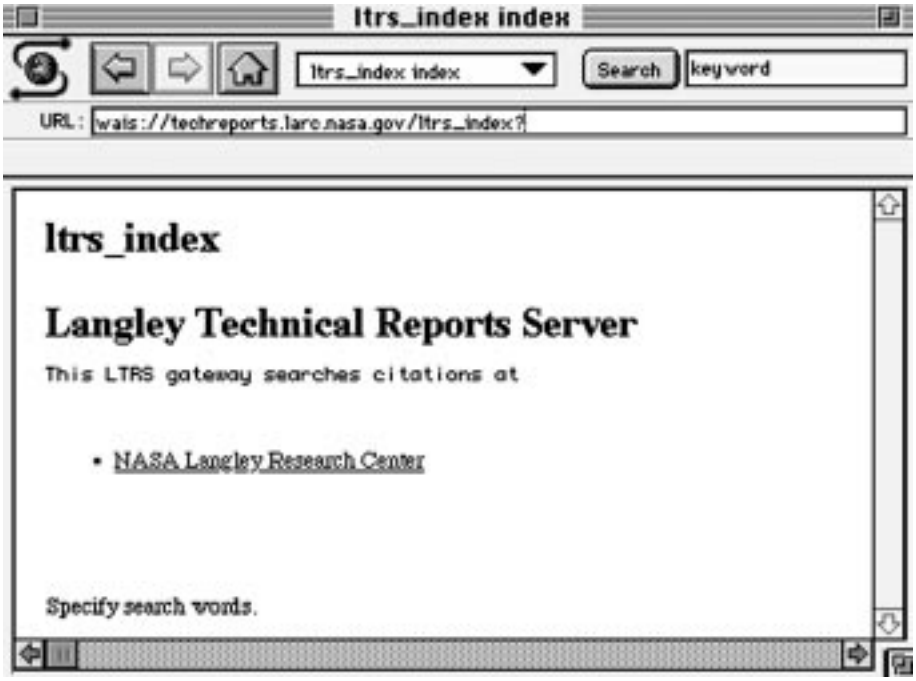
Items are either in black, blue, or symbols. Move the cursor to an item in black - cursor remains the same. Move cursor to item in blue or symbol - cursor becomes a pointing hand. When this occurs you can activiate the item by clicking on the item. Once you look at an item the blue will become red indicating you have already looked at that item. You can still look at it again even though it is red. **NOTE: For B&W monitor, items are underlined for links**

STEP 2 . Click on LTRS. The following will appear on your screen.

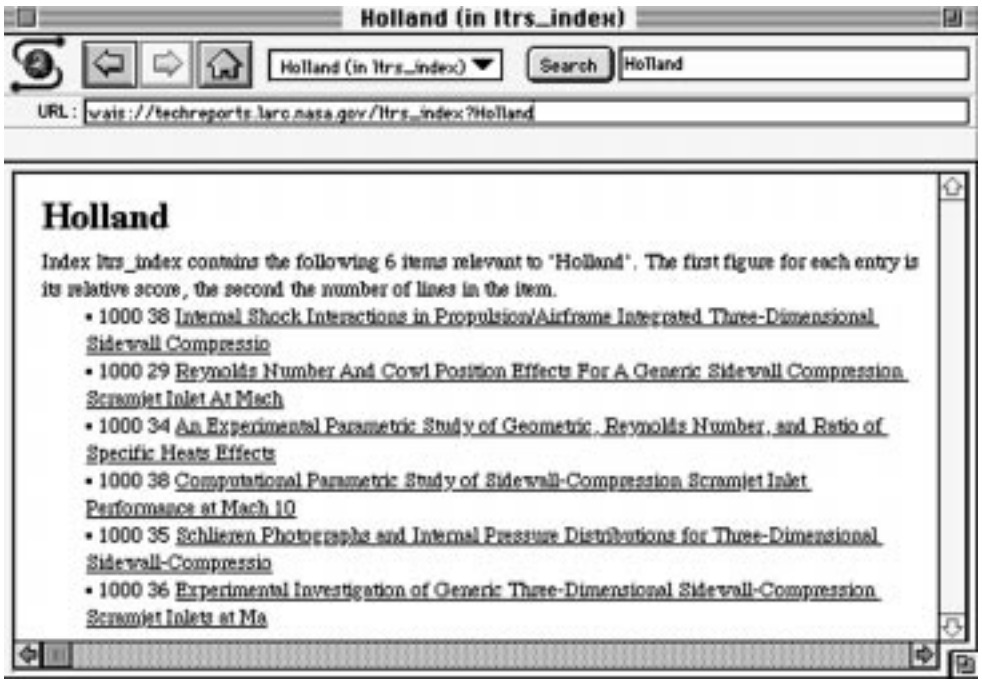


Move cursor to each item underlined in blue. An address appears in the box under the **URL** box.

STEP 3. To Search and Retrieve for a specific name, word, or combination of words, click on Search and Retrieve LaRC Technical Reports. The following window appears



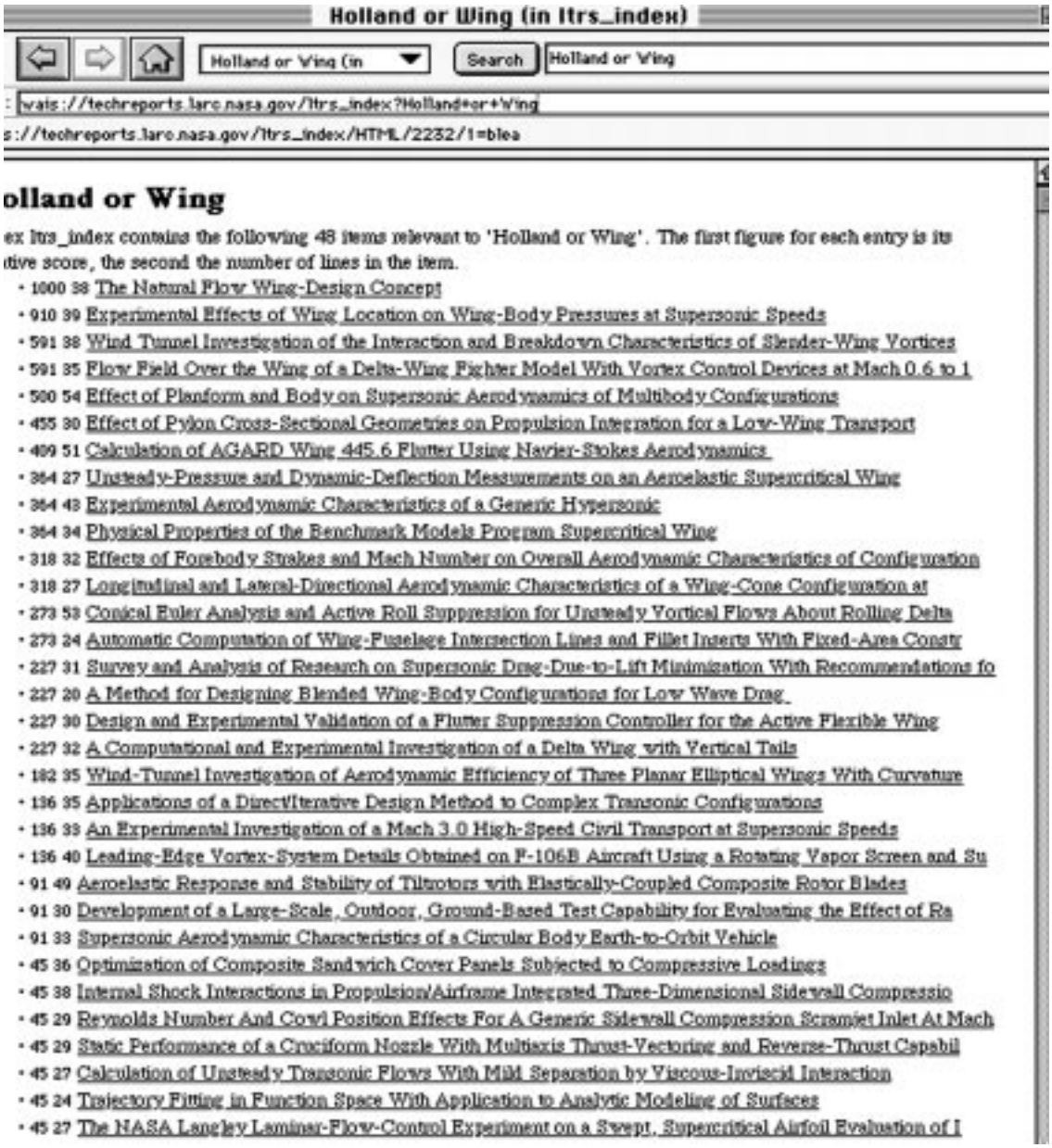
STEP 4. Enter the name or word to be searched in the box next to the Search button on the line with the MOSAIC symbol. Enter Holland and click on Search. The following window appear



The search for Holland found 6 items on ltrs_index

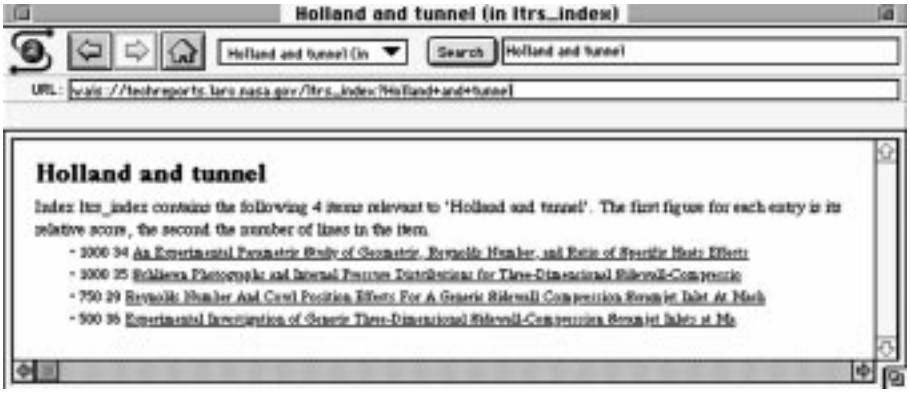
STEP 5. Search for wing. The following appears. Note 42 items relating to wing are found.

STEP 6. Search for Holland or wing. The following window will appear. Note we now have 48 items - the 6 items relating to Holland and the 42 items relating to wing

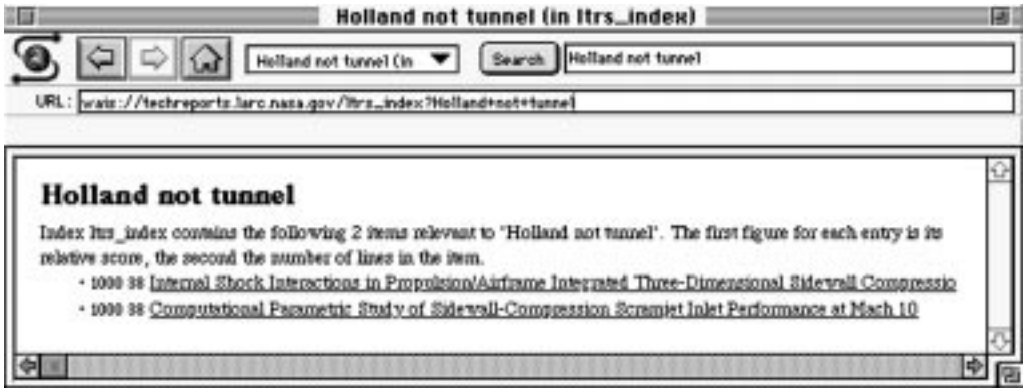


STEP 7. Search for Holland and wing. The following window will appear. Note: no items are found relating to Holland and wing

STEP 8. Search for Holland and tunnel. The following window will appear. Note: 4 items are found relating to Holland and tunnel. This is a subset of the items found in Step 4

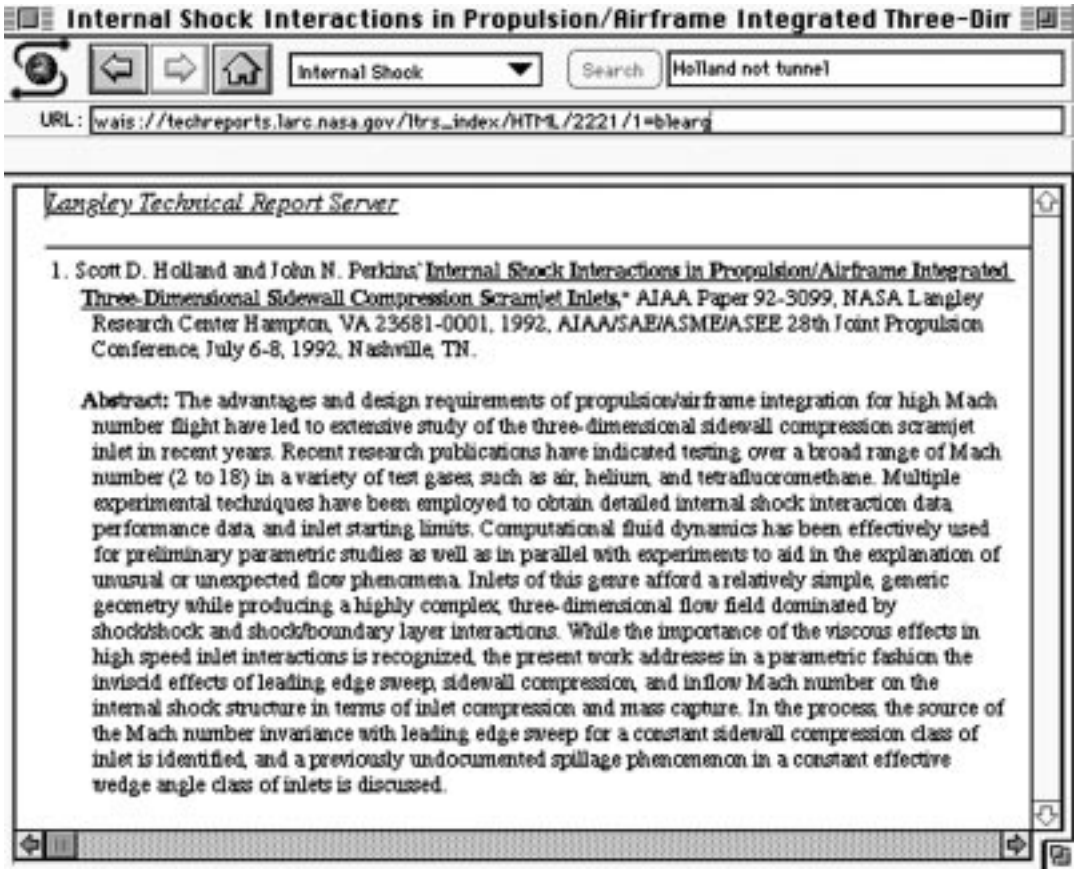


STEP 9. Search for Holland not tunnel. The following window will appear. Note: 2 items are found. This is a subset of the items found in Step 5. These are the other Holland items that do not involve tunnel.

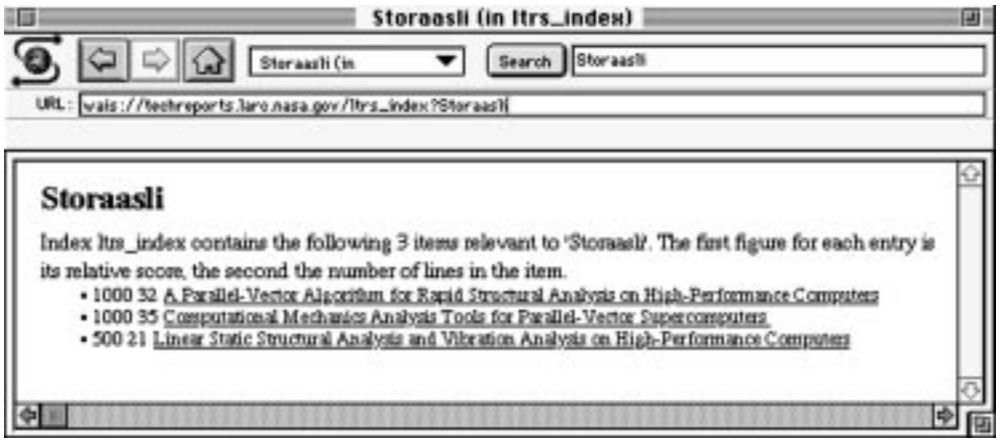


STEP 10. To examine the abstract for an item listed, click on the title of the item (e.g., click on the title of item 10038 " Internal Shock ..."). The following window appears

The entire paper can be retrieved as shown in **Steps 17-19**.

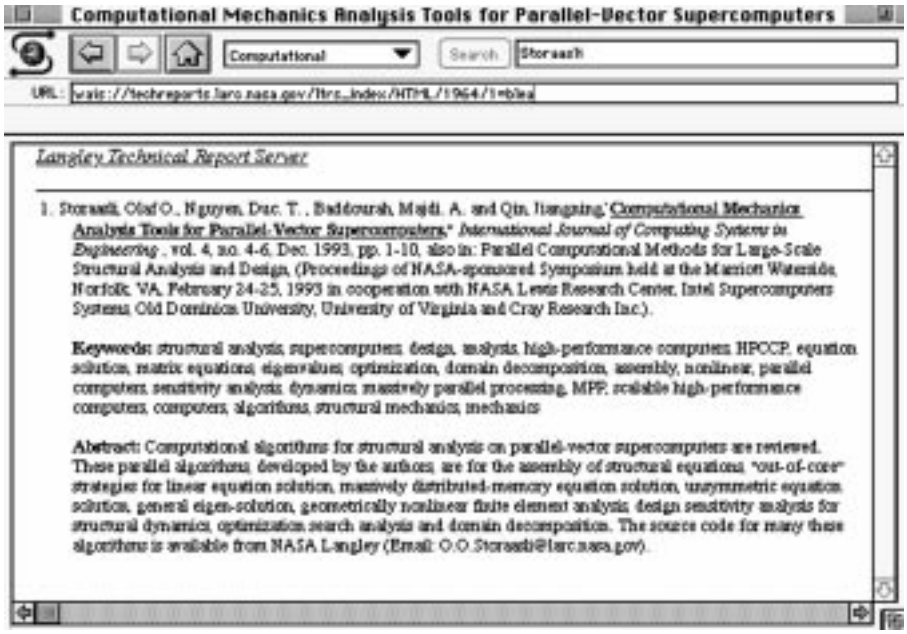


Step 11. Examine an **html** document. Search for **Storaasli**. The following appears.



Note 3 items relating to **Storaasli** are found.

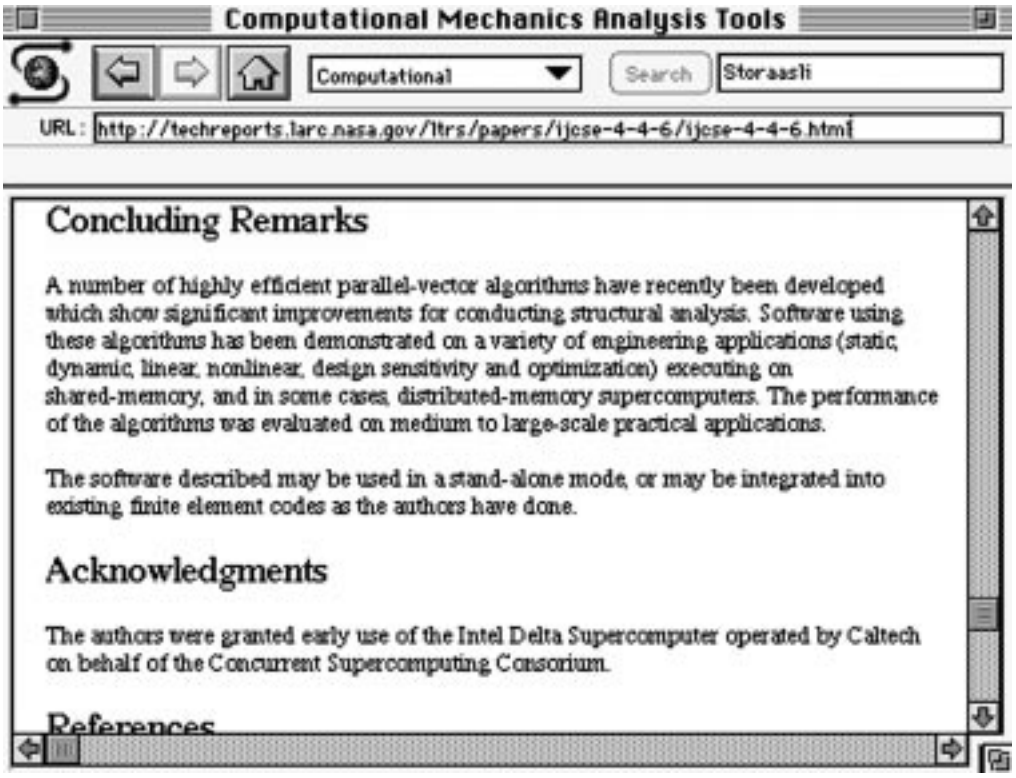
Step 12. Click on **"Computational Mechanics Analysis Tools for Parallel-Vector Supercomputers".** The following appears.



Notice on the line under the Mosaic symbol the following appears
http://techreports.larc.nasa.gov/ltrs/papers/ijce-4-4-6/ijcse-4-4-6.html
This is an **html** document. Click on the title**.** A **Table of Contents** appears.

.

STEP 13. Go to any section of the document by clicking on that item. Click on Concluding Remark



Click on left arrow and you will return to the Abstract entry. If you click on the title, you return to the **Concluding Remarks.** This is a limitation on the **MAC** version of an **html** document. It is better to use the scroll bar to navigate through an **html** document.

STEP 14. Notice on the **Table of Contents** an entry labelled

Postscript Version of Report

First go to **OPTIONS** on the menu bar and enable

LOAD to Disk

Now click on the entry

Postscript Version of Report

A window will appear

Discard Resource Fork: MosaicFile.Z

Click the **OK** box. Your PostScript version is called **MosaicFile.Z** and is found on your hard disk. Go to **OPTIONS** on the menu bar and enable

Turn off Load to Disk

To obtain a copy on your local printer follow **STEPS 19 and 21 (or STEPS 19A and 21A).**

STEP 15. Go back to the page headed LTRS--Langley Technical Report Server. This can be down by several methods

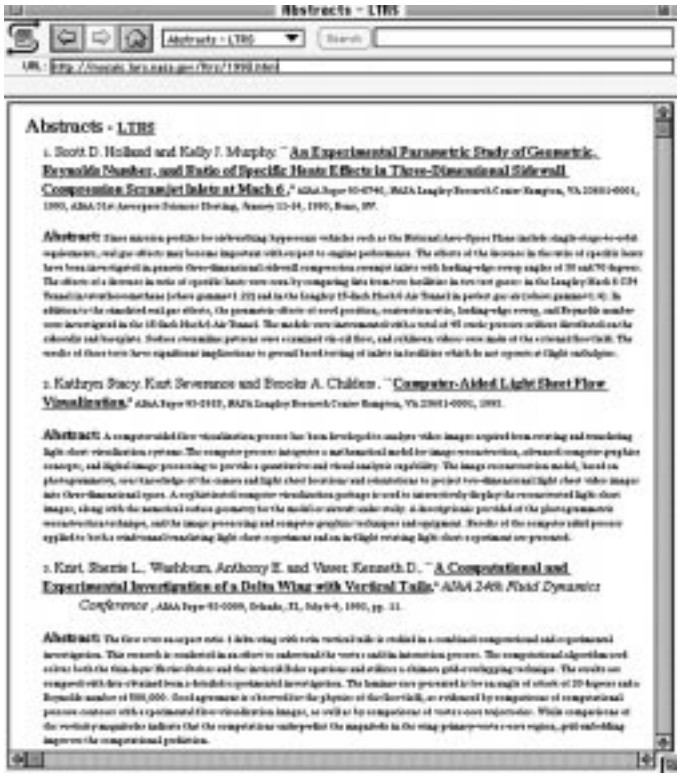
Method 1. Click on the House symbol which takes you back to the home page. Then click on the right arrow symbol.

Method 2. Click on the left arrow symbol until the page appears

Method 3. Go to the box next to the house symbol and hold down the mouse button.

Several labels appear. Move up tothe label **LTRS -- Langley Technical** Report Server (LTRS)

STEP 16. To examine the abstracts by year click on a year (e.g., 1993). All the abstracts for that year appear (as shown below)



STEP 17. To bring up a full report, first go to OPTIONS on the menu bar and enable

LOAD to Disk

STEP 18. Click on any report you want to examine. A window appears and asks you to save the file and name it. You may choose any name xxxxxx but you must use the .Z extension

xxxxxx.Z

The **Z** extension is necessary since the reports are in compressed format and need to be uncompressed. By default this file will be found in your Mosaic folder. Go to **OPTIONS** on the menu bar and enable

Turn off Load to Disk

STEP 19. To uncompress the file xxxxxx.Z. Go to your Tools for Mosaic folder. Drag the xxxxxx.Z icon so it is on the MacGzip icon. The following window appears.

gzip: xxxxxx.Z -> xxxxxx

The **xxxxxx.Z** file is replaced by **xxxxxx** . To obtain a copy of the report on your local printer go to **STEP 21**.

Note: STEPS 18A and 19A are alternatives to **STEPS 18-19**. You may skip **Steps 18A-19A**.

STEP 18A. Click on any report you want to examine. A window appears and asks you to save the file and name it. You may choose any name xxxxxx but you must use the .Z extension

xxxxxx.Z

The **Z** extension is necessary since the reports are in compressed format and need to be uncompressed. By default this file will be found in your Mosaic folder. Go to **OPTIONS** on the menu bar and enable

Turn off Load to Disk

STEP 19A. To uncompress the file xxxxxx.Z. Go to your Mosaic folder and double click on MacCompress3.2. A Progress window appears. Go to FORMAT on menu bar and enable

Unix compress

Go to **FILE** on menu bar and enable

Decompress file

All the files in the Mosaic folder appear. Select the file you want to decompress (in our case **xxxxxx.Z**) and click open. You can watch the file decompression in the Progress window. **xxxxxx.Z** file is replaced by **xxxxxx** in your Mosaic folder. Quit **MacCompress3.2**.

