The impact of signal processing research and development projects is, to a great degree, hampered by long publication delays, ineffective communication of results within the signal processing community, and the lack of publicly available data—measurements of real-world signals rather than simulations—for evaluating algorithms. A sequence of facts and events has brought these problems into focus.

- The publication delay—the time from paper acceptance to publication—stands today at about one year. The Society’s AdCom has placed this problem at the top of its priority list, but the queue is decreasing surprisingly slowly.

- Few know of the Signal Processing newsletter disseminated electronically from Georgia Tech (sidebar 1). A typical newsletter contains previews of journal contents, workshop announcements, and other "news" items for the signal processing community.

- At the most recent Digital Signal Processing Workshop, two researchers "discussed" the relative merits of their algorithms. When asked if a common set of data was available for comparing algorithms, they said no, but wished it was.

Other research communities have had similar problems, and have found at least a partial remedy in making effective use of the Internet and associated computer networks. After discussions with Dr. John Cozzens, Director of the Circuits and Signal Processing Program at the National Science Foundation, he agreed that the community would be served by an easily accessible, publicly available repository of information: data, software, papers, bibliographies, addresses. Toward this end, the Foundation funded, with AdCom’s endorsement, a proposal to establish SPIB—Signal Processing Information Base—at Rice University. This information base will provide "one-stop shopping" for both the signal processing researcher and the applications engineer. It represents the modern alternative to and extension of the DSP Program book: Data, programs, and papers can be accessed immediately via Internet and the information base will be continually updated (out-of-date material removed as well as new material added). In this way, current research results and interesting (challenging) datasets important to the signal processing community can be sustained over the long term.

We intend for SPIB to provide one of the cost-effective means of strongly impacting signal processing R&D recommended in the Keystone Report on Signal Processing, p. 6:

"The committee also identified several areas where they believed that a moderate investment of energy and money could have a significant immediate positive effect on theoretical and practical signal processing work. These include the establishment of some sort of community-wide, easily acces-
The E-LETTER on Digital Signal Processing} is issued bimonthly (more frequently in the future) and edited by Professors Douglas B. Williams (dbw@eedsp.gatech.edu) and Vijay K. Madisetti (vkm@eedsp.gatech.edu) at Georgia Tech. Items to be included in the e-letter may be sent to either editor. The editors welcome information from as diverse a group as possible. The e-letter's focus is primarily research and academic issues in digital signal processing and telecommunications. The newsletter covers items of interest to the signal processing community.

Articles are welcomed on:

- Conferences: Programs and Calls for Papers
- Funding opportunities
- Thesis abstracts
- Job opportunities (primarily academic)
- People on the move
- Reports on meetings and workshops
- Recent books and publications
- Software releases (non-commercial)
- Any other items that are of interest to the signal processing community

A recent issue's table of contents consisted of

**Awards and Honors**

**Journal Table of Contents**
*IEEE Transactions on Signal Processing*: August, September, October 1993  
*IEEE Transactions on Speech and Acoustics Processing*: October 1993  
*IEEE Transactions on Communications*: July 1993  
*IEEE Transactions on Communications*: August 1993  
*Circuits, Systems, and Signal Processing*

**Special Issues of Journals**
*International Journal of Robust and Nonlinear Control: H and Robust Estimation*

**Conferences and Calls For Papers**
First IEEE International Conference on Image Processing  
Third International Conference on Automation, Robotics, and Computer Vision (ICARCV'94)  
EUSIPCO'94: Special Session on the Higher Order Statistics  
IEEE Signal Processing Workshop on Higher-Order Statistics

**Book Announcements**
*Speech and Audio Coding for Wired and Network Applications* edited by B.S. Atal, V. Cuperman, and A. Gersho

**Electronic Technical Report**
*Toeplitz and Circulant Matrices: A Review* by R. M. Gray

**Thesis Abstracts**
sible library or repository of contributed signal data, and a library of software and algorithms "known to work," such as the old IEEE/ASSP DSP tapes. These, it was believed, would improve the effectiveness of many R&D efforts by removing the need to code and test "building block" algorithms used in the study of more advanced schemes.

This article describes the SPIB project, an overview of the initial contents of the information base, and a discussion of the various ways it may be accessed.

SPIB Overview

Because of the wide variety of information available on SPIB, perhaps the best way to present its contents is through a map of the system's prototypical directory tree (Fig. 1). This directory structure organizes some 5 Gb of disk (soon to be expanded to 10 Gb) located at Internet address spib.rice.edu. The physical computer is a UNIX workstation, and this directory tree literally corresponds to what you will find. At the top level, five directories form SPIB's major subdivisions. Note that SPIB's contents will change; this description merely expresses plans and what is available at this writing.

data: Datasets are subdivided into categories and are intended to be equivalent to archival literature, to be used as standard signals for algorithm evaluation, and to be referenced in articles. Preferred datasets are recordings of actual signals; i.e., integer (or floating point) values produced by A/D converters are stored. Currently available data tend to have long durations and exhibit time-varying characteristics.