STEP 20. To view the document xxxxxx, double click on MacGS 2.5.2ß2 Runtime *f* folder in your Mosaic folder. Double click on Ghostscript 2.5.2ß3. A window labelled Ghostscript 2.5.2ß3 will appear. In the background a large window labelled Graphics appears. On the menu bar under

MacGS

choose

Open file

Go back tothe Mosaic folder where you saved the file created in **STEP 19 (or STEP 19A)** and open this file **xxxxxx**. On the menu bar under

MacGS

If under **MacGS** you choose

Graphics window

the report is placed in the front window on your screen.

If your cursor becomes a fat cross when placed in the Graphics window, you can advance through the report by

selecting the **apple R** key combination (or **Resume** under **MacGS**)

You cannot go backwards in the report.

If your cursor becomes a thin cross when placed in the Graphics window, you cannot advance through the report.

This report falls in this category. The entire report can be printed as shown in **STEP 17**

Repeat **STEPS 11-17** but this time examine the abstracts in **1994.** This time choose the first paper by **Walsh, et al "A Multilevel Approach ..."**. The cursor is a fat cross . Advance through this report using the **apple R** key combina-

tion (or **Resume** on **MacGS** menu bar).

STEP 21. To print the report on your local printer, do the following.

Go to your **Tools for Mosaic** folder. Drag the **xxxxxx** icon so it is on the **Drop.PS** icon. The following window briefly appears

Waiting for "your printename"

The following window appears until the document is finished printing

Sending xxxxx

STEP 21A is an alternative printing method. You may skip Step21A.

STEP 21A To print the report on your local printer, do the following.

Double click on your **Laser Writer Utility** so that you can down load a PostScript file.

On the menu bar under **Utilites** choose

Download PostScript File . . .

Now double click on the PostScript file you want to print - in this case

xxxxxx

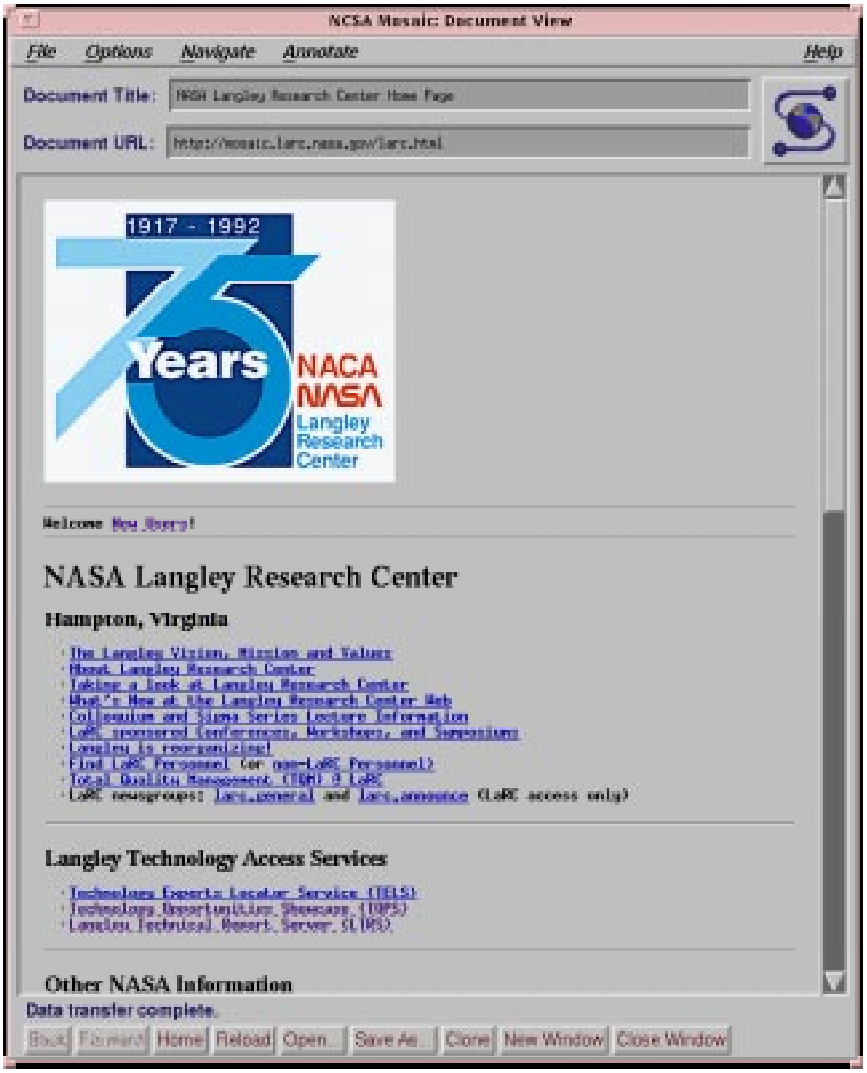
A window appears asking

Save PostScript output as

Choose **OK** or change the name to something else. Errors at printing are saved in this file. If no errors, the file is not saved.

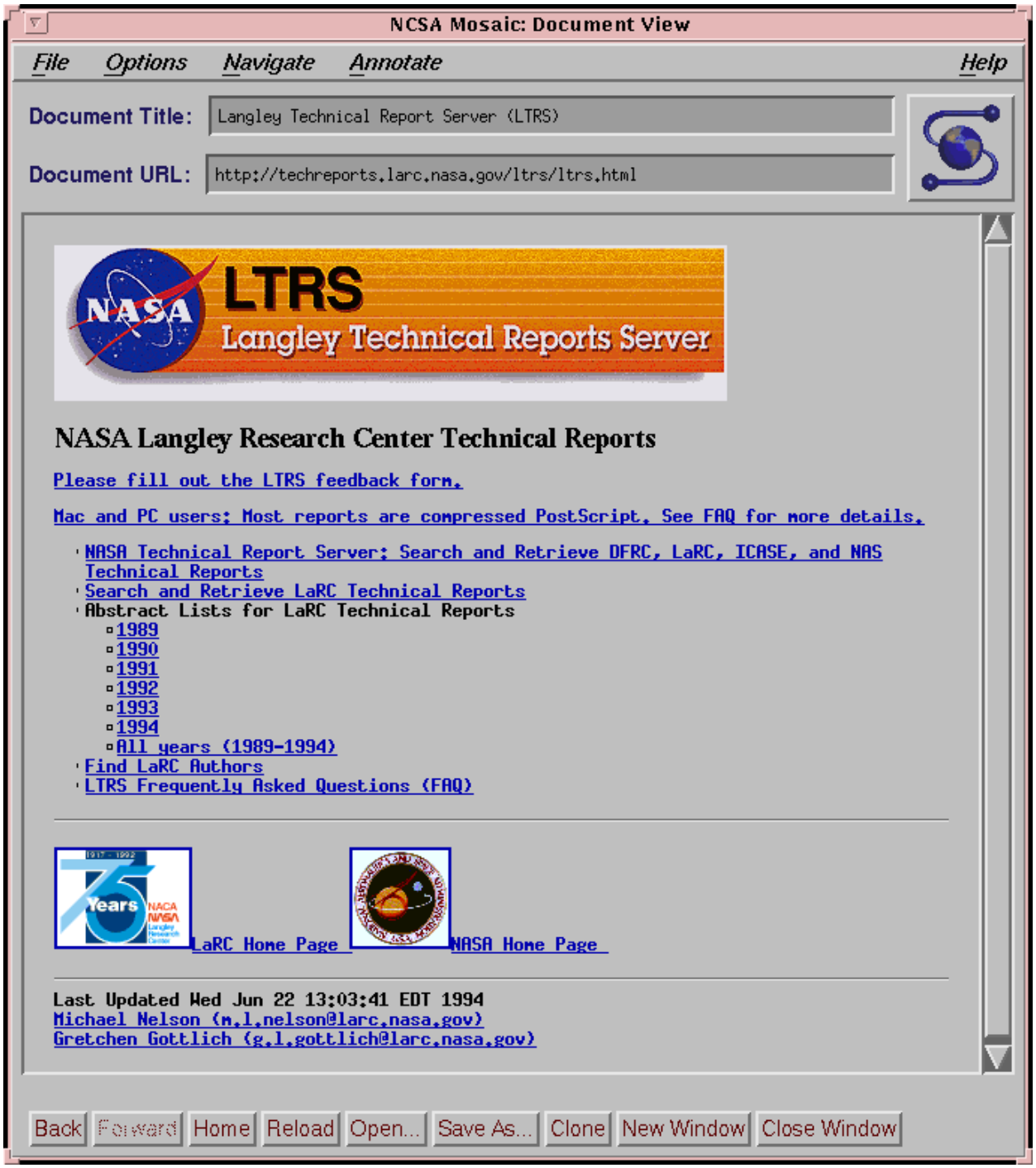
Instructions for Using LTRS on the UNIX

STEP 1. Open a shell tool and type xmosaic. If you have the NASA Langley Home Page as your default, then the following appears on your screen.



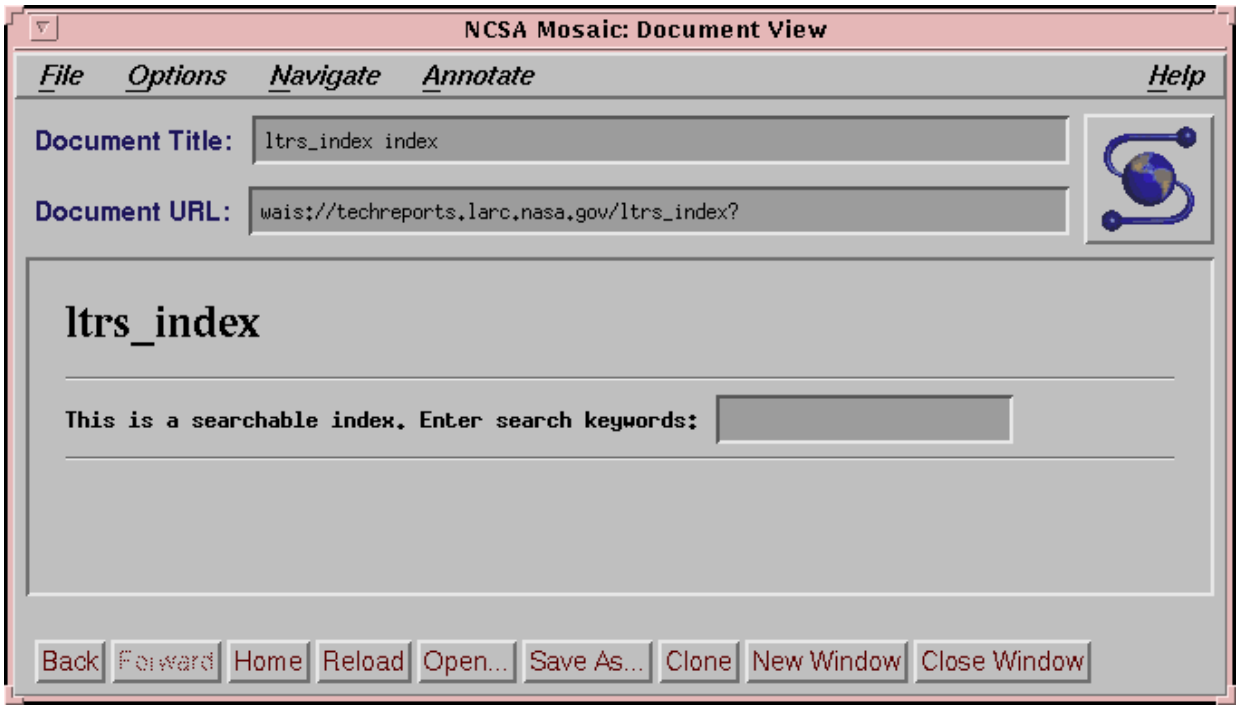
Items are either in black, blue, or symbols. Move the cursor over an item in black, and the cursor remains the same. Move the cursor over an item in blue or a symbol, and the cursor becomes a pointing hand. These items are hypertext links to other text, images, or files. You can activate the hypertext link by clicking the mouse on the item.

STEP 2. Click on LTRS. The following window appears:

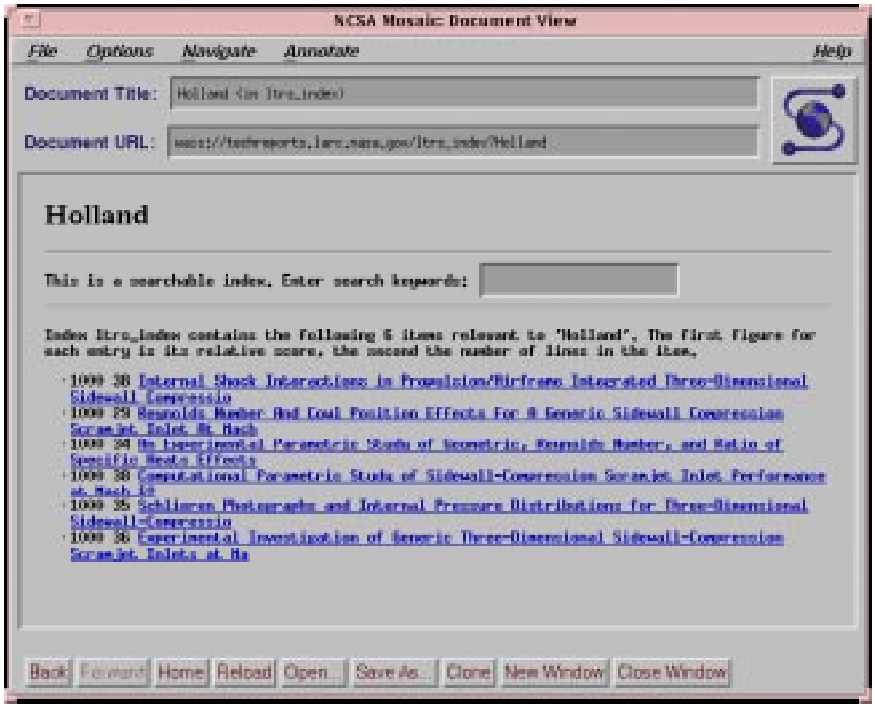


Move the cursor to each underlined item in blue. An address appears at the bottom of the page above the menu buttons.

STEP 3. To search and retrieve a document with a specific name, word, or combination of words, click on Search and Retrieve LaRC Technical Reports. The following window appears:



STEP 4. Enter the name or word to be searched in the box and select return. For example, search for Holland and the following window appears:

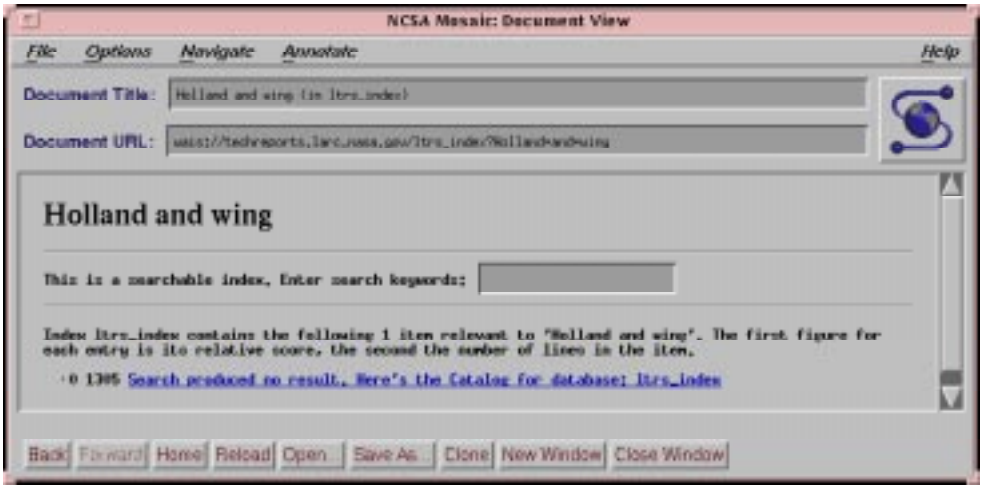


The search for Holland found 6 items in the LTRS index.

STEP 5. Search for wing. The following window appears with 46 items found relating to wing.

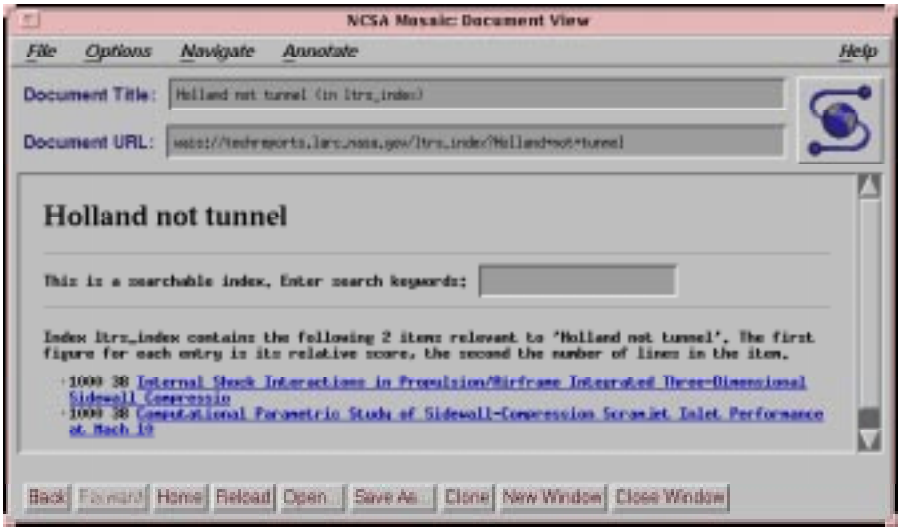
STEP 6. Search for Holland or wing. The following window appears. Note we now have all items relating to Holland and all items relating to wing.

STEP 7. Search for Holland and wing. The following window appears. Note no items are found relating to Holland and wing.

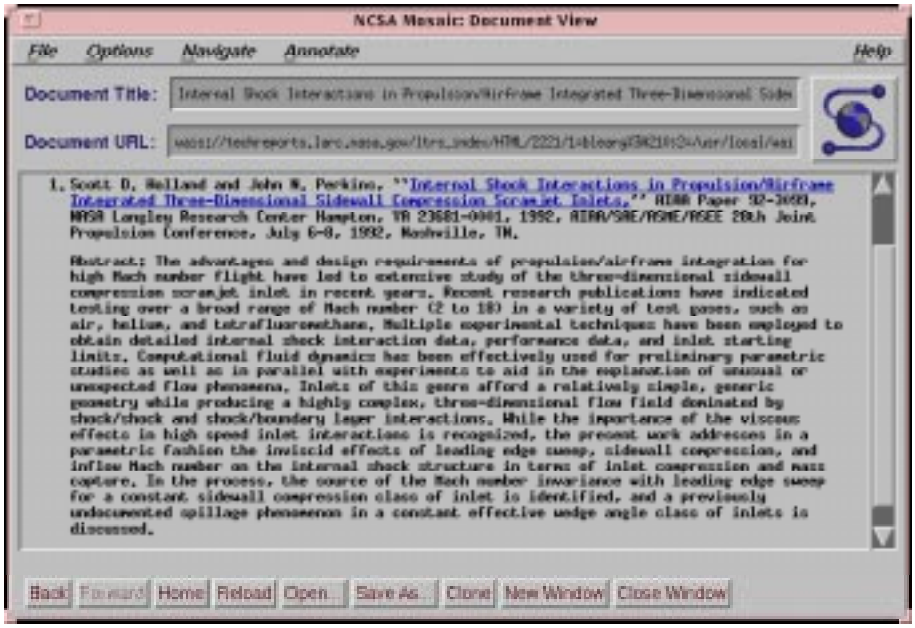


STEP 8. Search for Holland and tunnel. The following window appears. Note four items are found relating to Holland and tunnel. This is a subset of the items found in STEP 4.

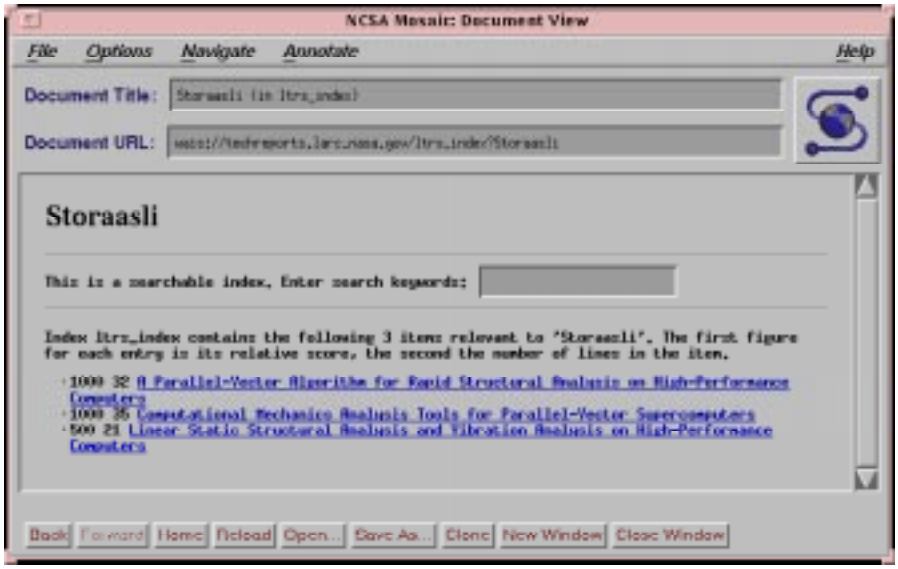
STEP 9. Search for Holland not tunnel. The following window appears. Note two items are found. This is a subset of the items found in **STEP** 5.



STEP 10. To examine the abstract for an item, click on the title of the item (e.g., click on the title of item 10038 "Internal Shock . . ."). The following window appears.

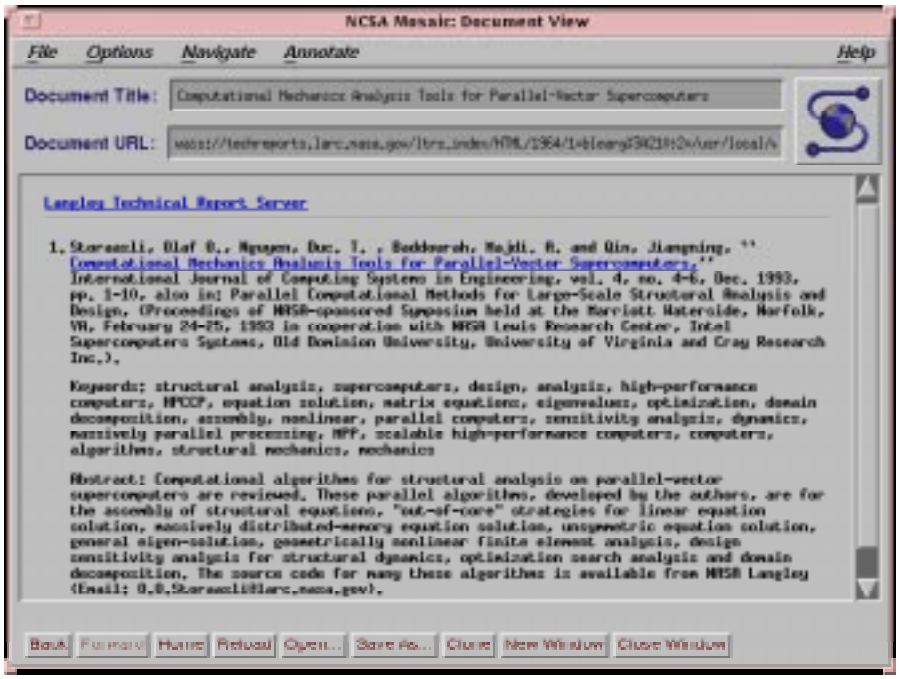


STEP 11. To examine an html document, first click on the back button at the bottom of the page. Then, search for Storaasli. The following window appears.



STEP 12. Click on "Computational Mechanics ... Supercomputers." The following window appears:

y



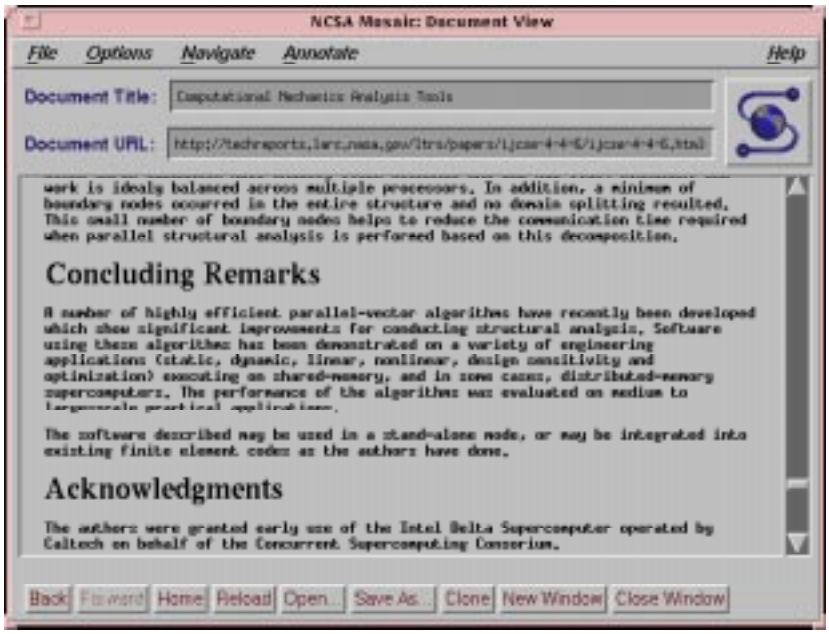
STEP 13. Note when you place the cursor over the title, the following appears at the bottom of the page:

http://techreports.larc.nasa.gov/ltrs/papers/ijce-4-4-6/ijcse-4-4-6.html

This is an html document. Click on the title and the following window appears:

STEP 14. You can go to any section of the document by clicking on the item in the Table of Contents.

For example, click on **Conluding Remarks.**

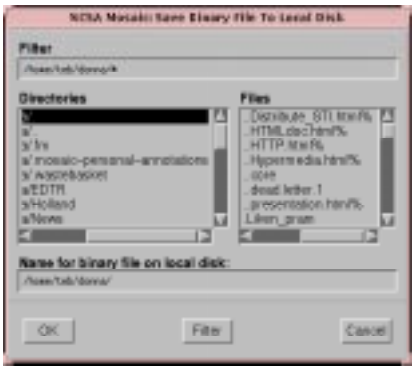


Click on the back menu button and you will return to the Table of Contents. You can also use the scroll bars to navigate through the document.

STEP 15. You can use the Print option under the File menu to print this html document in text, PostScript, or HTML format. You can also use the Save as option under the File menu to save this html document to your disk in text, PostScript, or HTML format.

STEP 16. To print the PostScript version of this html document, perform the following steps:

1. Select **Load To Local Disk** under the **Options** menu.
2. Click on the item **PostScript Version of Report** in the Table of Contents and the following window appears.

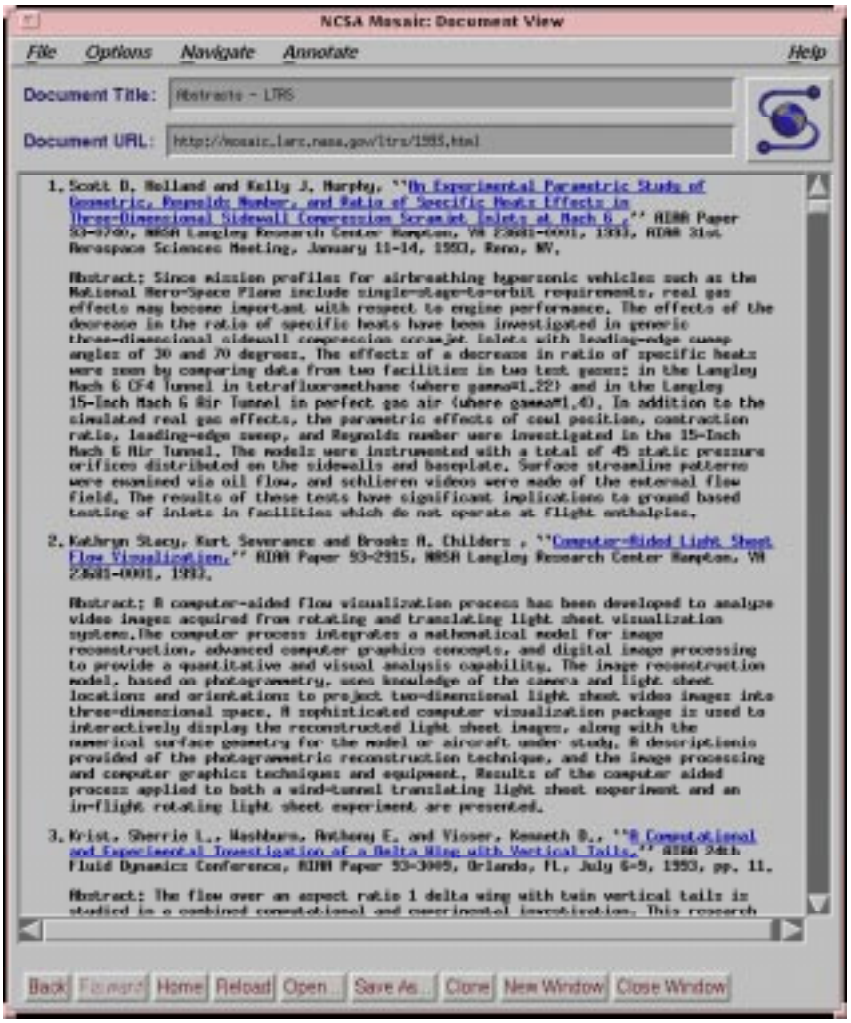


3. Type in any name for the file along with the extension .ps.Z. For example, name the file **Storaasli.ps.Z** and select **ok.**
4. Open a shell tool and type uncompress Storaasli.ps.Z and press return.

5. Type lpr -Pprintername Storaasli.ps and press return.

6. To return to the page entitled *LTRS -- Langley Technical Report Server*, either select the home button then select LTRS or select the back button until the page appears.

STEP 17. To examine the abstracts by year, click on a year (e.g., 1993). All the abstracts for that year appear in the window, as shown below.

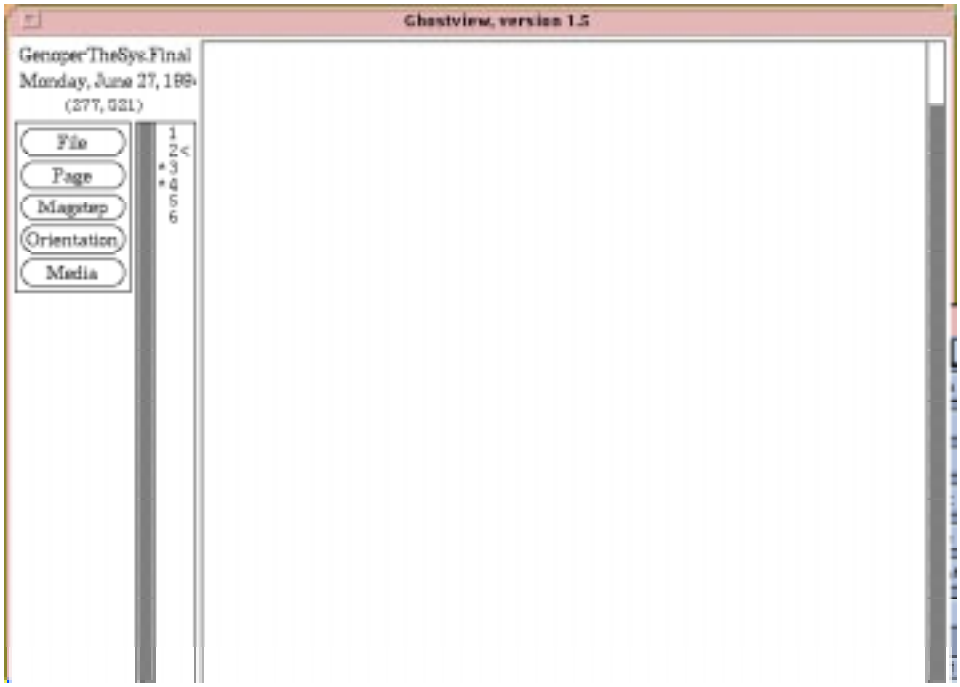


STEP 18. To view a report, scroll down until you find the report that you want to examine (e.g., Genopersisting the System), then select the title of the report. Mosaic opens the report in the application GhostView. Because not all PostScript reports are viewer friendly (but all are printer friendly), you may not be able to view the report. If the report is viewable, you can perform the following functions in GhostView.

1. If page numbers appear next to the menu, you can highlight the page number and then select **Next** under the **Page** menu to go to that page. If page numbers do not appear, you can go to the next page by selecting **Next** under the **Page** menu. (The symbol < to the right of a page number indicates the current page and the symbol * to the left of a page number indicates a marked page.)

2. If page numbers appear next to the menu, you can highlight the page number and then select **Mark** under the **Page** menu. Then, you can select **Print Marked Pages** or **Save Marked Pages** under the **File** menu. If page numbers do not appear, then you can go to a page and select **Print** under the **File** menu to print that page.

2. You can select a number under **Magstep** to change the size of the page or select an option under **Orientation** to change the orientation. (These options may distort the image.)



Instructions for Using LTRS on the PC

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To demonstrate NASA Langley Research Center's relevance and to transfer technology to external customers in a timely and efficient manner, Langley has formed a working group to study and recommend a course of action for the electronic dissemination of technical reports (EDTR). The working group identified electronic report requirements (e.g., accessibility, file format, search requirements) of customers in U.S. industry through numerous site visits and personal contacts. Internal surveys were also used to determine commonalities in document preparation methods. From these surveys, a set of requirements for an electronic dissemination system was developed. Two candidate systems were identified and evaluated against the set of requirements: the Full-Text Electronic Documents System (FEDS), which is a full-text retrieval system based on the commercial document management package Interleaf, and the Langley Technical Report Server (LTRS), which is a Langley-developed system based on the publicly available World Wide Web (WWW) software system. Factors that led to the selection of LTRS as the vehicle for electronic dissemination included searching and viewing capability, current system operability, and client software availability for multiple platforms at no cost to industry. This report includes the survey results, evaluations, a description of the LTRS architecture, recommended policy statement, and suggestions for future implementations.

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Executive Summary

The National Aeronautics and Space Act of 1958 directs NASA to “provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof.” The recent proliferation of Internet access and widespread information distribution capability allows NASA to more effectively meet this directive. To this end, the Electronic Dissemination of Technical Reports (EDTR) working group was formed by the Office of the Chief Scientist at Langley Research Center in September 1993. The EDTR working group was chartered to establish the capability of electronically disseminating NASA Langley's technical reports to the U.S. aerospace industry.

External Survey

During September 1993, the EDTR working group and employees from the Langley Scientific and Technical Information Division (STID) visited a representative sample of aerospace companies to ascertain their evaluation of NASA STI services and products and, in particular, their reaction to the possibility of electronic dissemination of Langley reports. This group met not only with the library staff but also with the research and engineering staff of each company. The five companies visited were Boeing Aerospace Company, McDonnell Douglas, United Technologies, Texas Instruments, and Bell Helicopter. A conference meeting was also attended by representatives from seven additional companies and two universities in southern California. After evaluating the information obtained during these visits, the working group identified a number of factors for establishing the EDTR system requirements:

1. Because of the reliance of industry researchers on their libraries, the industry library represents a viable target for (and customer of) electronic dissemination.
2. Because of the lack of Internet access by aerospace industry researchers, passively publishing Langley reports on the Internet is insufficient; more proactive approaches are also required, such as electronic current awareness announcements.
3. Because Internet access is increasing and libraries are beginning to deliver electronic products to their customers, interest among industry researchers in on-line products is expected to increase.
4. Because industry systems and network environments differ from Langley's, the EDTR system should not be modeled according to the Langley environment.
5. Any proposed EDTR system must significantly exceed the current capabilities of traditional NASA STI products and services, which typically do not sufficiently reach industry.
6. Electronic access and delivery of Langley reports must include basic printing and searching capabilities.
7. Timeliness must be exploited in the electronic dissemination process.
8. When possible, data files should be included or linked to the electronic report.

Internal Survey

A desired characteristic of any electronic dissemination system is that it be capable of handling documents in the form in which they are produced, that is, without additional staffing requirements for document conversion. An informal survey was therefore performed to determine the standard word processing and graphics packages used by Langley researchers in the preparation of documents for publication. Surveys were sent to researchers in four directorates to identify first the degree to which documents were being prepared electronically and second the principal software packages used. Researchers were also asked about the method used to include graphics and photographs in their documents.

Most reports are already being generated (at least in part) electronically. If an appropriate electronic distribution system is identified, electronic posting of most technical documents may be a realizable near-term goal. However, no standard software package exists at Langley for either word processing or graphics, and manually pasting figures into documents is still prevalent. In addition to differences in software utilization, no standard platform exists for producing the documents. The EDTR group decided that it is neither appropriate nor cost-effective to define a standard set of software and compel all researchers to conform. Rather, a common output format, such as Adobe PostScript, should be sought from among the set of software; the electronic dissemination system would then only need to handle the single common output format.

System Selection

Seven electronic information systems in the Washington, D.C., area were investigated to gain an understanding of the available technologies and approaches used by other national agencies and corporations. This information was used

to formulate a strategy for the development of the EDTR system. Three approaches are used to develop electronic information dissemination systems: (1) custom development, (2) commercial off-the-shelf software, and (3) public domain software. Custom development involves the internal staff developing the system, writing the custom code, and integrating the system. This approach for the EDTR system was considered too costly and not necessary. Most systems are developed with the various commercial off-the-shelf software packages. This approach is cost-effective in terms of the development, integration, and maintenance and also provides optimal functionality. For wide area network access, the site licensing of client software can be costly, but the vendors are willing to negotiate on a case-by-case basis. This approach was seriously considered and evaluated for the EDTR system. Public domain software for information delivery and retrieval over the Internet has proliferated and is widely use by those connected to the Internet. Overall, this approach can be cost-effective for wide access by various clients, but it may be expensive when customization and integration are required to enhance functionality. This approach was selected by the working group for the EDTR system.

Langley Technical Report Server

The Langley Technical Report Server (LTRS), an experimental proof-of-concept system based on World Wide Web (WWW) and Wide Area Information Server (WAIS) protocols, was in operation at the time. WWW and WAIS allow a simple model for indexing and distributing technical reports. The abstracts are indexed with WAIS, and each abstract contains a pointer to the report, which may or may not reside on the same computer as the indexed abstracts. Currently most reports are stored in PostScript format, a de facto standard used for output to printers. Supplying reports in PostScript format provides most users with the ability to download and print. The potential report user can browse the list of abstracts or search the abstracts for key words (such as subject terms, author names, report numbers). When a report of interest is identified, the author can choose the title in the abstract list and the report is downloaded to the user’s workstation for viewing or printing. LTRS currently provides access to over 300 reports. During the first 18 months of operation, this server has delivered over 11,000 copies of these reports.

At Langley 33 volunteers from technical and nontechnical fields evaluated LTRS on three platforms (Macintosh, UNIX, and PC). Most volunteers thought the LTRS home page was clear and easy to understand. Most were satisfied with the searching capability, wanted to be able to search the full text of the report, and valued the browsing capability. Although they wanted to view the abstract before the full text, they liked being able to go directly to the full text of the report. For the most part, they judged the system to be valuable, even though a limited number of reports are currently available. Overall, they believed that the major strength of LTRS is that it allows researchers to access and search Langley publications from their desktop. The volunteers wanted more reports available and wanted missing figures and photographs included to complete the reports. They complained of inconsistent viewing capability. Other problems seemed to result primarily from limitations of the platform rather than LTRS (i.e., speed, memory, and disk space).

Approximately 175 U.S. companies have accessed LTRS. In addition to numerous computer and software companies, 16 aerospace companies and many nonaerospace companies who are candidates for dual use of NASA's aerospace technology have used the LTRS system. Also over 200 universities and government agencies have accessed LTRS. Although LTRS has not made great penetration into the aerospace community, it has demonstrated the capability of disseminating Langley technical reports to the aerospace industry.

Recommendations

Management support and guidance are essential to the success of any electronic distribution system. Thus, the EDTR working group proposed a policy statement that provides guidelines for distribution and storage as well as a framework for managing the electronic distribution system. (See appendix A.) Although it has not been adopted by Langley management, the policy statement has been reviewed for adherence to copyright law and generally conforms to NASA STI publication policy. The EDTR working group recommends a framework for managing the EDTR system based on establishment of a committee to (1) establish electronic publication standards, (2) monitor adherence to policies, (3) maintain structure of the EDTR system, (4) ensure reliability of the system, (5) plan for the future, and (6) promote the use of the EDTR system, particularly among aerospace industry.

The EDTR working group recommends that the proposed policy statement be reviewed and implemented to move EDTR from a proof of concept to an important strategic direction for the Langley STI Program. Also, the open, unrestricted EDTR system must be extended to restricted information to provide a secure way of quickly disseminating our commercially valuable information to NASA's domestic customers. However, a restricted system will entail investment in labor to qualify users and investment in systems to manage the risk of restricted information on-line. Finally the evaluation of LTRS by Langley users clearly indicated areas for improving functionality. A high priority should be enlarging the collection to include most unrestricted technical documents originating from Langley.

Introduction

The National Aeronautics and Space Act of 1958 gives NASA the following directive for disseminating information: "The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof." The recent proliferation of Internet access and widespread information distribution capability allows NASA to more effectively meet this directive. To this end, the Electronic Dissemination of Technical Reports (EDTR) working group was formed by the Office of the Chief Scientist at Langley Research Center in September 1993. The EDTR working group was chartered to establish the capability of electronically disseminating NASA Langley's technical reports to the U.S. aerospace industry.

To accomplish this objective, the working group determined external customer (user) requirements, surveyed technology status, developed a vision for electronic dissemination, determined internal customer (Langley researchers) requirements and capabilities, and defined and implemented a system for electronic dissemination. The primary focus of this working group was the aerospace industry. Based upon the information gathered from external sources and from within Langley, basic and preferred requirements that described a desired report distribution method were derived. Two approaches were considered for developing a system to meet these requirements: (1) use of commercial off-the-shelf software and (2) use of public domain software based on the World Wide Web (WWW) protocols (ref. 1). After evaluating the two approaches in light of the stated requirements, the WWW approach was selected by the group. The Langley Technical Report Server (LTRS), an experimental report distribution system based on WWW protocols (ref. 2), was in operation at the time.

After LTRS was selected as the primary electronic distribution system, an evaluation was held at Langley to determine how to improve the functionality of the LTRS system. This report documents the findings of the EDTR committee, including customer surveys, system analysis and selection process, current system design, LTRS system evaluation, recommended policy statement, and suggestions for future implementations. Appendix A contains the recommended policy statement, appendix B contains LTRS usage statistics, and appendix C contains the LTRS instructions that were used during the evaluations.

External Survey of Industry Electronic Dissemination Usage

During September 1993, the EDTR working group and employees from the Langley Scientific and Technical Information Division (STID) visited a representative sample of aerospace companies to ascertain their evaluation of NASA scientific and technical information (STI) services and products and, in particular, their reaction to the possibility of electronic dissemination of Langley reports. This group met not only with the library staff but also with the research and engineering staff of each company. The companies visited were Boeing Aerospace Company, McDonnell Douglas, United Technologies, Texas Instruments, Loral Vought, Bell Helicopter, and Lockheed Corporation. A conference meeting was also attended by representatives from seven additional companies and two universities in southern California.

Among these companies, library and information services vary from centralized library systems, to several decentralized libraries, to minimal services. In most companies, researchers rely on libraries for searches, current awareness, and document acquisition and delivery. Many libraries provide electronic services, such as online catalogs, technical experts directories, and CD-ROM databases.

In general, aerospace companies are wary of Internet security and therefore provide electronic mail access only, restricted Internet access through a firewall, or no Internet access at all. However, Internet access is increasing. Company systems and network environments resemble Langley's in that multiplatform is the norm. Their systems and network environments differ from Langley's in that Macintosh is not as prevalent, IBM-compatible personal computers (PC's) are much more prevalent, and networks and electronic mail are more heterogeneous and may not be connected to the Internet.

The aerospace companies with viable libraries use a wide range of NASA STI products and services, including subscriptions to NASA reports, current awareness products, and NASA's aerospace database, RECON. The publication *Tech Briefs* was often mentioned. The companies generally considered NASA and NACA documents very valuable resources. However, many of these companies complained about NASA STI products (RECON) and used commercial replacements when available (Dialog and AIAA Aerospace Database). The nonaerospace company and the company with a minimal library had difficulty finding NASA documents and were generally unaware of NASA STI products. In addition, nearly no one understood or was concerned about

Table 1. EDTR System Considerations Inferred from Aerospace Industry Visits

1.	Because of the reliance of industry researchers on their libraries, the industry library represents a viable target for (and customer of) electronic dissemination.
2.	Because of the lack of Internet access by industry researchers, passively publishing Langley reports on the Internet is insufficient; more proactive approaches are also required, such as electronic current awareness announcements.
3.	Because Internet access is increasing and libraries are beginning to deliver electronic products to their customers, interest among industry researchers in on-line products is expected to increase.
4.	Because industry systems and network environments differ from Langley's, the EDTR system should not be modeled according to the Langley environment.
5.	Any proposed EDTR system must significantly exceed the current capabilities of traditional NASA STI products and services, which typically do not sufficiently reach industry, particularly nonaerospace companies.
6.	Electronic access and delivery of Langley reports must include as a minimum basic printing and searching capabilities.
7.	Timeliness must be exploited in the electronic dissemination process.
8.	When possible, data files should be included or linked to the electronic report.

distinctions among the NASA report series (i.e., TP's, TM's, etc.).

Many companies recommended improvements to NASA STI products and services such as RECON and the Center for Aerospace Information (CASI), which is under the auspices of NASA Headquarters. Companies recommended several new products, such as electronic current awareness, technical experts locator, monographs, and state-of-the-art reviews. They also recommended enhancements to our traditional reports, such as more informative abstracts and summaries.

The companies felt that NASA reports are not published and distributed quickly enough. Thus, electronic access to Langley reports is of interest to these companies provided that they can print a hard copy. They also wanted robust searching not only of bibliographic citations but also of full text of a large repository of documents, and they wanted direct electronic access to the data discussed in NASA reports.

After evaluating the information obtained during the industry visits, the working group identified a number of factors for establishing the EDTR system requirements. These system requirements are summarized in table 1.

Internal Survey of Langley Document Preparation Methods

A desired characteristic of any electronic dissemination system is that it be capable of handling documents in the form in which they are produced, that is, without document conversion. The EDTR working group therefore performed an informal survey to determine the word processing and graphics packages used by Langley researchers in the preparation of documents for publication. Surveys were sent to researchers in four directorates to identify first the degree to which documents were being prepared electronically and second the principal software packages used. Researchers were also asked about the method used to include graphics and photographs in their documents. For expediency, the surveys were distributed via electronic mail. Surveys were also sent to branch secretaries so that researchers who do not use electronic mail could have the opportunity to respond.

Over 250 researchers from four directorates responded. Many researchers also provided detailed commentary on the report generation process along with suggestions for process improvement. Because this was an informal poll, no attempt was made to aggregate the responses weighted by directorate size; the results are presented as a proportion of those who chose to respond. Trends resulting from that survey are presented in figures 1 to 4.

The first important observation from the survey results is that most reports are already being generated (at least in part) electronically. Even when handwritten manuscripts are delivered to secretaries for typing (relatively rare among the respondents), the secretaries prepare the documents electronically. Thus, if an appropriate electronic dissemination system is identified, electronic posting of reports may be a realizable near-term goal.

Authors need only be convinced of the desirability of using the skills they already possess or using available publication support services to provide reports in a

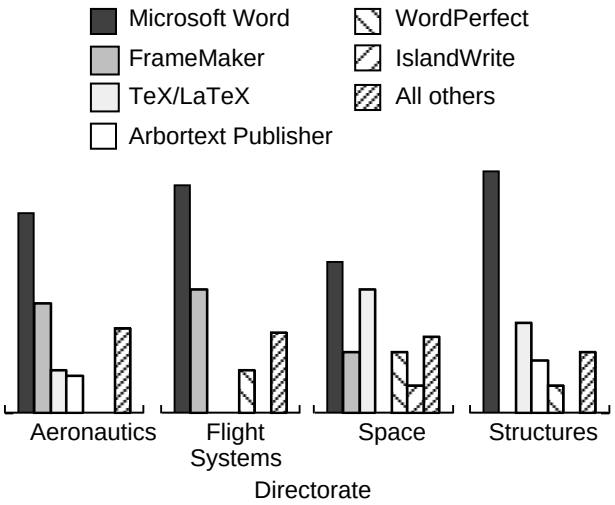

Figure 1. Usage of word processing software.

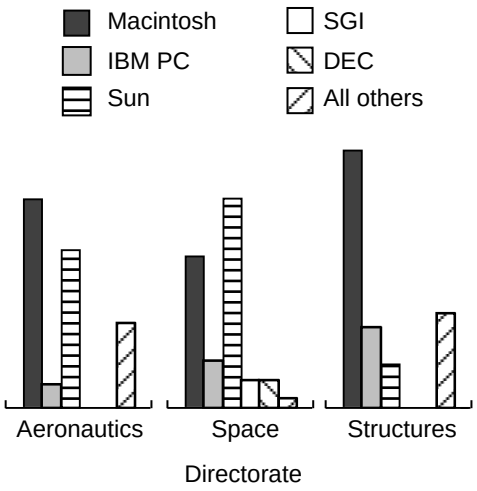

Figure 4. Usage of computer platforms.

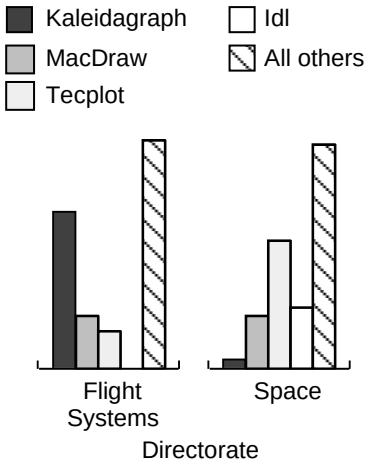

Figure 2. Usage of graphics software.

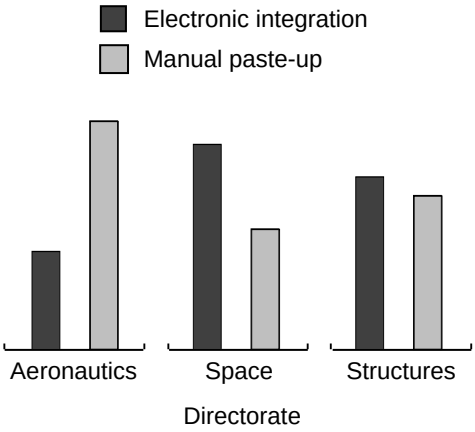

Figure 3. Figures incorporated in reports.

completely electronic format. Because many journals have already imposed such a requirement, the learning curve for the complete production of electronic documents should be short.

The second important observation from the survey is that no standard software package exists for either word processing (fig. 1) or graphics (fig. 2). A large fraction of respondents use individually preferred packages, particularly for graphics. Figure 3 shows that manually pasting figures into documents is still prevalent, especially in the Aeronautics directorate, where researchers commonly paste up photographs in documents. In addition to differences in software utilization, no standard platform exists for producing the documents (fig. 4). Respondents were almost evenly split between UNIX workstations and desktop personal computers.

Researchers at Langley have diverse requirements for appropriately publishing their findings. The EDTR group decided that it is neither appropriate nor cost-effective to define a standard set of software and compel all researchers to conform. Rather, a common output format such as Adobe PostScript should be sought from among the set of software; the electronic dissemination system would then only need to handle the single common output format. The disadvantage of standardizing on output format is that this format might limit the functionality of the system, such as full-text searching and hypertext.

System Capabilities

The EDTR working group used the information from the preliminary meetings with industry and the survey of NASA Langley researchers to compile a set of basic and preferred requirements for the electronic dissemination

Table 2. Basic System Requirements

1.	Compatible with multiple platforms with graphical capability.
2.	Accessible on a TCP/IP Network.
3.	Able to download, view, and print documents and parts of documents including graphics with reasonable speed.
4.	Able to perform interactive searching of bibliographic citation.
5.	Able to view files with sufficient functionality to determine relevance before downloading (e.g., scrolling, zooming, rotating, go to pages).
6.	Easy to use and not require users to be familiar with complex search systems or computer software and hardware integration.
7.	Accommodate delivery of a large repository of documents, including scanned documents as well as electronic documents from various text formatting systems.
8.	Accessible to people working within a restricted access (firewall) system.
9.	Offer minimal cost and labor for NASA and customer implementation, maintenance, and growth of system.

Table 3. Preferred System Requirements

1.	Ability to mark text with users' annotations and bookmarks.
2.	Ability to cut and paste text and graphics.
3.	Allow an optional full-text searching of selected documents.
4.	Ability to navigate through document with hypertext and to create links between documents and files.
5.	Accommodate various information formats including nonprint information such as numeric data files, photographs, video, audio.
6.	Ability to access databases resulting from other electronic publishing projects.
7.	Flexible enough to allow database to be included in future electronic publishing projects.
8.	Accommodate regular announcements containing abstracts of newly released papers grouped by subject or RTOP category
9.	Accommodate access to and transfer of sensitive information.
10.	Inclusion of a technology locator that identifies responsible offices and principal researchers.
11.	Compatible with nongraphical platforms.

system. These requirements are presented in tables 2 and 3, respectively. The EDTR working group deemed the basic requirements to be necessary for a viable EDTR system. The preferred requirements are important but not necessary.

System Selection Process

The system selection process consisted of surveying existing information dissemination systems, evaluating two approaches against the basic and preferred requirements, and deciding which approach would be better for the electronic dissemination of technical reports to the aerospace industry.

Seven electronic information systems in the Washington, D.C., area were investigated to gain an understanding of the available technologies and approaches used by other national agencies and corporations. This information was used to formulate a strategy for the development of the EDTR system. Systems at the following institutions were investigated:

- National Library of Medicine
- Naval Research Laboratory
- Kestrel
- Bell Atlantic Corp.
- Symbiont
- NASA Goddard Space Flight Center
- NASA Headquarters/Info Dynamics

System Development Approaches

Three major approaches are used to develop electronic information dissemination systems. These approaches are (1) custom development, (2) commercial off-the-shelf software, and (3) public domain software.

Custom development involves the internal staff developing the system, writing the custom code, and integrating the system. This approach was used for all systems at the National Library of Medicine. In general, this approach is expensive and is used when a specific application cannot be developed with existing software. In other words, the application may require so many modifications to the existing software that it is not worth the effort, or it may be virtually impossible to adapt a commercial product to work with an existing internal system. At the National Library of Medicine, this approach seems to be used because they have a 30-year-old MEDLINE system, permanent resources allocated to develop all necessary internal systems, and a philosophy that their needs are unique and will always require them to develop their own systems. This approach for the EDTR system was considered too costly and not necessary.

Most systems are developed with various commercial off-the-shelf software packages. The Projects Directorate at the NASA Goddard Space Flight Center, NASA Headquarters, the Naval Research Laboratory Library, and Bell Atlantic Information Systems have used this approach. Of all the systems that were investigated, the most successful ones in terms of meeting the original objectives used this approach. This approach is cost-effective in terms of the development, integration, and maintenance and also provides optimal functionality. For wide area network access, the site licensing of client software can be costly, but the vendors are willing to negotiate on a case-by-case basis. This approach was seriously considered and evaluated for the EDTR system.

Public domain software for information delivery and retrieval over the Internet have proliferated and are widely used by those connected to the Internet. The Astrophysics Data Facility at the NASA Goddard Space Center developed a prototype system with this approach. This specific implementation did not seem to achieve its intended objectives. The reason seemed to be inexperience with selection and integration of the various hardware and software pieces. The EDTR working group realized that this prototype was not a good implementation and integration of public domain software. Overall, this approach can be effective for wide access by various clients, but it may become expensive when customization and integration are required to enhance functionality. This approach was also seriously considered and evaluated for the EDTR system.

Existing Langley Prototypes

Two efforts were in progress at Langley in the area of electronic dissemination of technical reports: LTRS and FEDS. The LTRS project sponsored by the Information Systems Division and STID is based on the WWW protocols and NCSA Mosaic, a public domain WWW browser (ref. 3). The LTRS project was started as a proof-of-concept service in late 1992 (ref. 4). The other project, a prototype full-text electronic documents system (FEDS), was sponsored by STID and was initiated as a result of a grant from the Director's Discretionary Fund awarded to the Technical Library in September 1993. This project proposes use of Interleaf Worldview and commercial off-the-shelf software for the development of the system. Although both projects shared the common goal of electronic dissemination and retrieval of reports, their approaches, objectives, and developmental cycles differed significantly.

The goal of FEDS was to build a system of full-text NACA/NASA reports that exist in paper and electronic (T_EX) format. Langley researchers would then have desktop access to NACA/NASA reports from all clients (PC, Macintosh, and UNIX) with excellent functionality, an easy-to-use interface, full-text searching, hyperlinks, manipulation, and printing. This project proposed a unified approach for providing access to all NASA reports regardless of their format. It also proposed to integrate full-text searching, viewing, and printing of reports with their original ‘‘look and feel.’’ The emphasis of this project was providing desktop document delivery and retrieval to the Langley community with a high level of functionality. The prototype project was given a year for development with a projected completion date of July 1994.

The goal of LTRS was to disseminate Langley technical reports to a wide audience on the Internet. The report set was initially comprised of Langley formal technical reports from recent years that were archived in electronic (T_EX) format (ref. 5). These reports were converted to Adobe PostScript format, but hypertext reports have since been included and other formats can easily be integrated. Based on WWW protocols, LTRS offers access from numerous platforms, even nongraphical terminals, running WWW client software such as NCSA Mosaic. LTRS offers browsing, searching of bibliographic data and abstracts, full-text viewing, and printing. The emphasis of this project was to quickly disseminate Langley technical information to a wide audience through an Internet-based solution to information

delivery. LTRS has been in operation since January 1993.

Selection of LTRS for EDTR System

The FEDS prototype project, based on commercial off-the-shelf software, and the LTRS proof-of-concept, based on WWW public domain protocols, offered the EDTR working group the opportunity to explore two approaches to decide which approach was more suitable for the electronic dissemination of Langley's technical information. At the time of the EDTR system selection, the FEDS project was at the software selection stage prior to system development, while LTRS was already operational. Therefore, the EDTR working group focused on the functionality and suitability of the software. The group examined Interleaf Worldview and NCSA Mosaic software to determine whether they were fully compliant (FC), partially compliant (PC), or not compliant (NC) with the basic and preferred requirements listed in tables 2 and 3. The results of this evaluation are given in table 4.

Both NCSA Mosaic and Interleaf Worldview were fully compliant with most of the basic requirements and many of the preferred requirements. Thus, the working group resorted to considerations other than the system requirements in selecting a system approach. The WWW public domain approach exemplified by LTRS was selected for the following reasons:

1. System flexibility: LTRS is based on publicly documented open systems and standard protocols that are an intrinsic part of the Internet functionality.

2. Wide dissemination: LTRS is widely used (appendix B) because of availability of public-domain client software running on numerous platforms, access to other NASA and non-NASA information from a single WWW interface, and demonstrated delivery of a wide variety of information.

3. Cost: LTRS imposes no direct cost for software on either NASA or its customers.

Although the commercial off-the-shelf approach had the following advantages, they were believed to be less significant to the charter of the EDTR system presented in the Introduction.

1. Functionality: Commercial software generally provides greater functionality, such as user-friendly search capabilities, full-text searching, hypertext links between search results and text.

Table 4. Evaluation of Interleaf and Mosaic

[FC, fully compliant; PC, partially compliant, NC, not compliant]

Requirement	Interleaf	NCSA Mosaic
Basic		
1	FC	FC
2	FC	FC
3	FC	FC
4	FC	FC
5	FC	PC
6	FC	FC
7	FC	FC
8	PC	PC
9	NC	FC
Preferred		
1	FC	PC
2	FC	PC
3	FC	NC
4	FC	PC
5	FC	FC
6	PC	FC
7	PC	FC
8	FC	FC
9	PC	PC
10	PC	PC
11	FC	FC

2. Software integration: Commercial document delivery systems include fully integrated client software.

3. Access control: Users can usually be categorized with most commercial systems to allow varying levels of access depending on sensitivity of documents.

4. Large collections: Commerical systems have been demonstrated on very large collections.

Evolution of LTRS

Pre-WWW LTRS

LTRS officially began serving reports on January 14, 1993 (ref. 4). The initial stage consisted of only one server, an anonymous FTP (file transfer protocol) server on `techreports.larc.nasa.gov.` The FTP server was the historical model for distributing reports, program codes, and other information on the Internet. Figure 5 shows the file system hierarchy for the FTP server. Initially, the reports that were available were formal technical reports in compressed PostScript format. Abstract lists, which were available in ASCII format, could be browsed or loaded into a text editor for searching.

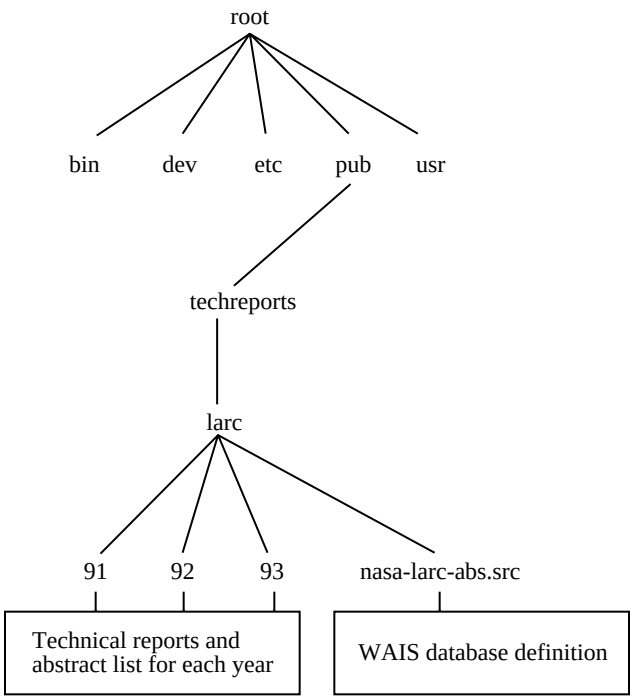

Figure 5. File hierarchy of technical reports on server.

On February 10, 1993, a Wide Area Information Server (WAIS) was added to LTRS, which allowed interactive searching of the abstracts. The FTP server and the ASCII abstract lists were still available. However, searching the abstracts and retrieving the reports were not integrated into a single process.

Many gophers (menu-based systems for exploring Internet resources) soon started to point to the FTP and WAIS servers of LTRS, but before LTRS could be implemented as a gopher server, the developers discovered NCSA Mosaic and the WWW. The gopher implementation was bypassed in favor of WWW.

WWW Version of LTRS

The initial WWW version of LTRS began August 1993. This version consisted only of a WWW wrapper around the existing FTP and WAIS servers. The integration of WWW made the separate services easier to use and collected them into a single location for convenience; however, it did not allow for the integration of searching and retrieving.

The current WWW version of LTRS, described in detail in reference 2, made its debut in October 1993. (See fig. 6.) LTRS is now a collection of servers (HyperText Transfer Protocol (HTTP), FTP, and WAIS), which are combined in a manner transparent to the user (fig. 7). Only functionality choices are presented to the user (search and browse) and the implementation details (FTP and WAIS) are hidden. Perhaps most importantly, the current version of LTRS integrates the search and retrieve functions. Users can now search the citations and abstracts of reports and then retrieve (view or save locally) the report. Also, users can now retrieve the reports directly by browsing abstract lists.

The increasingly seamless integration of new servers does not obviate the previous servers. For example, many users still access the technical reports via anonymous FTP or through a gopher gateway that points to the FTP server. The current version builds upon the prior work of the LTRS project. Even when a user accesses LTRS through WWW, a retrieval ultimately results in an anonymous FTP access to `techreports.larc.nasa.gov` for most of the reports. This orthogonal, building-block approach insures that older systems remain functional even with rapid improvements in information servers.

Although accessing LTRS via the previous methods is still possible, the use of WWW has allowed it to grow beyond the level of just serving reports from one computer. LTRS takes advantage of the distributed nature of WWW to catalog and provide access to reports that were once outside its domain. The compressed PostScript files available via anonymous FTP on `techreports.larc.nasa.gov` now represent only a large subset of the reports that are available.

Current System Design

New Model for Document Distribution

WWW and WAIS allow a simple model for indexing and distributing technical reports. The model is general enough to be used for a variety of applications and well-suited for the distribution of reports in a variety of formats. A small amount of metadata, in this case an abstract, is indexed with WAIS. The abstract itself holds a pointer to the report. Because WWW can point

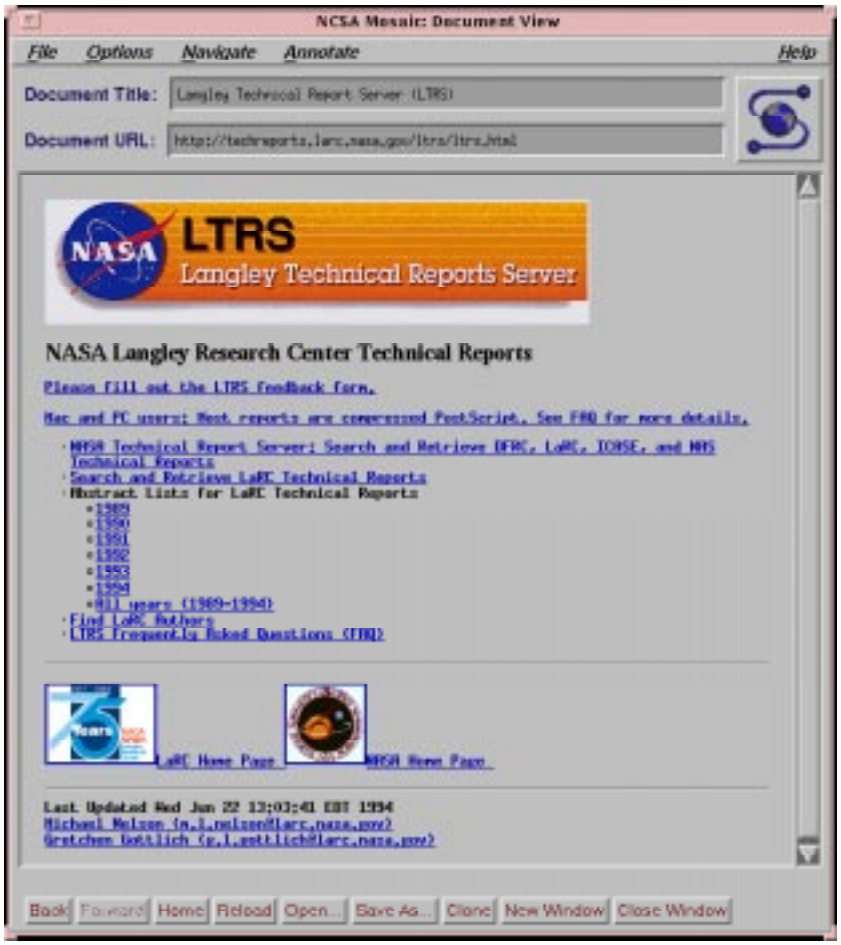

Figure 6. LTRS home page as displayed in NCSA Mosaic.

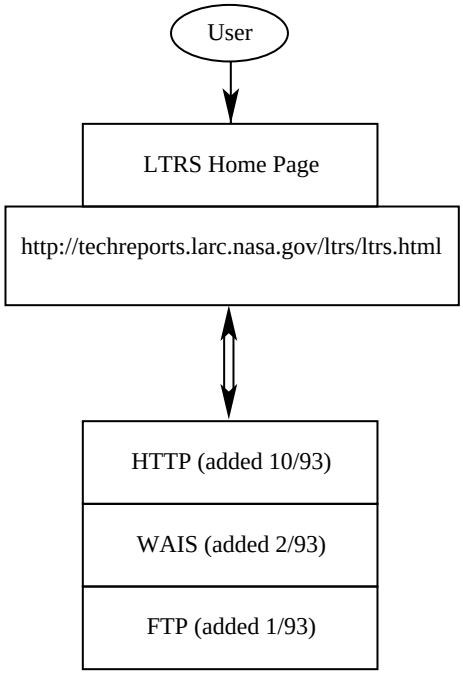

Figure 7. Collection of servers in LTRS system.

anywhere on the network, the abstract can point to a report (or other data object) residing on a different computer, possibly even with a different type of server (HTTP or gopher). Currently, the abstracts in LTRS only point to one copy of the report, but the system could easily be extended so that the abstracts point to reports in multiple formats, related reports, or even supplementary material such as photographs or video. Figure 8 illustrates a simplified view of the data model.

Report Storage in LTRS

Initially, the contents of the single anonymous FTP server defined the contents of LTRS. With the use of WWW, logical content and physical content can now be separated. All abstracts for the reports are stored centrally, and while all the reports appear to be stored centrally, about 5 percent are now stored on other computers at Langley. More distributed storage of reports is anticipated in the future. However, the degree of distributed storage is an issue as yet to be resolved.

Report Indexing Method

A distinction is made between the archival format of the abstracts and the presentation format. Abstracts are accepted in refer format (ref. 6), and a script is used to translate the refer format into hypertext markup language (HTML). (See figs. 9 and 10.) Although refer is a popular bibliographic format, it is generally not preferred by users. HTML (ref. 7) is currently the obvious choice for presentation of the abstracts with pointers to reports. (See sample abstracts in figs. 10 to 12.)

The resulting HTML files are then indexed with WAIS. The WAIS index program was originally unable to index HTML documents. The LTRS developers modified the index program so that it handled HTML documents appropriately. The resulting changes to the WAIS index program have been submitted to the Clearinghouse for Networked Information Discovery and Retrieval (CNIDR), the organization that maintains the free version of WAIS.

Report Collection

Central to wide use of any document delivery system is the quality and extent of the collection. LTRS currently provides access to over 300 unique reports, including NASA reports, journal articles, conference papers, and NASA-sponsored theses. During the first 18 months of operation, LTRS has delivered over 11,000 copies of reports from this database. (See appendix B.)

The initial report set was comprised of unrestricted NASA formal technical reports that the Research Publishing and Printing Branch (RPPB), STID, had archived in native electronic format, that is, in the format of the software used to produce the reports (T_EX). These files were converted to PostScript format, a de facto standard used for output to printers. Supplying reports in the PostScript format provides most users with the ability to download and print.

The RPPB continues to submit new NASA Langley formal reports to the LTRS system. After the manuscripts are approved for printing and hardcopy distribution, the same electronic files are processed into PostScript files for electronic delivery and submitted to LTRS. Because these reports are all produced with the same publishing software and conventions, the abstract and citation in refer format can automatically be extracted from the electronic file. These formal reports continue to be a large subset of the total number of reports available from the system.

Authors may submit their reports directly to LTRS by preparing a citation in refer format and submitting it along with a PostScript file for the report. If the report is already available on-line, the author may simply include the universal resource locator (URL) so that LTRS can point to the report on the author's server. Documents formated with HTML are also accepted.

The most limiting factor to the quality of the LTRS report collection is that not all reports are complete. Often manual processes are still used to produce the report manuscripts; for example, photographs and illustrations may be pasted up instead of electronically inserted. Then, the reports on LTRS do not include the manually inserted material.

Evaluation of LTRS by Langley Users

LTRS was evaluated on three platforms: Macintosh, UNIX, and PC. Instructions illustrating the searching, browsing, viewing, and printing capabilities of the system were written for each platform. (See appendix C.) Thirty-three Langley volunteers from technical and nontechnical fields were asked to follow these instructions and then fill out a two-part evaluation form of Likert scale and free responses.

The volunteers were divided into four sessions so that they could evaluate LTRS on their platform of choice: Macintosh (16), UNIX (11), and PC (7). At each session four Macintosh, three UNIX, and two PC platforms were available. Each platform had the same version of NCSA Mosaic and the appropriate viewing and printing software. The Macintosh and UNIX platforms were connected to a printer. No formal training was given during the scheduled 2-hour sessions; however, EDTR group members were available to answer questions. Most volunteers finished in 1 to 1.5 hours.

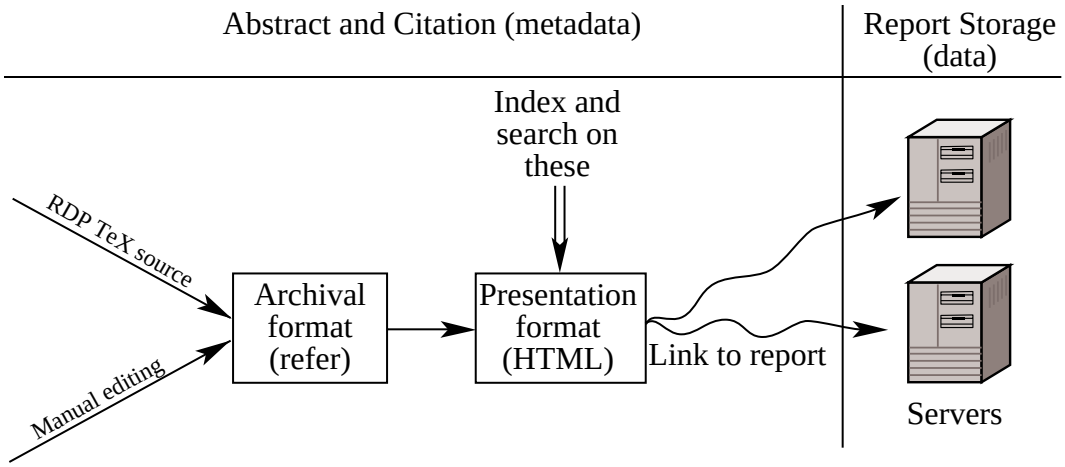

Figure 8. LTRS data model.

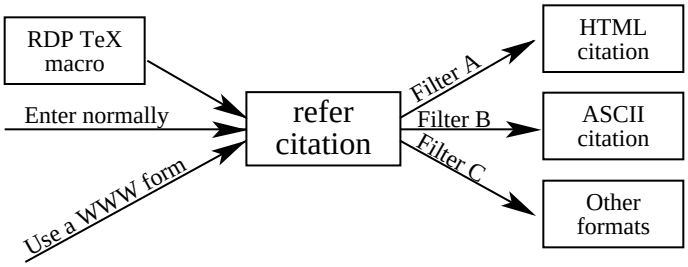

Figure 9. Abstract-generation method.

```
%A Lin C. Hartung
%A Robert A. Mitcheltree
%A Peter A. Gnoffo
%T Stagnation Point Nonequilibrium Radiative Heating and the Influence of Energy Exchange Models
%J Journal of Thermophysics and Heat Transfer
%V 6
%N 3
%D July–September, 1992
%P 412–418
%O Prior version appeared as AIAA Paper 91–0571
%U ftp://techreports.larc.nasa.gov/pub/techreports/larc/92/jtht–6–3–92.ps.Z
%X A nonequilibrium radiative heating prediction method has been used to evaluate several energy exchange
models used in nonequilibrium computational fluid dynamics methods. The radiative heating measurements
from the FIRE~II flight experiment supply an experimental benchmark against which different formulations for
these exchange models can be judged. The models which predict the lowest radiative heating are found to give
the best agreement with the flight data. Examination of the spectral distribution of radiation indicates that despite
close agreement of the of the total rediation, many of the models examined predict excessive molecular radiation.
It is suggested that a study of the nonequilibrium chemical kinetics may lead to a correction for this problem.
```

Figure 10. Sample abstract in refer format.

```
<TITLE>Stagnation Point Nonequilibrium Radiative Heating and the Influence of Energy Exchange Models</TITLE>

<i><A HREF="http://www.larc.nasa.gov/ltrs/ltrs.html">Langley Technical Report Server</A></i><hr>

<OL>

<LI><A NAME="">Lin C. Hartung,
Robert A. Mitcheltree and
Peter A. Gnoffo,
<B> ' ' <A HREF="ftp://techreports.larc.nasa.gov/pub/techreports/larc/92/jtht–6–3–92.ps.Z">Stagnation Point
Nonequilibrium Radiative Heating and the Influence of Energy Exchange Models,</A> ' ' </B>
<I>Journal of Thermophysics and Heat Transfer</I>,
vol. 6, no. 3, July–September, 1992,
pp. 412–418,
Prior version appeared as AIAA Paper 91–0571.
</A>
<P>
<B>Abstract: </B>
A nonequilibrium radiative heating prediction method has been used to evaluate several energy exchange
models used in nonequilibrium computational fluid dynamics methods.  The radiative heating measurements
from the FIRE~II flight experiment supply an experimental benchmark against which different formulations for
these exchange models can be judged.  The models which predict the lowest radiative heating are found to give
the best agreement with the flight data.  Examination of the spectral distribution of radiation indicates that despite
close agreement of the of the total rediation, many of the models examined predict excessive molecular radiation.
It is suggested that a study of the nonequilibrium chemical kinetics may lead to a correction for this problem.<P>
```

Figure 11. Sample abstract in HTML format.

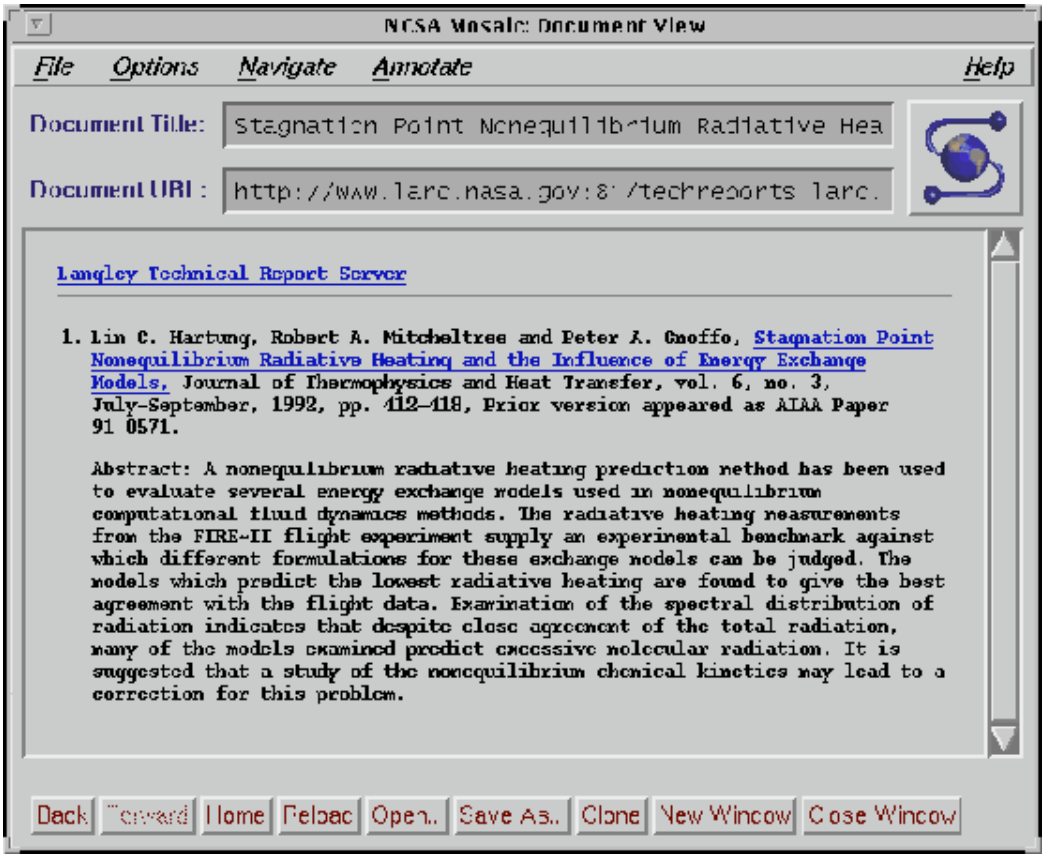

Figure 12. Sample abstract displayed in NCSA Mosaic.

The results of this evaluation are summarized in this section.

Evaluation Results: Likert Responses

In section I of the evaluation, the volunteers were asked for their level of experience with their chosen platform, the Internet, and NCSA Mosaic. Most considered themselves very experienced on the platform tested (fig. 13), not as experienced with the Internet (fig. 14), and even less familiar with NCSA Mosaic (fig. 15).

Section I of the evaluation form also contained 25 statements about LTRS. The volunteers were asked to what extent they agreed with the statement on a Likert scale of 1 (do not agree) to 5 (strongly agree). These statements can be grouped into the following five categories: instructions (statements 1,14,15), searching (statements 3 to 7, and 21), report viewing (statements 8 to 12), printing (statements 13 and 22), and report types (statements 16 to 20, 24, and 25). Each statement as it appeared on the evaluation form is presented along with the response in table 5.

Most volunteers thought that the instructions and the LTRS home page were clear and easy to understand. However, one commented that the LTRS instructions needed to be taken ‘‘slowly.’’ Most volunteers were satisfied with the searching capability, wanted to be able to search the full text of the report, found the browsing capability valuable, and were in strong agreement that they wanted to view the abstract before the full text. For the most part, they liked having the capability to go directly to the full text of the report.

In response to statements 8 and 9, one volunteer commented that what one would view depended on what one knew about the report. Most would use the system to preview the paper before printing. One volunteer commented that, for the most part, the procedure for viewing the paper on the screen was straightforward. Another felt the instructions were good but the procedure itself was not easy to use. Most wanted the document to be legible on the screen and felt the procedure for printing was straightforward. Either training or written instruction was deemed necessary for the experienced computer user and even more so for the inexperienced user.

Even though LTRS currently provides access to over 300 reports, they judged LTRS to be a valuable system. They would like to see the full text of classic NACA and NASA reports. In particular, one volunteer suggested immediate inclusion of some NACA reports, while another suggested expanding LTRS slowly to include past reports. Even though they thought figures and photos currently unavailable electronically should be added to the reports, they indicated that LTRS was still a

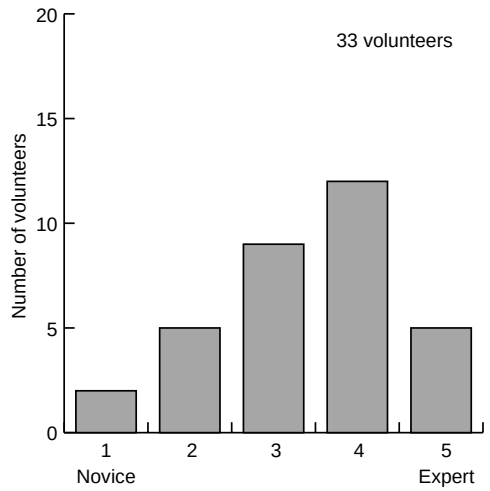

Figure 13. Level of experience on platform.

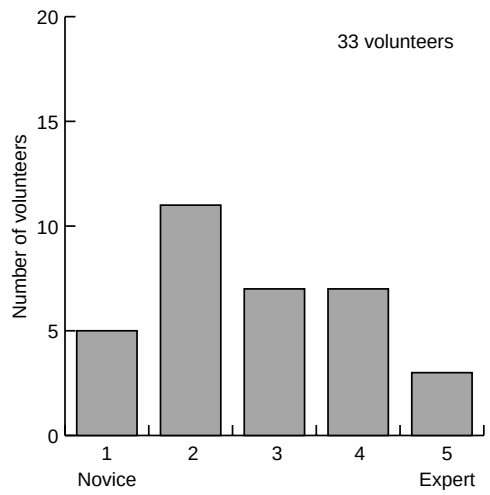

Figure 14. Level of experience with Internet.

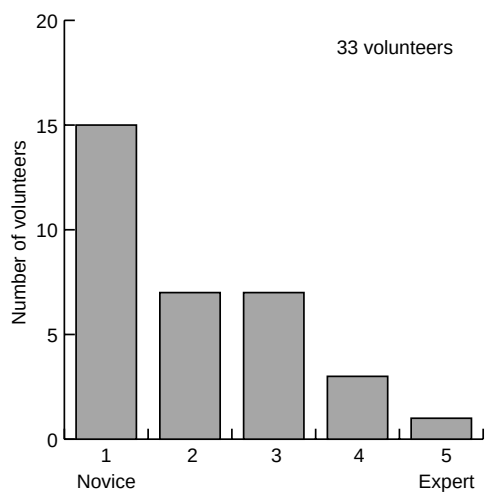

Figure 15. Level of experience with NCSA Mosaic.

Table 5. Responses to LTRS Survey Questions

[Response of 1 or 2 on Likert scale = Do not agree; response of 4 or 5 on Likert scale = Agree]

Survey	Mean	Do not agree, percent	Agree, percent
1. The written instructions explaining how to use the LTRS system are clear and easy to understand	3.91	3	76
2. The LTRS home page is clear and easy to understand.	4.18	0	85
3. Searching LTRS for a specific author or word is intuitive and user friendly.	4.09	3	76
4. The search results screen is clear and easy to understand.	3.76	6	61
5. I am satisfied with the current search capability provided by LTRS which allows for retrieval from the bibliographic description (author, title, report number, date, etc.) and abstract.	3.80	6	73
6. I want the capability to search the full text of the report or paper.	3.82	6	61
7. The LTRS system provides browsing capability for bibliographic descriptions (title, author, report number, date, etc.) and abstracts which is both easy to use and valuable to me as a researcher.	4.00	3	76
8. I want to view the bibliographic description and abstract of the paper before deciding to view the full text of the report.	4.55	0	94
9. I want the capability to navigate directly to the full text of the report or paper without having to first view the bibliographic description and abstract.	3.30	27	42
10. I would use the system to preview the text before printing the complete report or paper.	4.42	3	91
11. The procedure for viewing and reading the full text of the report or paper on the screen is easy, simple, and straightforward.	3.55	15	45
12. I require the full text of the report or paper to be fully legible on the screen.	3.79	9	61
13. The procedure for printing the full text of the report is easy, simple, and straightforward.	3.48	12	48
14. Written instructions and/or training on how to use LTRS is not necessary for the experienced computer user since the system is very intuitive and easy to use.	2.61	52	24
15. Written instructions or training on how to use LTRS is not necessary for even the inexperienced computer user since the system is very intuitive and easy to use.	1.67	85	3
16. With only selected reports and papers from 1989 to the present, LTRS's material content is still valuable.	4.03	9	73
17. LTRS should include the electronic full-text version of classic NACA and NASA reports issued prior to 1989.	4.30	3	82
18. For LTRS to be a valuable research tool, the missing figures and photographs must be added to the system.	3.55	18	55
19. In spite of the missing figures and photographs, LTRS is still a valuable research tool.	3.88	3	73
20. The LTRS reports which are available in hypertext format are easier to work with and provide greater research value than those which are in PostScript format.	3.45	12	45
21. Response time for searching and browsing is acceptable.	3.56	15	67
22. The response time for printing is acceptable.	3.58	9	55
23. Overall, the LTRS system is an easy to use, effective, and valuable research tool.	4.12	3	85
24. In the future, the electronic full text of Langley reports and papers should be stored in a permanent and routinely accessible distribution system available on the Internet.	4.58	0	88
25. I would be willing to contribute my own reports and papers for electronic distribution via LTRS.	4.64	0	94

valuable research tool. In addition, most liked to view hypertext format reports better than PostScript reports.

Most agreed that the response time for searching and browsing was acceptable; however, one commented that the PC response time was slow. (Exact times were not measured; thus, reaction to response time is extremely subjective.) The 25 who tried printing found the response to be acceptable. Most believed that Langley reports should be available on the Internet, and one wanted Langley researchers to also have access to foreign reports. Most were strongly agreeable to adding their reports to LTRS.

Evaluation Results: Free Responses

In section II of the evaluation, the volunteers were asked to list (1) what they felt were the strengths of the LTRS system, (2) what features needed to be added or enhanced in the system, (3) what specific problems they encountered during the evaluation session, and (4) any thoughts they had about the collection of reports and papers available on LTRS. This section summarizes those comments, which were consistent with those indicated numerically in section I of the evaluation.

In response to question 1 concerning the strengths of the LTRS system, the comments ranged from “the basic idea is there but it needs work” to “the system has great potential.” Overall, the volunteers believed that the major strength of LTRS is that it allows researchers to access and search Langley publications from their desktop. They thought that having access to Langley reports would make literature searches easier and would reduce the turnaround time for needed information. This theme of on-line access to reports (instant availability of reports) occurred repeatedly in the volunteers' comments. They liked having the full text available so that they could preview the report or abstract before printing. They also liked the quick searching techniques and the ease of use.

In response to question 2 concerning what features needed to be added or enhanced, two comments were prevalent: The volunteers wanted to have more reports available in the collection, and they wanted missing figures and photographs included to complete the reports. One volunteer wanted to see NACA as well as NASA reports prior to 1989 added to the collection. In addition, the volunteer wanted the collection to include reports currently processed through STID.

One volunteer suggested that the system include an abbreviated browsing capability of abstracts by year and the ability to browse abstracts by subject. The capability to view the documents was not consistent; that is, some reports were encountered that could not be viewed past the first page. The volunteers would like the viewing capability to be consistent and enhanced so that the reports are clearer on the screen. Another suggested that the abstracts include the total size of the compressed file so that users could determine whether their local machine has sufficient disk space to download and decompress the file.

In response to question 3 concerning problems encountered using LTRS, the comments seemed to deal primarily with the limitations of the platform rather than LTRS (i.e., speed, memory, and disk space) or viewing software (i.e., MacGS or Ghostview). One problem seemed to be not knowing when the file was compressed PostScript and when it was uncompressed and not knowing what software was needed with which version.

In response to question 4 concerning the collection of reports and papers available on LTRS, almost every respondant thought that the LTRS database should be expanded to include University grantees' reports; all NASA TM, TP, and journal articles; and JIAFS articles. One volunteer suggested that the report date be added to alphabetic and subject lists. One volunteer wanted to know how to contribute reports. Another hoped more people would take advantage of the system and increase the collection of reports.

The volunteers also offered some suggestions concerning the LTRS instructions used for the evaluation. As a result, the instructions in appendix C will be modified to incorporate their suggestions.

Use of LTRS by U.S. Industry

As previously discussed, aerospace companies are wary of Internet access and generally provide restricted access or none at all. In contrast, such disciplines as astronomy, physics, and computer science seem to have enthusiastically embraced publication over the Internet.

Appendix B lists organizations that have accessed LTRS. From the list of 173 companies, 16 aerospace companies can be identified, including Gulfstream, Lockheed, Loral, Martin Marietta, McDonnell Douglas, Pratt & Whitney, Rockwell, TRW, Boeing, and United Technologies. In addition to numerous computer and software companies, many nonaerospace companies who would be candidates for dual use of NASA’s aerospace technology are listed. For example, ARCO Oil and Gas, Allied-Signal, Dupont, Eastman Kodak, Exxon, Ford, General Motors, Monsanto, and Pacific Gas and Electric have used the LTRS system. Also over 200 universities and government agencies have accessed LTRS.

Although LTRS has not made great penetration into the aerospace community, it has demonstrated the

capability of disseminating Langley technical reports to the aerospace industry.

Implementation of EDTR System

Management support and guidance are essential to the success of any electronic distribution system. Thus, the EDTR working group devised a policy statement that provides guidelines for distribution and storage as well as a framework for managing the electronic distribution system. The policy statement proposed by this group is given in appendix A. Note that Langley management has not adopted this policy. However, it has been reviewed for adherence to copyright law and generally conforms to NASA STI publication policy.

The proposed policy statement has two major impacts on the publishing strategy of NASA Langley. First, approval of the policy statement amounts to a mandate to all Langley authors to provide technical documents for electronic dissemination: "Therefore, in any instance where NASA has the legal right to do so, publications shall be made available electronically via Internet to NASA customers." (See appendix A.) Such a mandate leads to the second impact: an electronic server for Langley technical documents must be supported as part of the Langley publication infrastructure. Such support includes technical support for the server system, support for producing the on-line information, managing the information to ensure responsible and reliable dissemination, strategic planning, and promoting use of the system among aerospace and nonaerospace customers.

To ensure the success of the electronic distribution system, the EDTR working group outlined a framework for managing the system. This framework is based upon the establishment of a committee responsible for establishing publication standards for electronic documents, monitoring adherence to the EDTR policy, and maintaining the structure of the electronic distribution system. The goals of the committee are as follows:

1. Establishing electronic publication standards: The possibility of electronic dissemination immediately raises policy and quality issues. Should restricted documents be available on Internet? Should electronic versions with illustrative material missing be on-line? Should documents submitted to external publishers (e.g., journals) be on-line? The future will hold a new set of issues. On-line dynamic documents (bibliographies, computer documentation, data sets) will be up-to-date, while their hard copy counterparts become obsolete. Multimedia or hypermedia documents will exist on-line, while no hard copy counterpart will be possible. The committee will provide a forum for resolving these issues with STI Program management.
2. Monitoring adherence to policies: The disadvantage of a distributed LTRS system is the difficulty of coordinating and communicating policy. Communication of policy is the primary goal of the committee. In general, the Langley community is very responsible when STI policy (e.g., copyright and management approval) is clearly communicated.
3. Maintaining structure of LTRS system: A technical interface among server administrators, publication policy makers, and information professionals will ensure that a well-designed state-of-the-art system is maintained that adheres to NASA management requirements and meets NASA information customer needs.
4. Ensuring reliability of the system: Any quality information system must display dependability and integrity. Information including bibliographic information, should be reliable in content and availability.
5. Strategic planning: Electronic publishing technology is in its infancy. As this technology matures, we must bring new developments to bear on deficiencies in the current LTRS system.
6. Promoting use of LTRS system: While some technical disciplines such as astronomy, physics, and computer science are well-connected and proficient in use of Internet for EDTR, the aerospace community is not. To capitalize on the cost benefits and efficiency of electronic information transfer, we must market EDTR.

Reference 8 suggests that management of electronic delivery requires a balance of ‘‘the reality of decentralized, dispersed, user-oriented agency automation with the need for some measure of centralized, yet flexible, policy direction and oversight.’’ The concept of an LTRS Committee proposes to do just that, to capitalize on the decentralized, dispersed, user-oriented WWW servers coming on-line under auspices of branches and divisions, while providing central, flexible policy direction and information management services (e.g., indexing and browsing capabilities).

Concluding Remarks

Approval and Implementation of Policy Statement

Because of the wide impact of EDTR on Langley and its significance in support of technology transfer, the working group recommends that the Langley Senior Staff endorse the policy statement for implementation by the Langley STI Program through the Langley Technical Report Server (LTRS) Committee described in the policy statement.

The use of electronic on-line publishing is an important strategic direction with impacts not only on the publishing research community but also on the Langley institution, in particular, the Langley STI Program. Langley and NASA are embracing the World Wide Web (WWW) technology at the "grass roots" level, as are many of our customers. WWW is rapidly becoming a de facto standard technology for electronic dissemination not only within NASA but also within the electronic publishing community in general. Any EDTR effort should conform to WWW standards; however, several electronic document delivery projects not based on WWW are in various stages within NASA. With endorsement by Langley management of the policy statement, EDTR will no longer be a grass roots experiment at Langley; it will become a strategic direction for the STI Program management.

Enhancements to LTRS

The open, unrestricted LTRS system must be extended to restricted information to provide a secure way of quickly disseminating our commercially valuable information to NASA's domestic customers. The current unrestricted system will provide a catalyst for the restricted system. Users who like LTRS will be willing to accept inconveniences of accessing a separate, similar restricted system. However, a restricted system will entail investment in labor to qualify users and in systems to manage the risk of restricted information on-line.

The evaluation of LTRS by Langley users clearly indicated areas for improving functionality: for example, providing full-text searching, producing hypertext documents, and adding missing illustrations and photographs. A high priority should be enlarging the collection of documents to include current informal reports, meeting papers, and articles as well as NACA and pre-1989 NASA reports. In addition to the functionality and content of the server, client configuration presents issues such as auxiliary software for viewing and printing, available disk space, training, and instructions. Although many of these problems represent technological challenges, some can be solved or minimized by system design and process improvements. For example, the LTRS collection can certainly be rapidly enlarged by instituting a process making electronic dissemination routine.

The Langley technical publications program is at a critical juncture. EDTR has been demonstrated to be feasible with no direct cost for software imposed on NASA or its customers. Should Center management endorse EDTR as the strategic direction for disseminating Langley STI, Langley is ready to face the challenges of developing, designing, and managing an electronic dissemination system.

NASA Langley Research Center
Hampton, VA 23681-0001
December 15, 1994

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7. *A Beginners Guide To HTML*. NCSA Technical Summary available at `http://www.pnncsa.uiuc.edu/General/Internet/WWW/HTMLPrimer.html`.

8. Making Government Work—Electronic Delivery of Federal Services Office of Technology Assessment, OTA-TCT-579, September 1993.

Appendix A

Proposed Policy

Policy Statement Introduction

For the United States to remain an international leader in aerospace research and development, NASA must not only perform state-of-the-art research relevant to U.S. industry but must also make the results of that research available in the fastest, most cost-effective manner. Technology currently exists to make NASA's products (formal and informal publications, data sets, etc.) available electronically.

Responsibility for maintenance and technical support of an electronic document dissemination system shall lie with the LTRS committee, under the direct supervision of the head of the Research Publishing and Printing Branch (RPPB). This committee, comprised of representatives from each division at Langley, shall have responsibility for establishing publication standards for electronic documents (including proper copyright notations), monitoring adherence to this policy statement, updating this policy statement, and maintaining the structure of the electronic distribution system. The committee shall further be responsible for promotion of the use of the electronic distribution system as a means of technology transfer to aerospace and nonaerospace customers.

This policy statement covers the following aspects of the electronic dissemination of unclassified, unlimited technical reports: (1) copyright, (2) distribution, (3) electronic document storage, (4) preliminary release of formal reports, (5) approval for posting informal reports to distributed servers, and (6) publication standards for electronic documents.

Copyright

All NASA publications that are cleared for public release (unclassified, unlimited TP's, low-numbered TM's, high-numbered TM's, conference papers, journal articles, etc.) should be posted to an electronic server accessible worldwide via the Internet to assist the customer in rapidly obtaining NASA research. If NASA produced the research, then it is by definition a work of and property of the United States government. Even in cases of journal publications, NASA retains a license to use the work in any manner deemed in the interest of the U.S. government. Therefore, in any instance where NASA has the legal right to do so, publications shall be made available electronically via Internet to NASA customers. In instances where copyright agreements exist with external publishers, the copyright statement must be included in the electronic version of the document.

Distribution

Proper handling of restricted information necessarily requires that some level of difficulty be imposed (for proper user validation) in obtaining the data. The unfortunate effect is a delay to eligible users. The electronic distribution system is patterned after the current paper system to preclude foreign access to restricted information. Currently, within the open Internet environment, this means that restricted (classified, limited, ITAR, FEDD, etc.) information is *not* included for electronic dissemination.

Electronic Document Storage

Because of the large volume of documents published within NASA annually, a distributed document storage environment is necessary. (Additionally, the disk space required to store a compressed PostScript document that includes figures is approximately 1 MB.) As previously noted, the LTRS committee shall have responsibility for maintenance and technical support of this distributed-storage electronic dissemination system, as well as responsibility for promotion of the use of the electronic distribution system within the aerospace community.

All formal NASA publications shall be maintained centrally, under the control of the chair of this committee, and representatives from each Langley division to this committee will have responsibility for maintaining their own division repository of informal documents (conference papers, journal publications, etc.). The electronic dissemination system (known as LTRS) will index and point to these informal report servers via NCSA Mosaic. (NCSA Mosaic is a well-documented public-domain software for browsing and searching the world-wide web, available for PC, Macintosh, and most UNIX platforms via anonymous FTP. Thus, the burden of obtaining and integrating NCSA Mosaic and associated tools shall lie with the end user.) To insure continuity and availability of papers within the system, division representatives shall offer the committee electronic versions of any documents prior to removal of such documents from the distributed servers.

Preliminary Release of Formal Reports

Upon completion of the technical changes required by the editorial committee for NASA formal publications, the author shall have the option of seeking division approval for electronic release of the preliminary document. If approval is granted, the document shall be clearly marked that it is a preliminary draft, cleared for

release with respect to its technical content, but not yet meeting NASA's editorial requirements. The document shall also bear the date of that release with an estimate of when the final draft will be available. Once prepared and cleared for release, the final draft will replace the preliminary draft on the file server. It shall be the responsibility of the customer to retrieve the updated copy of the report.

Approval for Posting Informal Reports to Distributed Servers

Approval for posting new informal reports to distributed servers shall be obtained from the author's division office. Determination of document restrictions shall continue to be made at the division level. Once the document has been approved, responsibility for updating and maintaining the division's report server and for providing LTRS with the appropriate indexing information shall lie with the division's representative to the LTRS committee.

Publication Standards for Electronic Documents

The LTRS committee shall define standards for electronic versions of NASA documents. In the interest of making NASA publications rapidly available, electronic documents generated prior to the definition of such standards will be accepted for posting to the report server provided that they are significantly complete, that is, full text with sufficient figures and tables to be useful. The documents must be marked such that the absence of any data, photographs, figures, or tables is obvious. Responsibility for assessing the desirability and cost effectiveness of completing electronic versions of existing documents (e.g., via scanning photographs, figures, etc.) shall lie jointly with the author and the head of RPPB.

Appendix B

LTRS Usage Statistics

Reports Accessed by Internet Hostnames

Domain	No.
.com	1282
.edu	3120
foreign	3781
.gov	207
.larc.nasa.gov	1358
.mil	287
.nasa.gov	750
.net	19
unknown	213
.org	51

Reports Accessed by Foreigners

Country	No.
Austria	219
Australia	208
Canada	451
Switzerland	105
Germany	423
Finland	69
France	466
Italy	58
Japan	383
The Netherlands	185
Norway	99
Sweden	70
Singapore	60
Taiwan	392
United Kindgom	335
Others	258

Organizations That Have Accessed LTRS

Companies

3Com Corporation
ARCO Oil and Gas
ASK/Ingres Products Division
AT&T Bell Laboratories
AT&T Global Information Solutions
Adobe Systems Inc.
Adroit Systems, Inc.
Advance Geophysical Corp.
Advanced Decision Systems
Advantis
Alcatel Network Systems
Allied-Signal, Inc.
Anasazi, Inc.
Apple Computer Corporation
Asea Brown Boveri
Aware, Inc.
BP
Bailey Controls Company
Ball Aerospace, Inc.
Beckman Instruments, Inc.
Bob Gustwick & Associates, Inc.
Bolt Beranek and Newman Inc.
Box Hill Systems Corporation
Bull HN Information Systems Inc.
Byte Information Exchange
CAE-Link Corporation
CFD Research Corporation
CLAM Associates
Calspan Advanced Technology Center
Centerline Software
Centric Engineering Systems
Charles Stark Draper Laboratories
Chevron Information Technology Co.
Chicago Title & Trust
Cisco Systems, Incorporated
Compaq Computer Corporation

Computervision Corp
Concurrent Computer Corporation
Concurrent Technologies Corporation
Connected, Inc.
Convergent Technologies, Inc.
Convex Computer Corporation
Cray Research, Inc.
DHL Systems, Inc.
Data General Corporation
Dell Computer Corporation
Delmarva Power and Light Company
Delphi Internet Service Corporation
Digital Equipment Corporation
Dupont Experimental Station
EUTeC
Eastman Kodak
Electric Power Research Institute
Electronic Data Systems
Electronic Data Systems
Enterprise Integration Technologies Corp.
Epoch Systems Inc.
Exa Corporation
Exxon Research and Engineering
Fluent, Inc.
Ford Motor Company
GTE Government Systems Corporation
General Dynamics / Computer Sciences Corp.
General Motors Research Laboratory
General Research Corp.
Gulfstream Aerospace Corporation
Hal Computer Systems, Inc.
Harris Corporation
Hewlett-Packard
Hibbett, Karlson, and Sorensen Inc.
Honeywell, Inc.
Horizon Research Inc.
Hughes Aircraft Company
Hughes Information Technology Company
IDT/CCTT
Informix Software, Inc.
Insignia Solutions Inc
Intel Corporation
Intergraph Corporation
Intermetrics, Inc.
International Business Machines
Internet Direct, Inc.
JP Morgan
James Spottiswoode & Assoc.
Kendall Square Research Corporation
Kofax Image Products
LSI Logic Corporation
Landmark Graphics Corporation
Lockheed Information Technology Company
Locus Computer Corporation
Loral Corporation
MRJ Inc.
Malin Space Science Systems
Martin Marietta Astronautics Group
McDonnell Douglas Corporation
Mead Data Central
Merck and Co., Inc.
Micrognosis
Microsoft Corporation
Mirador Computing Systems
Monsanto Company
Motorola Inc.
NETCOM
NYNEX Science and Technology
Ncube
Network Equipment Technologies, Inc.
Networx, Inc
Niagara Mohawk Power Corp.
North American Philips Corporation
Northern Telecom Ltd.
Oracle Corporation
PARAMAX SYSTEMS CORPORATION
PIXAR
Pacer Software, Inc.
Pacific Bell
Pacific Gas and Electric Company
Panasonic Technologies, Inc.
Panix Public Access Unix of New York
Performance Systems International Inc.
PictureTel Corporation

Portal Communications Company
Pratt & Whitney
Process Software Corporation
Pyramid Technology Corporation
Qualcomm Inc.
Radius Inc.
Rational Systems, Inc.
Real/Time Communications
Rocket Research Company
Rockwell International
SAIC
SAS Institute, Inc.
SCUBED Corporation
SPARTA, Inc.
SRI International
SSDS, Inc.
Schlumberger Limited
Sequent Computer Systems, Inc.
Silicon Graphics, Inc.
Software Tool & Die
Solbourne Computer Inc.
Southwestern Bell Corporation
Sterling Software
Stratus Computer, Inc.
Structural Dynamics Research Corporation
Sun Microsystems Inc.
Sun Tech Journal
TRW Inc.
Tandem Computers, Inc.
Tekelec, Inc.
Teknekron Communications Systems, Inc.
Telebit Corporation
Texas Instruments
The Analytic Sciences Corporation
The Boeing Company
The MathWorks, Inc.
The Wollongong Group
Thinking Machines Corporation
Titan, Inc.
Transarc Corporation
Unison Software, Inc.
Unisys Corporation
United Technologies Corporation
Varian Associates, Inc.
Visidyne Inc.
Warner Lambert / Parke-Davis
Western Digital Corporation
Westinghouse Electric Corporation
Wyvern Technologies, Inc.
XMission
Xerox Palo Alto Research Center
Zycad Corporation

Universities

Appalachian State University
Arizona State University
Auburn University
Baylor College of Medicine
Baylor University
Boston University
Bowling Green State University
Brandeis University
Brown University
Bucknell University
Cal Poly State University
California Institute of Technology
California State University, Chico
Carnegie-Mellon University
Case Western Reserve University
City University of New York
Clarkson University
Clemson University
College of William and Mary
Colorado State University
Columbia University
Cornell University
Drake University
Drexel University
Duke University
Embry-Riddle Aeronautical University
Emory University
Florida Institute of Technology
Florida State University ACNS
George Mason University

George Washington University
Georgia Institute of Technology
Hampton University
Hartford Graduate Center
Harvard University
Indiana University
Institute for Computer Applications in Science and Engineering
Iowa State University
Johns Hopkins Applied Physics Laboratory
Johns Hopkins University
Kent State University
Lehigh University
Louisiana State University
Louisiana Tech University
Loyola College
Marquette University
Massachusetts Institute of Technology
Mayo Foundation
McGill University Internet
Merit Computer Network
Miami University
Michigan State University
Michigan Technological University
Minnesota State University System
Minnesota Supercomputer Center
Mississippi State University
Monmouth College
Montana State University
Muskingum College
National Center for Atmospheric Research
National Technology Transfer Center
New Jersey Institute of Technology
New Mexico State University
New York University
North Carolina Agricultural and Technical State University
North Carolina State University
Northeast Missouri State University
Northeastern University
Northwestern State University
Northwestern University
Nova University
Ohio Northern University
Ohio State University
Ohio University
Oklahoma State University
Old Dominion University
Oregon Graduate Institute
Oregon State University
Pennsylvania State University
Pittsburgh Supercomputer Center
Polytechnic University
Prairie View A&M University
Princeton University
Purdue University
Rensselaer Polytechnic Institute
Rice University
Rochester Institute of Technology
Rockefeller University
Rutgers University
SUNY College of Technology
SUNY at Buffalo
San Diego State University
San Diego Supercomputer Center
Santa Clara University
Seattle University
Southern College of Technology
Southern Illinois University
Southern Illinois University at Edwardsville
St. Louis University
St. Mary's College of Maryland
Stanford University
State University of New York at Stony Brook
Syracuse University
Temple University
Texas A&M University
Texas A&M University - Corpus Christi
Texas Education Agency
The Institute for Advanced Study
The Wichita State University
University of Akron
University of Alabama
University of Alabama in Huntsville

University of Arizona
University of Arkansas Little Rock
University of California
University of California at Berkeley
University of California at Irvine
University of California at Los Angeles
University of California at Riverside
University of California at San Diego
University of California at San Francisco
University of California at Santa Barbara
University of Central Oklahoma
University of Chicago
University of Cincinnati
University of Colorado
University of Connecticut
University of Dayton
University of Delaware
University of Denver
University of Florida
University of Houston
University of Illinois at Chicago
University of Illinois at Urbana-Champaign
University of Iowa
University of Kansas
University of Kentucky
University of Maine
University of Maryland
University of Maryland Baltimore County
University of Massachusetts
University of Michigan -- Computing Center
University of Minnesota
University of Missouri-Rolla
University of Nebraska at Lincoln
University of Nevada at Las Vegas
University of New Hampshire
University of New Mexico
University of North Carolina at Chapel Hill
University of North Carolina at Charlotte
University of North Florida
University of Oklahoma
University of Oregon
University of Pennsylvania
University of Pittsburgh
University of Pittsburgh Medical Center
University of Rochester
University of Southern California
University of Southern California
University of Tennessee
University of Tennessee at Chattanooga
University of Texas at Arlington
University of Texas at Austin
University of Texas at Dallas
University of Texas at San Antonio
University of Toledo
University of Toronto
University of Tulsa
University of Utah
University of Virginia
University of Washington
University of Wisconsin
University of Wisconsin, Milwaukee
Vanderbilt University
Villanova University
Vincennes University
Virginia Commonwealth University
Virginia Institute of Marine Science
Virginia Tech
Wake Forest University
Walla Walla College
Washington University
Wayne State University
West Virginia Network for Educational Telecomputing
West Virginia University
Western Washington University
Worcester Polytechnic Institute
Yale University

Government Agencies

Ames Laboratory
Argonne National Laboratory
Battelle Pacific Northwest Laboratory
Continuous Electronic Beam Acceleator Facility
Department of Energy Richland
Fermi National Accelerator Laboratory

Idaho National Engineering Laboratory
Lawrence Berkeley Laboratory
Lawrence Livermore National Laboratory
Los Alamos National Laboratory
National Energy Research Supercomputer Center
National Institute of Standards and Technology
National Institute of Standards and Technology
National Institutes of Health
National Oceanic and Atmospheric Administration
Oak Ridge National Laboratory
Sandia National Laboratories
Super Conducting Super Collider Laboratory
U.S. Department of Energy
U.S. Department of the Interior
USDA Forest Service- Pacific Southwest Research Station
USDA National Agricultural Library
United States Geological Survey
Westinghouse Savannah River Company
Military Institutions
Air Force Institute of Technology
Army Armament Research Development and Engineering Center
David Taylor Research Center
Defense Information Systems Agency
Defense Logistics Agency
Defense Technical Information Center
Eglin Air Force Base
Human Systems Division
National Computer Security Center
Naval Air Test Center
Naval Air Test Center
Naval Air Weapons Station
Naval Civil Engineering Laboratory
Naval Ocean Systems Center
Naval Postgraduate School
Naval Research Laboratory
Naval Ship Systems Engineering Station
Naval Surface Warfare Center
Naval Undersea Warfare Center
Naval Weapons Center
Naval Weapons Center
Rome Laboratory
U.S Army Corps of Engineers
U.S. Army Research Laboratory
United States Air Force Academy
Wright Patterson Air Force Base

Network Organizations

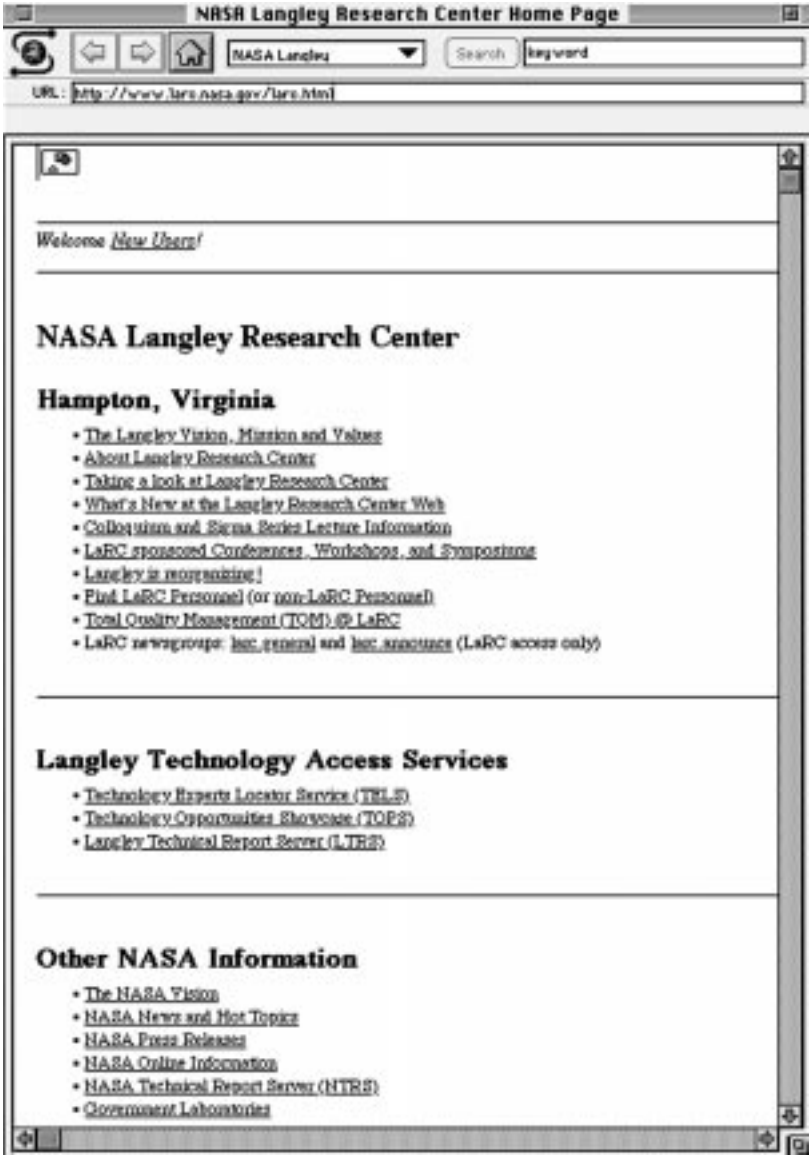
Communications for North Carolina Education, Research, and Technology
Digital Express Group, Inc.
EUnet Ltd
Geschaeftsbereich XLINK
Hong Kong Supernet
Information Access Technologies, Inc.
InteleCom Data Systems
MountainNet, Inc.
NirvCentre
Shadow Information Services
Stichting NLnet
The Internet Access Company
Other Organizations
American Mathematical Society
Capital Area Central Texas Unix Society
Chemical Abstracts Services
Commission of the European Communities
Cooperative Library Agency For Systems and Services
European Southern Observatory
IDA/Supercomputing Research Center
Industrial Technology Institute
Institute for Defense Analyses
International Internet Association
Logistics Management Institute
MITRE Corporation
Microelectronics Center of North Carolina
North Carolina Supercomputing Center
Online Computer Library Center, Inc.
Open Software Foundation
Research Triangle Institute
Software Productivity Consortium
The Information Network of Kansas
The Rand Corporation

Appendix C

LTRS Instructions

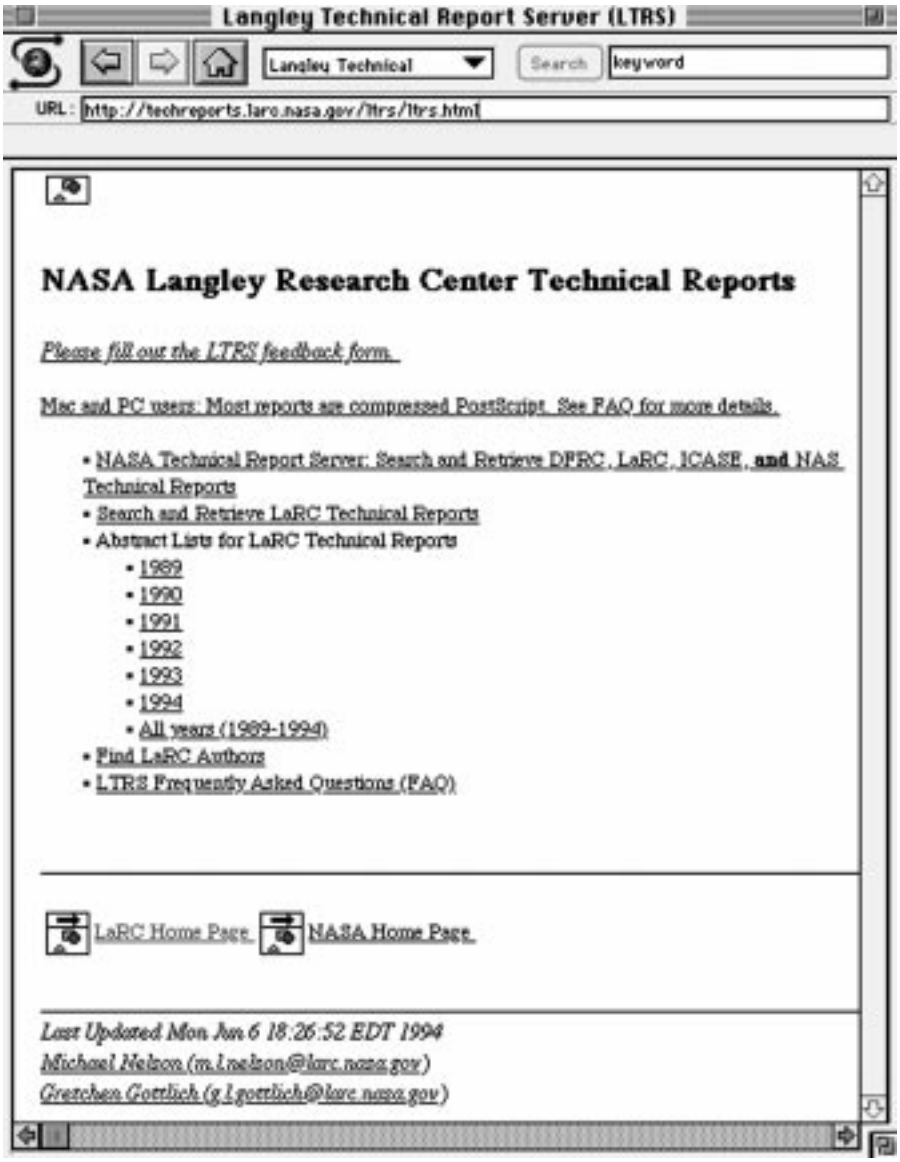
Instructions for Using LTRS on the Mac

STEP 1. Open Mosaic folder. Double click on NCSA Mosaic 1.0.3. If you have the NASA Langley Home Page as your default the following appears on your screen



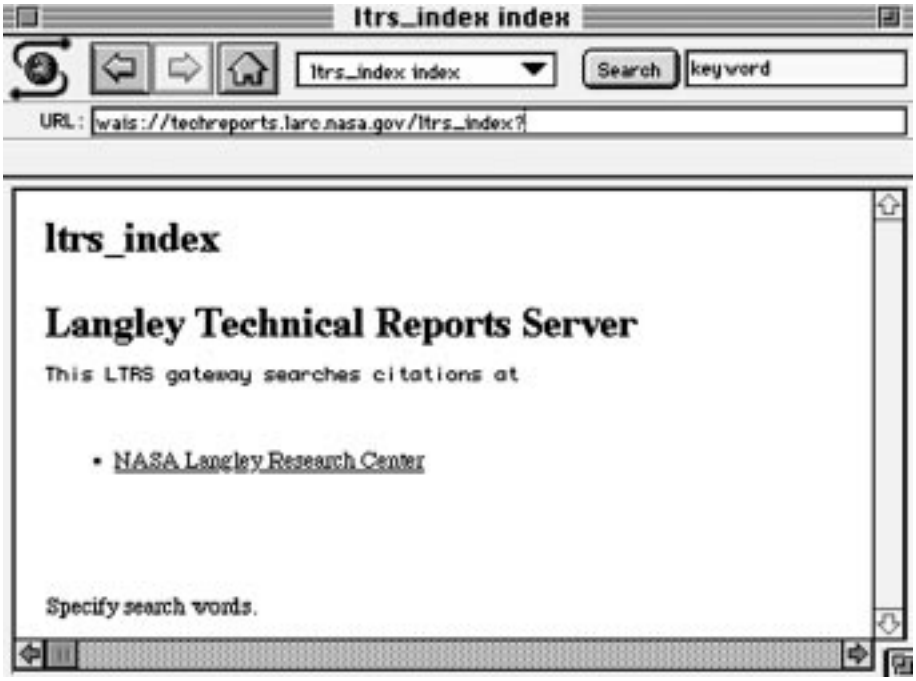
Items are either in black, blue, or symbols. Move the cursor to an item in black - cursor remains the same. Move cursor to item in blue or symbol - cursor becomes a pointing hand. When this occurs you can activiate the item by clicking on the item. Once you look at an item the blue will become red indicating you have already looked at that item. You can still look at it again even though it is red. **NOTE: For B&W monitor, items are underlined for links**

STEP 2 . Click on LTRS. The following will appear on your screen.

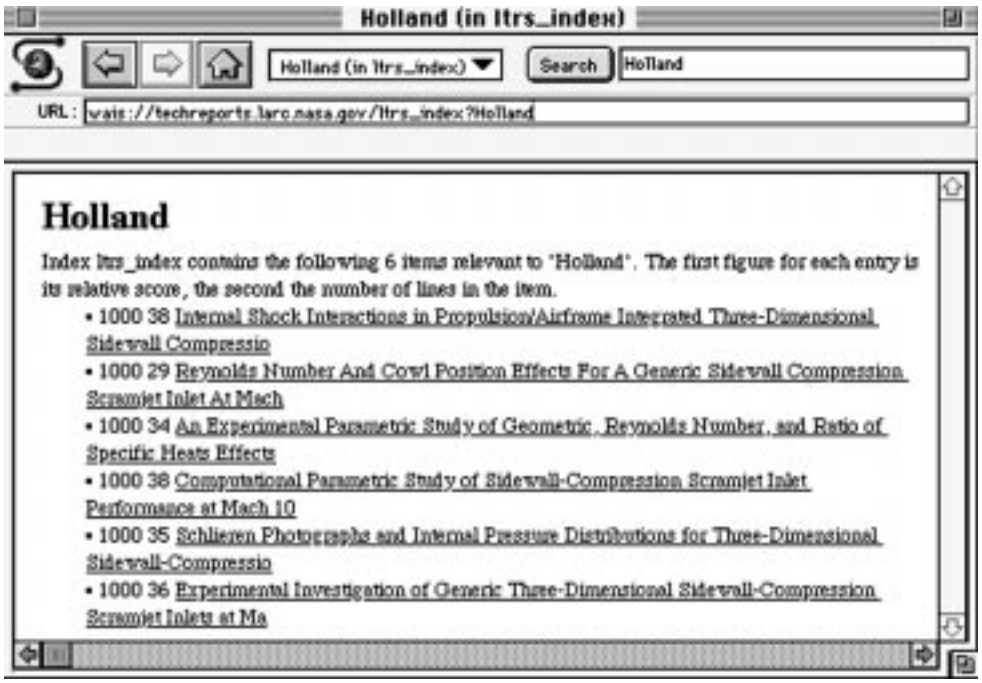


Move cursor to each item underlined in blue. An address appears in the box under the **URL** box.

STEP 3. To Search and Retrieve for a specific name, word, or combination of words, click on Search and Retrieve LaRC Technical Reports. The following window appears



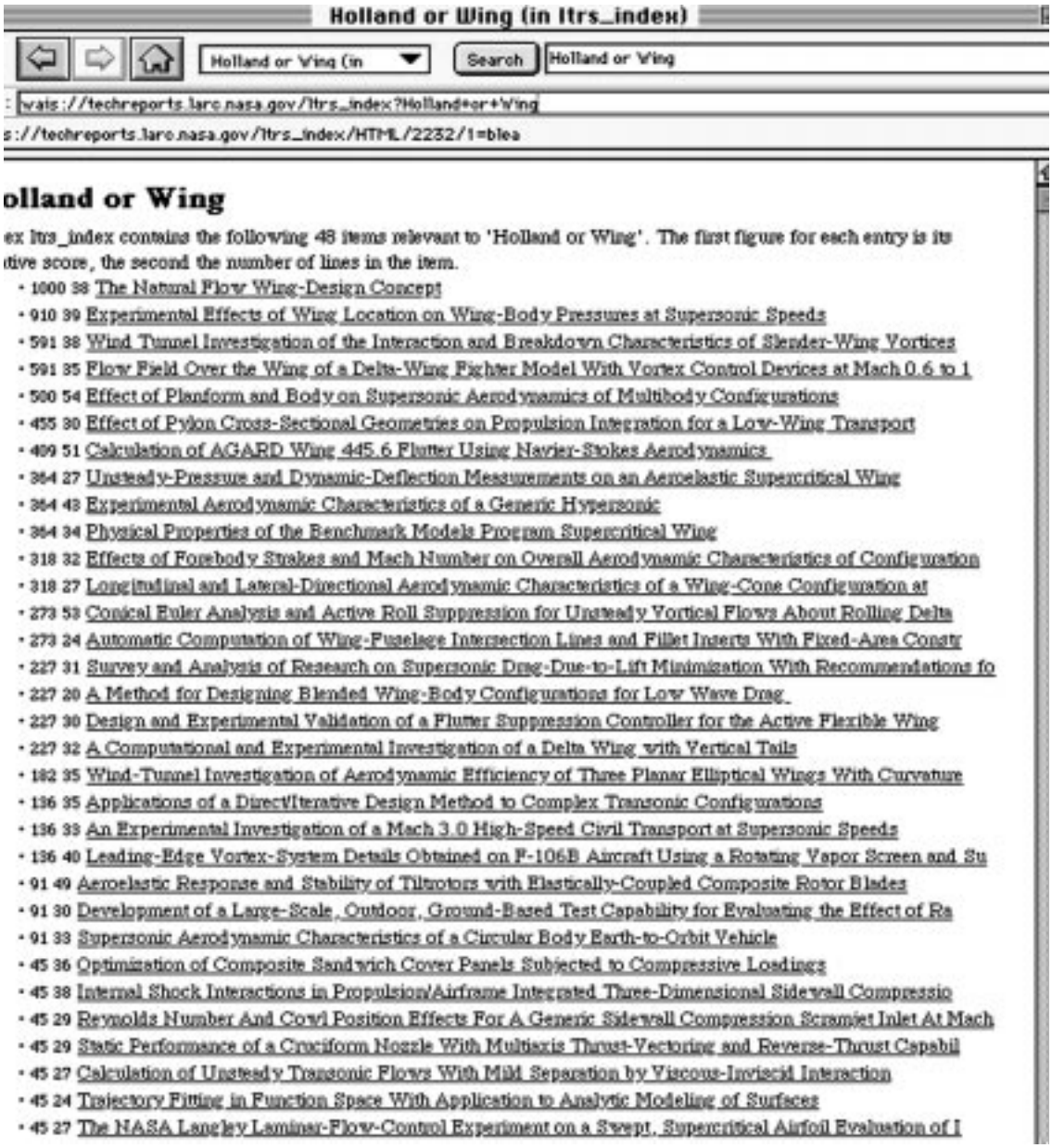
STEP 4. Enter the name or word to be searched in the box next to the Search button on the line with the MOSAIC symbol. Enter Holland and click on Search. The following window appear



The search for Holland found 6 items on ltrs_index

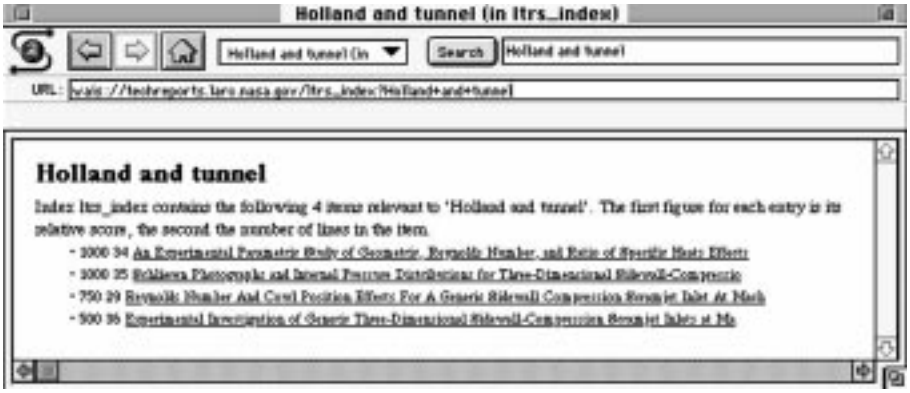
STEP 5. Search for wing. The following appears. Note 42 items relating to wing are found.

STEP 6. Search for Holland or wing. The following window will appear. Note we now have 48 items - the 6 items relating to Holland and the 42 items relating to wing

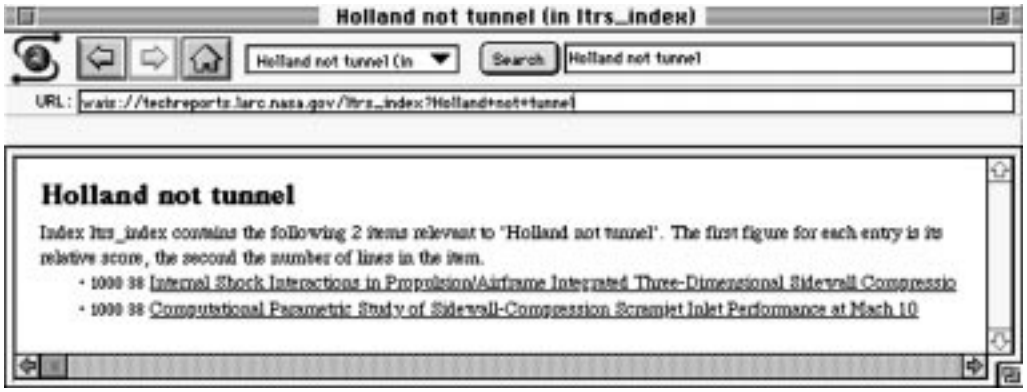


STEP 7. Search for Holland and wing. The following window will appear. Note: no items are found relating to Holland and wing

STEP 8. Search for Holland and tunnel. The following window will appear. Note: 4 items are found relating to Holland and tunnel. This is a subset of the items found in Step 4

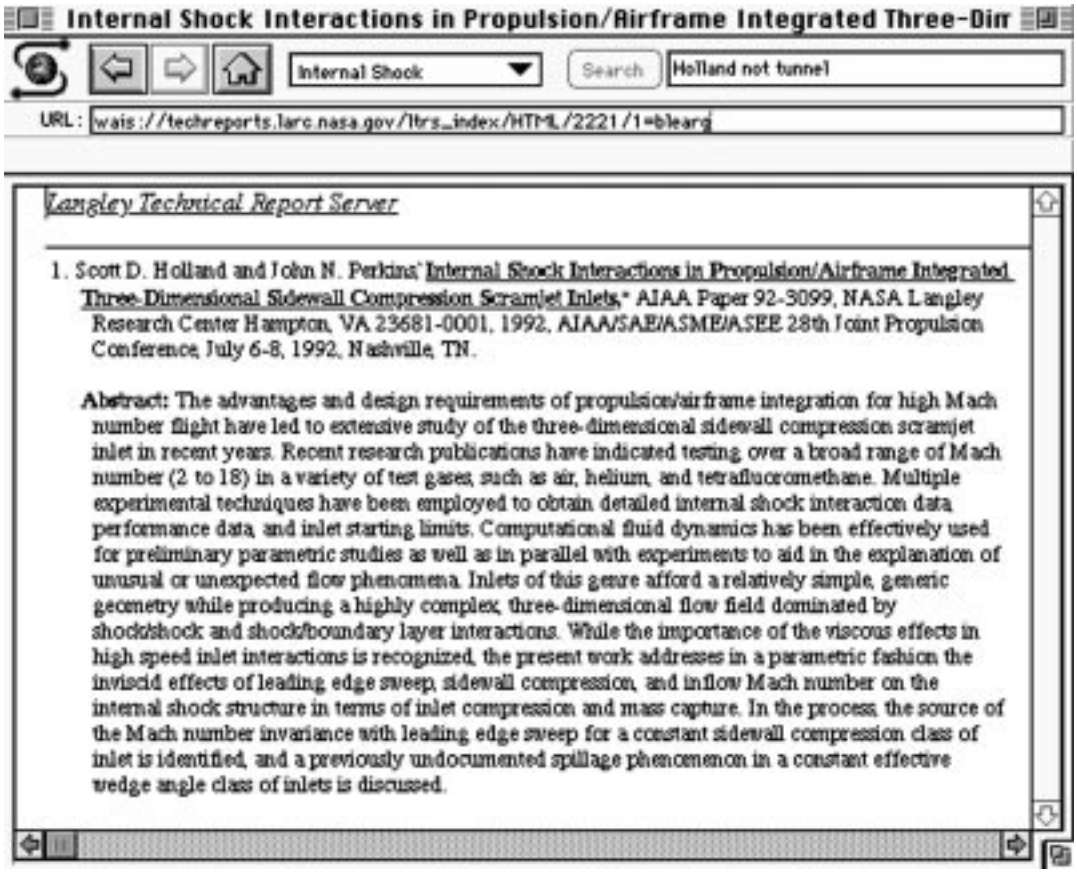


STEP 9. Search for Holland not tunnel. The following window will appear. Note: 2 items are found. This is a subset of the items found in Step 5. These are the other Holland items that do not involve tunnel.

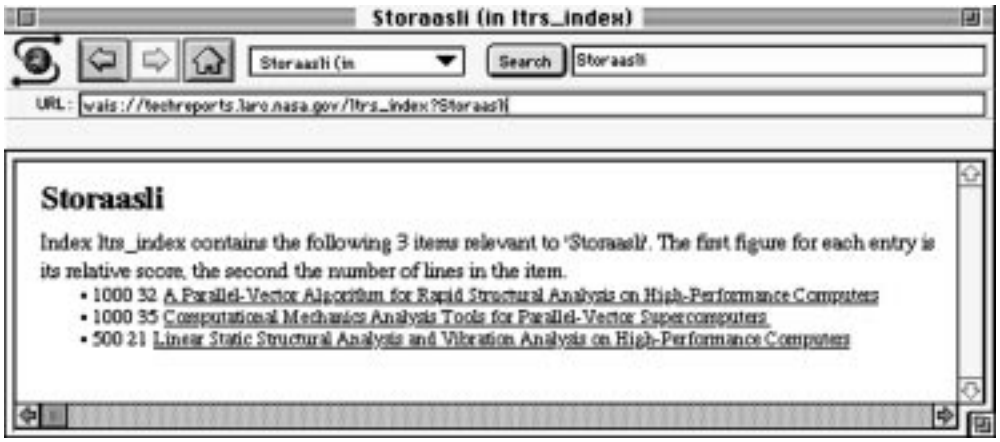


STEP 10. To examine the abstract for an item listed, click on the title of the item (e.g., click on the title of item 10038 " Internal Shock ..."). The following window appears

The entire paper can be retrieved as shown in **Steps 17-19**.

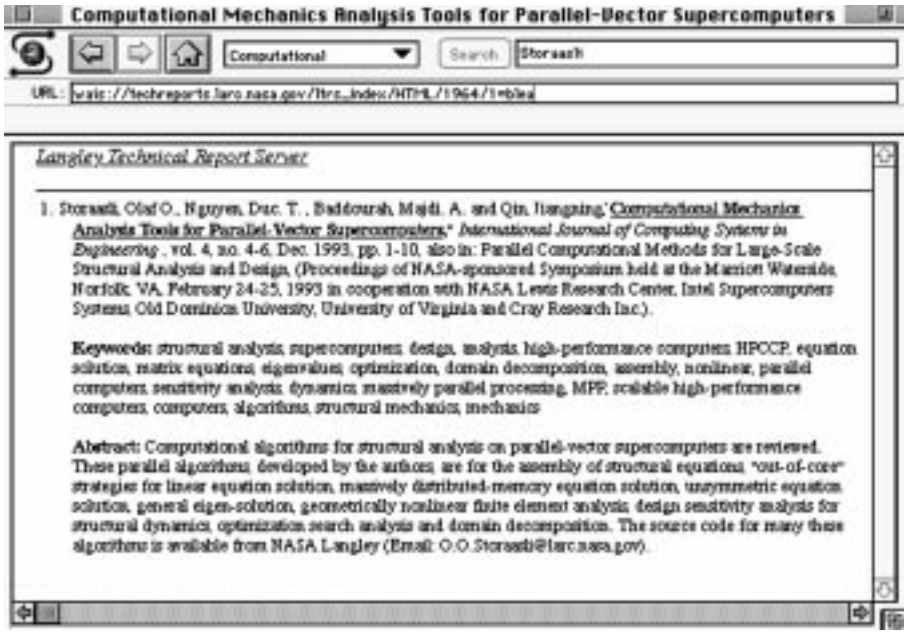


Step 11. Examine an **html** document. Search for **Storaasli**. The following appears.



Note 3 items relating to **Storaasli** are found.

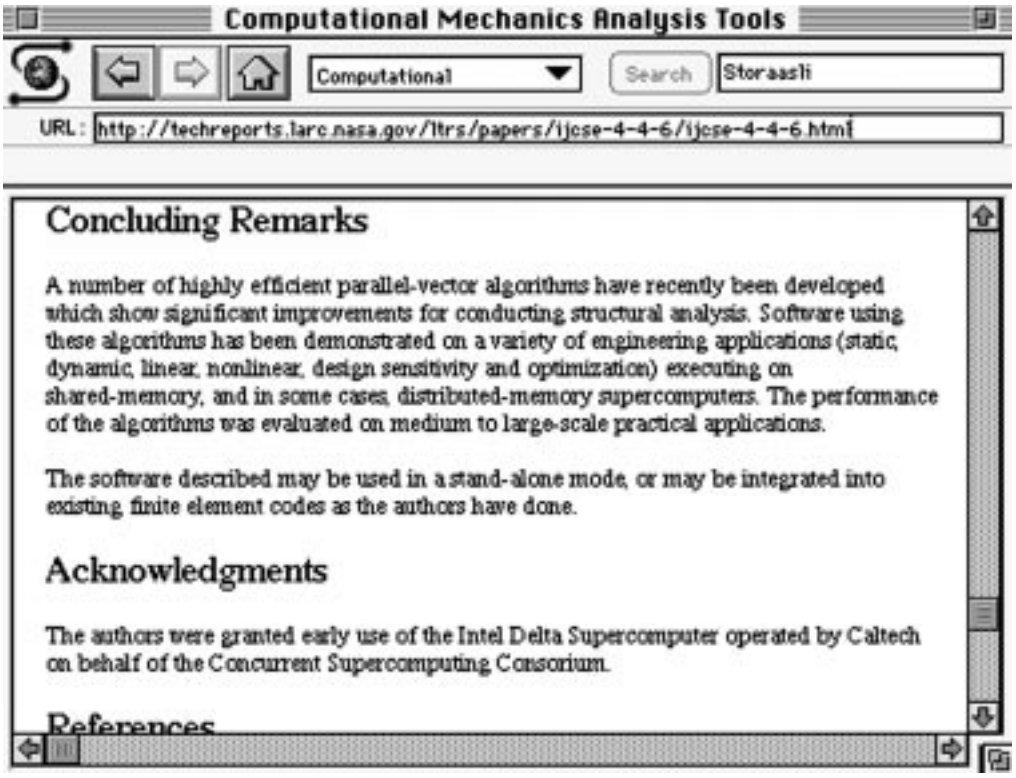
Step 12. Click on **"Computational Mechanics Analysis Tools for Parallel-Vector Supercomputers".** The following appears.



Notice on the line under the Mosaic symbol the following appears
http://techreports.larc.nasa.gov/ltrs/papers/ijce-4-4-6/ijcse-4-4-6.html
This is an **html** document. Click on the title**.** A **Table of Contents** appears.

.

STEP 13. Go to any section of the document by clicking on that item. Click on Concluding Remark



Click on left arrow and you will return to the Abstract entry. If you click on the title, you return to the **Concluding Remarks.** This is a limitation on the **MAC** version of an **html** document. It is better to use the scroll bar to navigate through an **html** document.

STEP 14. Notice on the **Table of Contents** an entry labelled

Postscript Version of Report

First go to **OPTIONS** on the menu bar and enable

LOAD to Disk

Now click on the entry

Postscript Version of Report

A window will appear

Discard Resource Fork: MosaicFile.Z

Click the **OK** box. Your PostScript version is called **MosaicFile.Z** and is found on your hard disk. Go to **OPTIONS** on the menu bar and enable

Turn off Load to Disk

To obtain a copy on your local printer follow **STEPS 19 and 21 (or STEPS 19A and 21A).**

STEP 15. Go back to the page headed LTRS--Langley Technical Report Server. This can be down by several methods

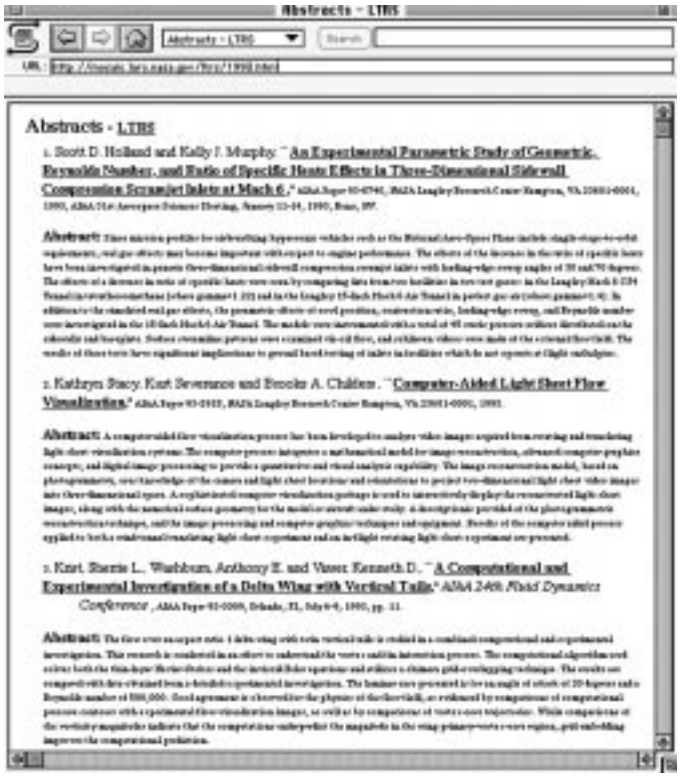
Method 1. Click on the House symbol which takes you back to the home page. Then click on the right arrow symbol.

Method 2. Click on the left arrow symbol until the page appears

Method 3. Go to the box next to the house symbol and hold down the mouse button.

Several labels appear. Move up tothe label **LTRS -- Langley Technical** Report Server (LTRS)

STEP 16. To examine the abstracts by year click on a year (e.g., 1993). All the abstracts for that year appear (as shown below)



STEP 17. To bring up a full report, first go to OPTIONS on the menu bar and enable

LOAD to Disk

STEP 18. Click on any report you want to examine. A window appears and asks you to save the file and name it. You may choose any name xxxxxx but you must use the .Z extension

xxxxxx.Z

The **Z** extension is necessary since the reports are in compressed format and need to be uncompressed. By default this file will be found in your Mosaic folder. Go to **OPTIONS** on the menu bar and enable

Turn off Load to Disk

STEP 19. To uncompress the file xxxxxx.Z. Go to your Tools for Mosaic folder. Drag the xxxxxx.Z icon so it is on the MacGzip icon. The following window appears.

gzip: xxxxxx.Z -> xxxxxx

The **xxxxxx.Z** file is replaced by **xxxxxx** . To obtain a copy of the report on your local printer go to **STEP 21**.

Note: STEPS 18A and 19A are alternatives to **STEPS 18-19**. You may skip **Steps 18A-19A**.

STEP 18A. Click on any report you want to examine. A window appears and asks you to save the file and name it. You may choose any name xxxxxx but you must use the .Z extension

xxxxxx.Z

The **Z** extension is necessary since the reports are in compressed format and need to be uncompressed. By default this file will be found in your Mosaic folder. Go to **OPTIONS** on the menu bar and enable

Turn off Load to Disk

STEP 19A. To uncompress the file xxxxxx.Z. Go to your Mosaic folder and double click on MacCompress3.2. A Progress window appears. Go to FORMAT on menu bar and enable

Unix compress

Go to **FILE** on menu bar and enable

Decompress file

All the files in the Mosaic folder appear. Select the file you want to decompress (in our case **xxxxxx.Z**) and click open. You can watch the file decompression in the Progress window. **xxxxxx.Z** file is replaced by **xxxxxx** in your Mosaic folder. Quit **MacCompress3.2**.

STEP 20. To view the document xxxxxx, double click on MacGS 2.5.2ß2 Runtime *f* folder in your Mosaic folder. Double click on Ghostscript 2.5.2ß3. A window labelled Ghostscript 2.5.2ß3 will appear. In the background a large window labelled Graphics appears. On the menu bar under

MacGS

choose

Open file

Go back tothe Mosaic folder where you saved the file created in **STEP 19 (or STEP 19A)** and open this file **xxxxxx**. On the menu bar under

MacGS

If under **MacGS** you choose

Graphics window

the report is placed in the front window on your screen.

If your cursor becomes a fat cross when placed in the Graphics window, you can advance through the report by

selecting the **apple R** key combination (or **Resume** under **MacGS**)

You cannot go backwards in the report.

If your cursor becomes a thin cross when placed in the Graphics window, you cannot advance through the report.

This report falls in this category. The entire report can be printed as shown in **STEP 17**

Repeat **STEPS 11-17** but this time examine the abstracts in **1994.** This time choose the first paper by **Walsh, et al "A Multilevel Approach ..."**. The cursor is a fat cross . Advance through this report using the **apple R** key combina-

tion (or **Resume** on **MacGS** menu bar).

STEP 21. To print the report on your local printer, do the following.

Go to your **Tools for Mosaic** folder. Drag the **xxxxxx** icon so it is on the **Drop.PS** icon. The following window briefly appears

Waiting for "your printename"

The following window appears until the document is finished printing

Sending xxxxx

STEP 21A is an alternative printing method. You may skip Step21A.

STEP 21A To print the report on your local printer, do the following.

Double click on your **Laser Writer Utility** so that you can down load a PostScript file.

On the menu bar under **Utilites** choose

Download PostScript File . . .

Now double click on the PostScript file you want to print - in this case

xxxxxx

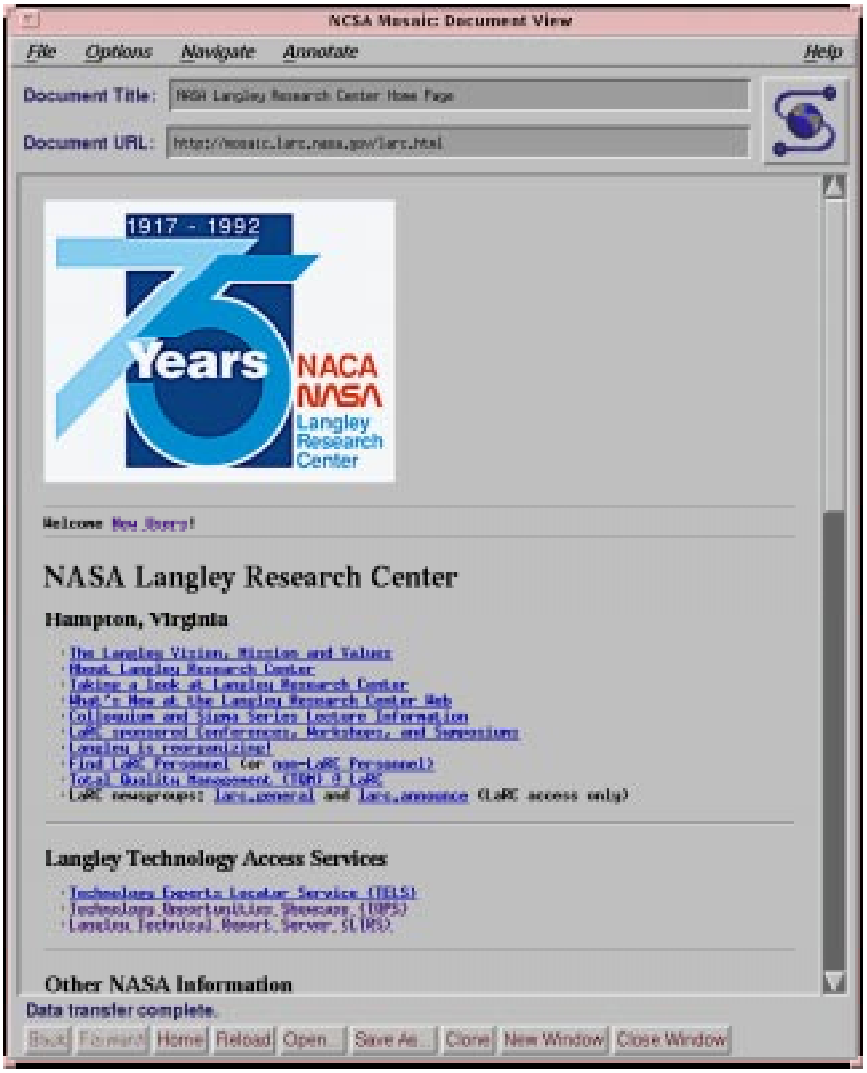
A window appears asking

Save PostScript output as

Choose **OK** or change the name to something else. Errors at printing are saved in this file. If no errors, the file is not saved.

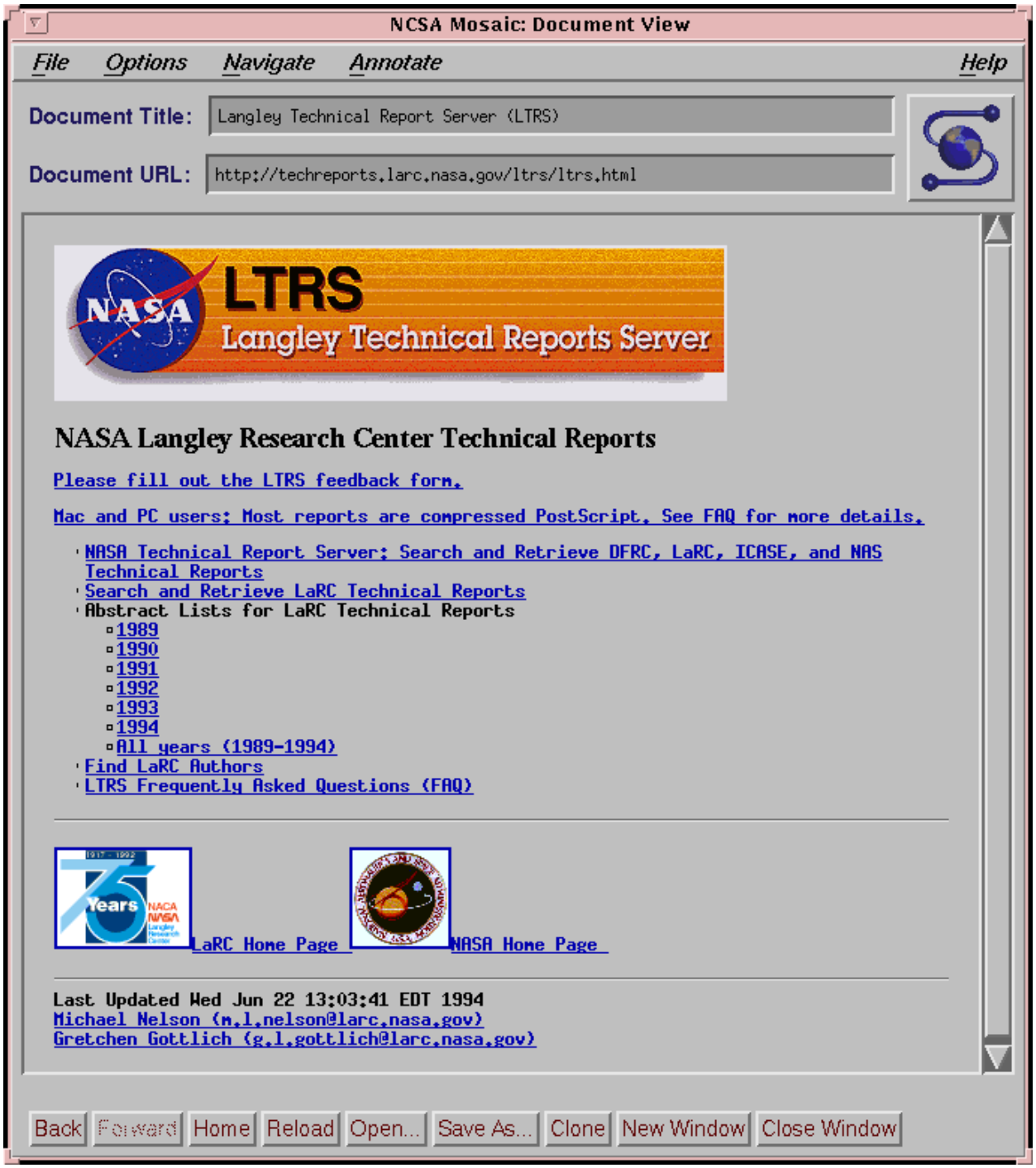
Instructions for Using LTRS on the UNIX

STEP 1. Open a shell tool and type xmosaic. If you have the NASA Langley Home Page as your default, then the following appears on your screen.



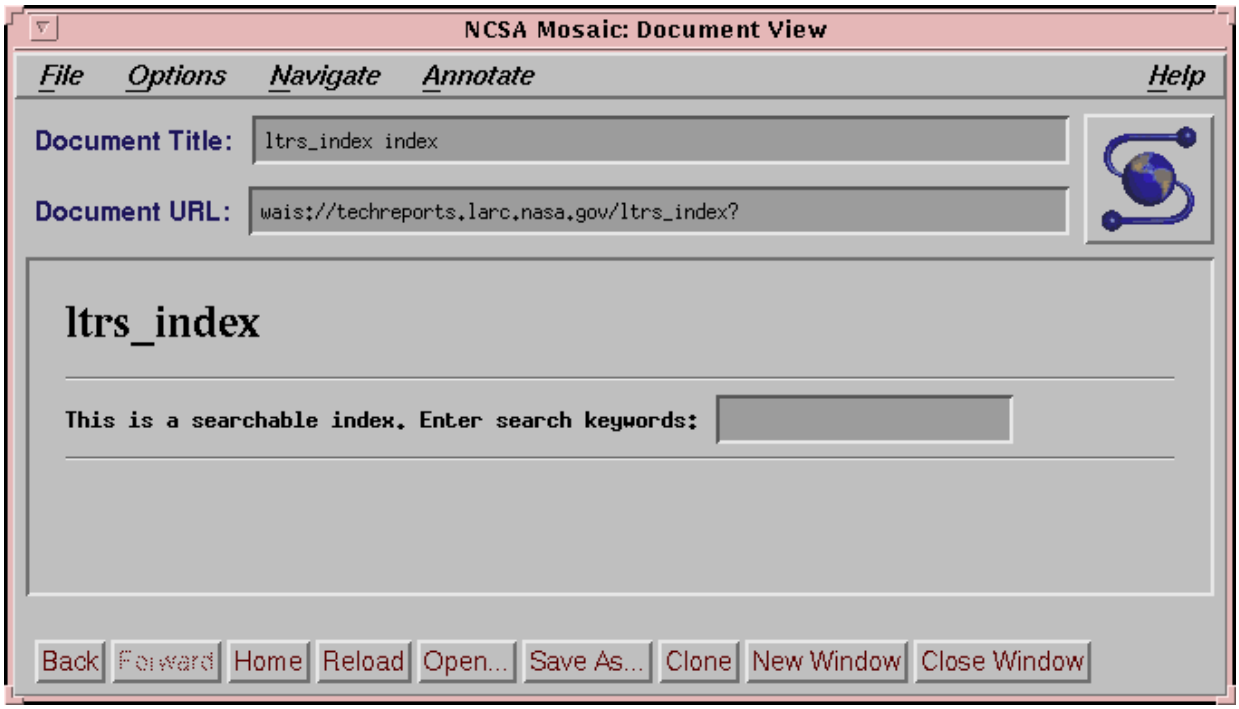
Items are either in black, blue, or symbols. Move the cursor over an item in black, and the cursor remains the same. Move the cursor over an item in blue or a symbol, and the cursor becomes a pointing hand. These items are hypertext links to other text, images, or files. You can activate the hypertext link by clicking the mouse on the item.

STEP 2. Click on LTRS. The following window appears:

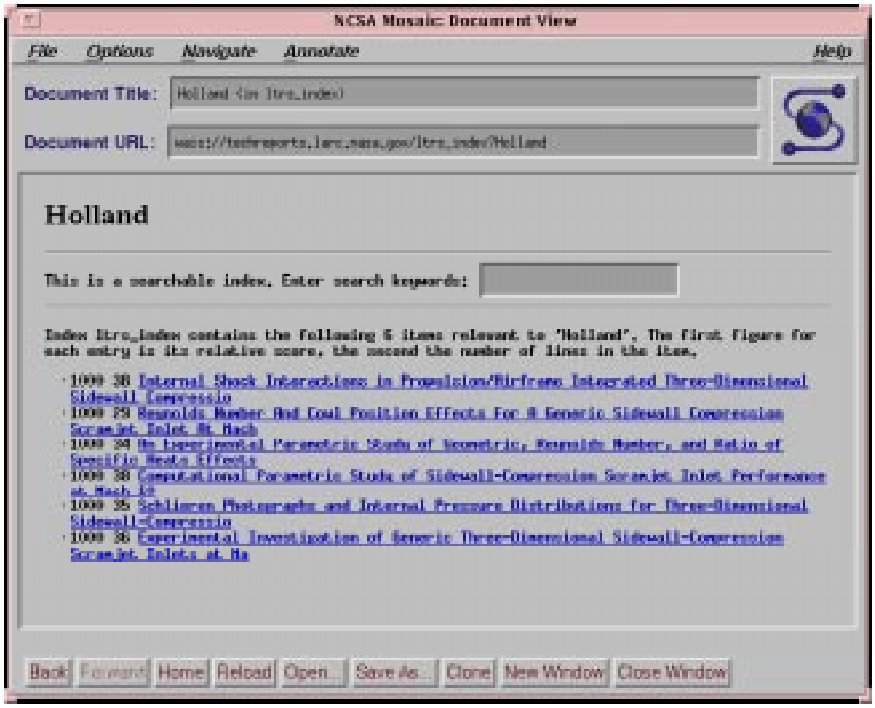


Move the cursor to each underlined item in blue. An address appears at the bottom of the page above the menu buttons.

STEP 3. To search and retrieve a document with a specific name, word, or combination of words, click on Search and Retrieve LaRC Technical Reports. The following window appears:



STEP 4. Enter the name or word to be searched in the box and select return. For example, search for Holland and the following window appears:

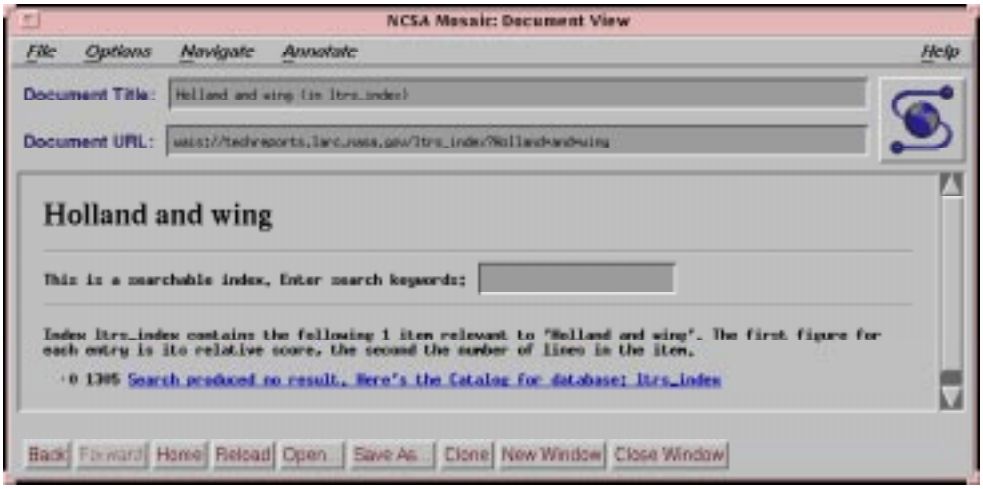


The search for Holland found 6 items in the LTRS index.

STEP 5. Search for wing. The following window appears with 46 items found relating to wing.

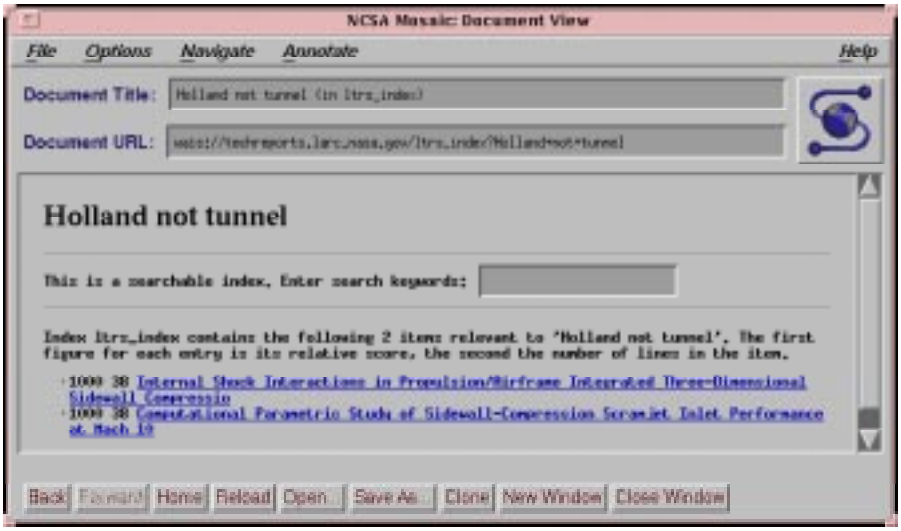
STEP 6. Search for Holland or wing. The following window appears. Note we now have all items relating to Holland and all items relating to wing.

STEP 7. Search for Holland and wing. The following window appears. Note no items are found relating to Holland and wing.

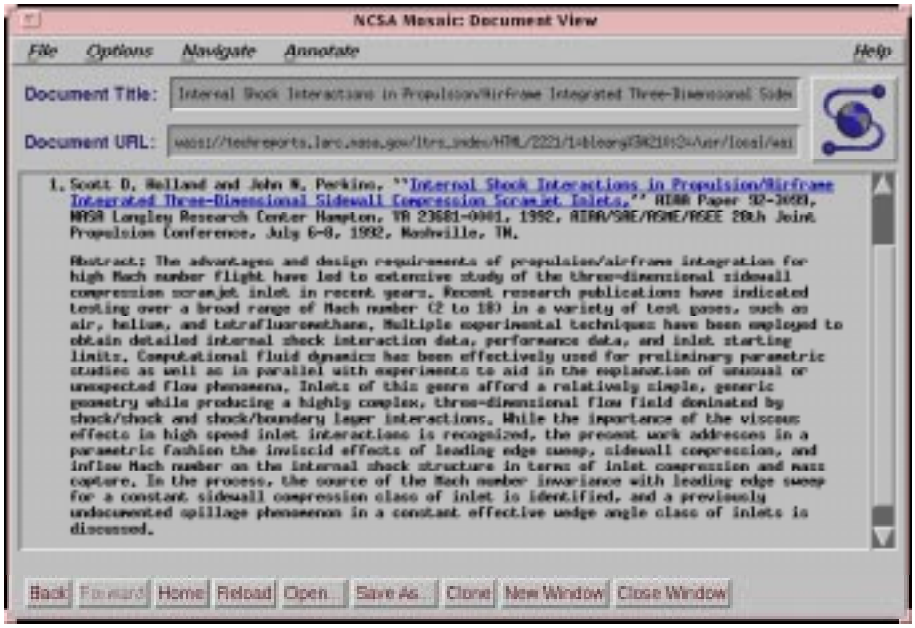


STEP 8. Search for Holland and tunnel. The following window appears. Note four items are found relating to Holland and tunnel. This is a subset of the items found in STEP 4.

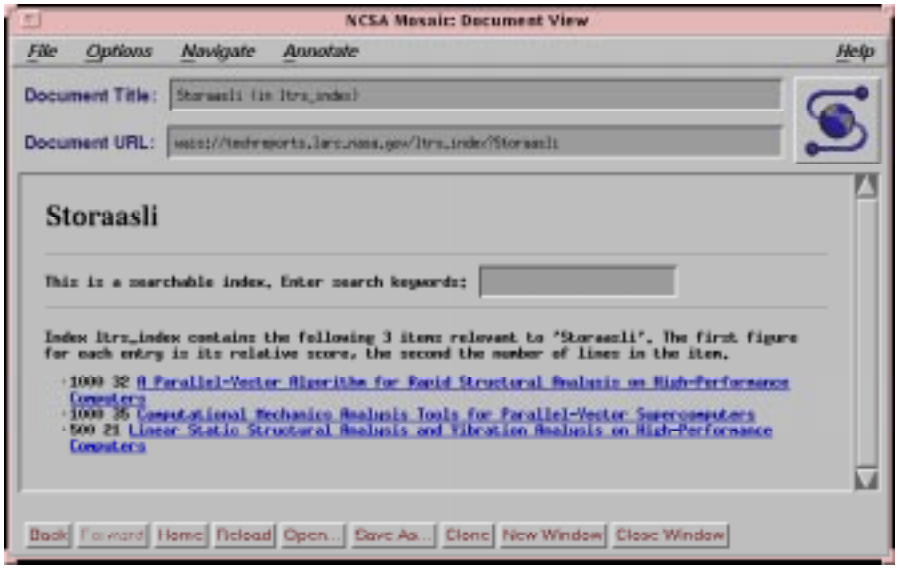
STEP 9. Search for Holland not tunnel. The following window appears. Note two items are found. This is a subset of the items found in **STEP** 5.



STEP 10. To examine the abstract for an item, click on the title of the item (e.g., click on the title of item 10038 "Internal Shock . . ."). The following window appears.

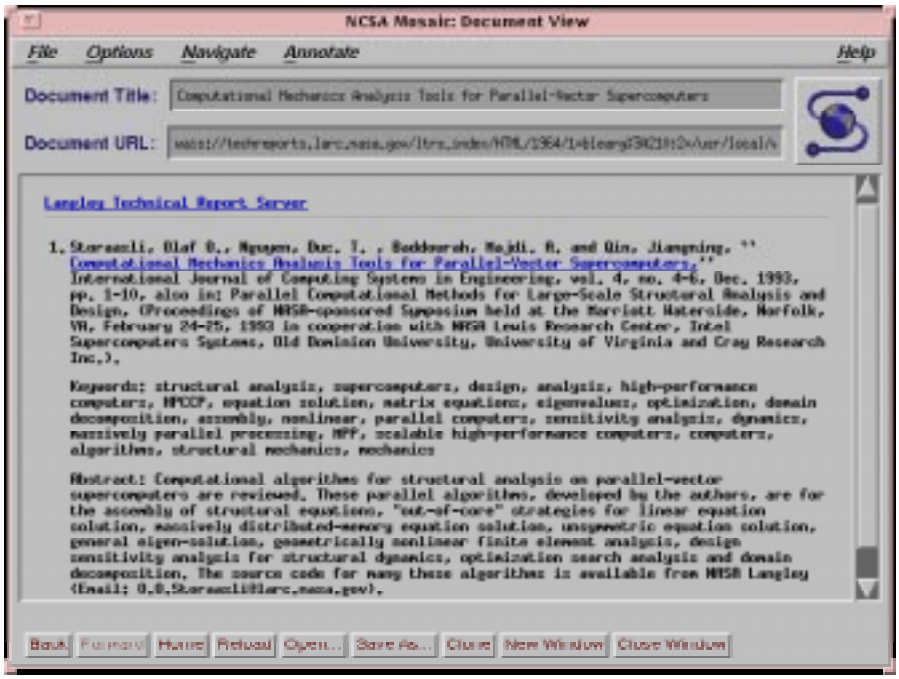


STEP 11. To examine an html document, first click on the back button at the bottom of the page. Then, search for Storaasli. The following window appears.



STEP 12. Click on "Computational Mechanics ... Supercomputers." The following window appears:

y



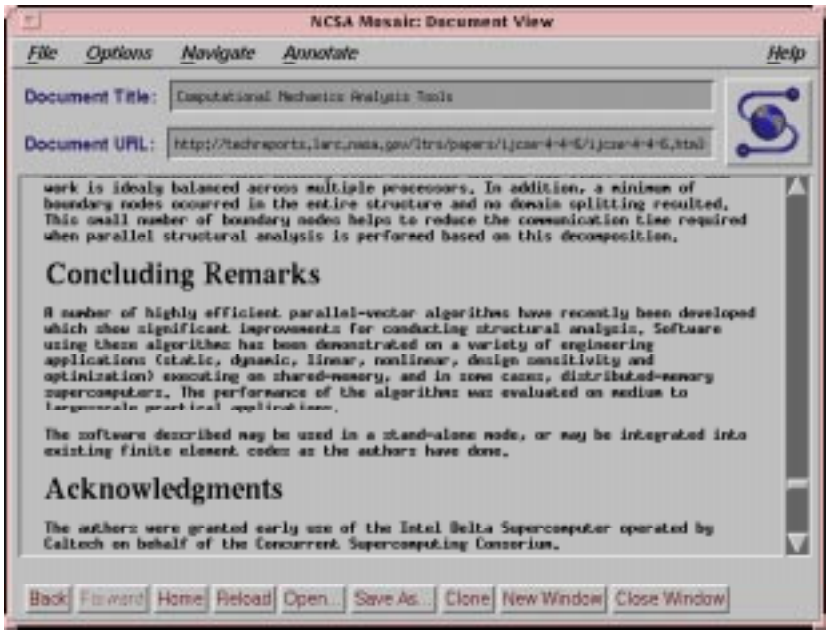
STEP 13. Note when you place the cursor over the title, the following appears at the bottom of the page:

http://techreports.larc.nasa.gov/ltrs/papers/ijce-4-4-6/ijcse-4-4-6.html

This is an html document. Click on the title and the following window appears:

STEP 14. You can go to any section of the document by clicking on the item in the Table of Contents.

For example, click on **Conluding Remarks.**

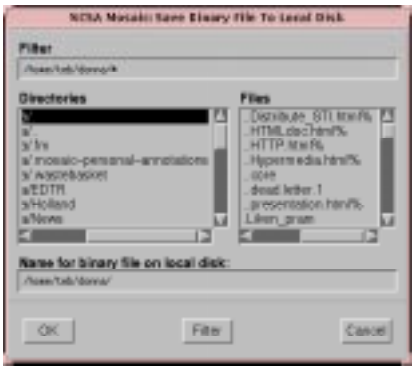


Click on the back menu button and you will return to the Table of Contents. You can also use the scroll bars to navigate through the document.

STEP 15. You can use the Print option under the File menu to print this html document in text, PostScript, or HTML format. You can also use the Save as option under the File menu to save this html document to your disk in text, PostScript, or HTML format.

STEP 16. To print the PostScript version of this html document, perform the following steps:

1. Select **Load To Local Disk** under the **Options** menu.
2. Click on the item **PostScript Version of Report** in the Table of Contents and the following window appears.

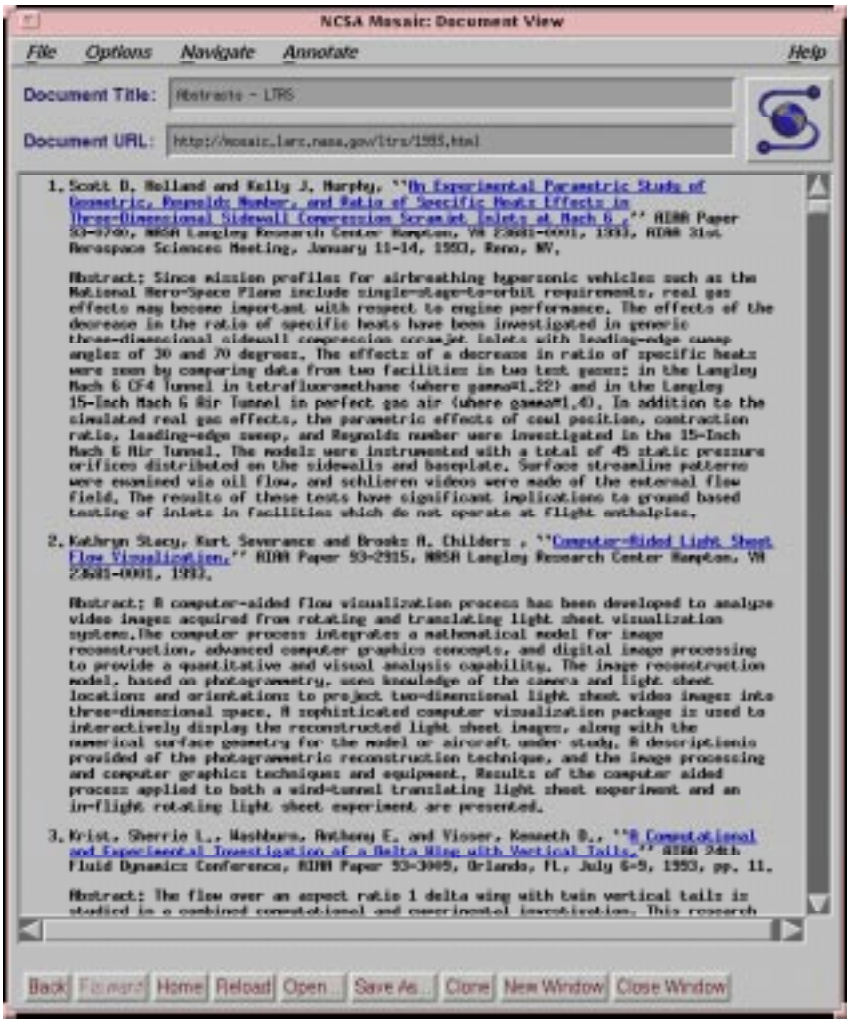


3. Type in any name for the file along with the extension .ps.Z. For example, name the file **Storaasli.ps.Z** and select **ok.**
4. Open a shell tool and type uncompress Storaasli.ps.Z and press return.

5. Type lpr -Pprintername Storaasli.ps and press return.

6. To return to the page entitled *LTRS -- Langley Technical Report Server*, either select the home button then select LTRS or select the back button until the page appears.

STEP 17. To examine the abstracts by year, click on a year (e.g., 1993). All the abstracts for that year appear in the window, as shown below.

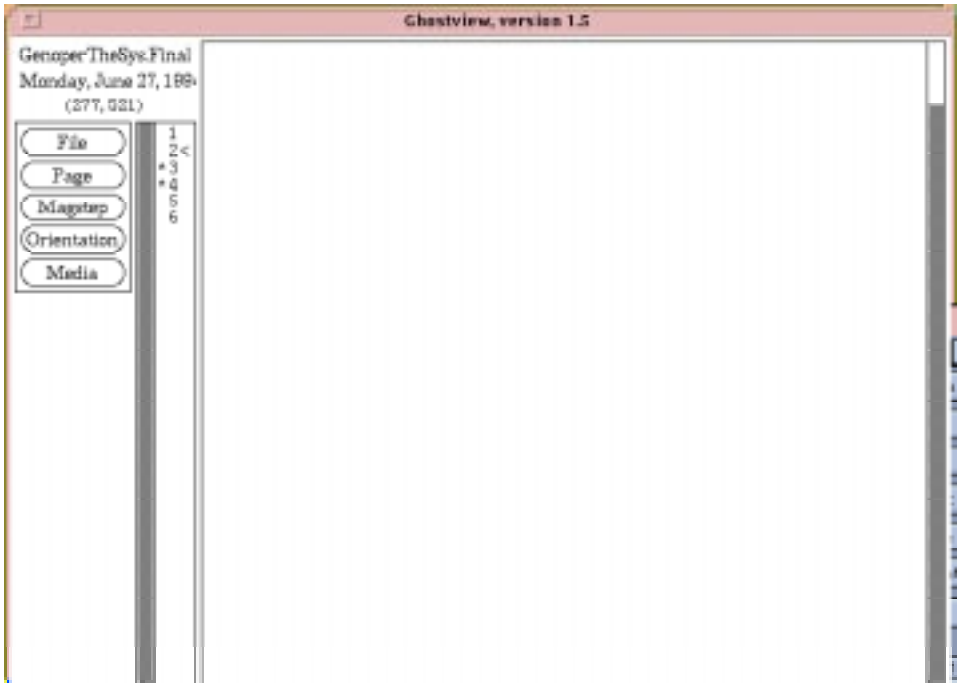


STEP 18. To view a report, scroll down until you find the report that you want to examine (e.g., Genopersisting the System), then select the title of the report. Mosaic opens the report in the application GhostView. Because not all PostScript reports are viewer friendly (but all are printer friendly), you may not be able to view the report. If the report is viewable, you can perform the following functions in GhostView.

1. If page numbers appear next to the menu, you can highlight the page number and then select **Next** under the **Page** menu to go to that page. If page numbers do not appear, you can go to the next page by selecting **Next** under the **Page** menu. (The symbol < to the right of a page number indicates the current page and the symbol * to the left of a page number indicates a marked page.)

2. If page numbers appear next to the menu, you can highlight the page number and then select **Mark** under the **Page** menu. Then, you can select **Print Marked Pages** or **Save Marked Pages** under the **File** menu. If page numbers do not appear, then you can go to a page and select **Print** under the **File** menu to print that page.

2. You can select a number under **Magstep** to change the size of the page or select an option under **Orientation** to change the orientation. (These options may distort the image.)



Instructions for Using LTRS on the PC

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13. ABSTRACT *(Maximum 200 words)*
To demonstrate NASA Langley Research Center's relevance and to transfer technology to external customers in a timely and efficient manner, Langley has formed a working group to study and recommend a course of action for the electronic dissemination of technical reports (EDTR). The working group identified electronic report requirements (e.g., accessibility, file format, search requirements) of customers in U.S. industry through numerous site visits and personal contacts. Internal surveys were also used to determine commonalities in document preparation methods. From these surveys, a set of requirements for an electronic dissemination system was developed. Two candidate systems were identified and evaluated against the set of requirements: the Full-Text Electronic Documents System (FEDS), which is a full-text retrieval system based on the commercial document management package Interleaf, and the Langley Technical Report Server (LTRS), which is a Langley-developed system based on the publicly available World Wide Web (WWW) software system. Factors that led to the selection of LTRS as the vehicle for electronic dissemination included searching and viewing capability, current system operability, and client software availability for multiple platforms at no cost to industry. This report includes the survey results, evaluations, a description of the LTRS architecture, recommended policy statement, and suggestions for future implementations.

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Electronic document dissemination; World Wide Web; Technical report servers; LTRS; Information retrieval

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