Examples of such datasets are factory noise, animal vocalizations, biomedical recordings (EEG, for example), and radar array signals recorded in clutter. Suitability of datasets for the information base is judged by members of the Society's technical committees.

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papers: Rather than serving as an electronic journal, the SPIB repository of technical reports (unreviewed documents, perhaps submitted for publication) is made available to the entire signal processing community less than one week after transmission to SPIB. These papers are grouped according to the Society's broad EDICS categories and can be cross-listed. In contrast to data, new papers should become available almost daily. Interested signal processing researchers will receive weekly notification of newly submitted papers' titles and authors.

software: Representing a modern version of the Digital Signal Processing Program book, program sources (Matlab®, C, Fortran) are stored so that newly published algorithms and signal processing environments can become more accessible to the community. Thus, we hope the signal processing community will rely on SPIB, as a viable alternative to journals and magazines, for publishing algorithm and design software.

misc: To provide general information, SPIB will contain an address list of signal processing researchers, bibliographies, and other items.

info: All of SPIB's information files describing access and submission procedures are kept in this directory.

Storage formats

In virtually all cases, information on SPIB is stored in ASCII. For data, in particular, we chose this method rather than binary fixed-or floating-point representations. Related files are kept together in tar archives. To save space, these and single files are then passed through UNIX's data compression program compress. Macintosh and PC-compatible versions of compress and tar are available on SPIB in the software section.

Data

All data are stored as compress'ed ASCII files. The signal values represent their original form (actual values generated by the A/D converter in the sampling process), or as close to this as possible. All samples taken at the same sampling time should appear on the same line, separated by at least one space. In this way, multichannel data as well as single recordings can be expressed by a common format. This format allows Matlab users to read a data file directly, creating a matrix of recordings. Each data file includes a preamble specifying:

- A brief description (title) of the data
- How the signal was acquired: sample rate, presence and
description of any filters or prefilters, description of pre-emphasis or other types of conditioning applied to the signal

- Where the signal was acquired: as complete a description as possible of the environment in which the signal was recorded
- Creator and submitter of data: how to reference the data, whom to contact for further information.

Papers

Each paper is stored in one of two ways: either the source, with TeX and its offshoots (particularly LaTeX) as the standard format for text and PostScript the format for included figures, or the formatted output of the entire paper expressed in PostScript. When transmitted to SPIB, each paper is assigned a paper# according to the year, month, and relative time of submission; for example, the thirteenth paper submitted in August of 1993 is assigned the number 9308013. The text of the paper is stored in a file named paper#.abs. A paper’s figures are merged with the source into a single tar file. The preamble of a submitted paper contains, in unformatted text, the paper’s title, authors, and abstract. This information is stored in a file named paper#.abs. The abstracts of a month’s submissions are merged into uncompressed ASCII list files for browsing.

Software

We welcome algorithmic, design, and simulation software on SPIB. The sources for a given software system will be placed in a single tar file and compress’ed. We are reluctant to impose language standards, and rely on the programmer to produce portable programs.

As with the DSP Program Book, examples should be included so that the person installing the software can determine if installation errors exist. Review mechanisms will be established for programs to determine their utility.

**Accessing SPIB**

Although each information category has its own peculiarities, information retrieval procedures have been designed to be as similar in “look and feel” as possible. To begin and to obtain detailed instructions on obtaining any of SPIB’s entries, send electronic mail to spib@rice.edu, with the message’s subject containing the single word “help.” A program, known as the mailserver, responds to your request, sending instructions on obtaining more specific information.

Generally, indexes and searches are available through electronic mail, ftp, and gopher. Papers and general information can be obtained through the same means, but data and programs more than likely require use of anonymous ftp or gopher (see table).

Gopher

Gopher represents an exciting, interactive way of retrieving all kinds of information (sidebar 2). Gopher servers, the one at SPIB being but one example, run on computers throughout the Internet. Information about them is obtained by your local gopher program (the X-windows variant is known as xgopher), which searches throughout the network to satisfy your information requests. Through gopher, any of SPIB’s entries can be retrieved.

Anonymous ftp

Anonymous ftp (sidebar 3) can be used to access SPIB in a more tedious and almost as capable fashion when compared to gopher (keyword searches cannot be performed in ftp). You can use ftp’s commands to browse the directory structure, retrieving any interesting files. Because virtually all files are stored compress’ed, binary transfer mode must be enabled.

Using ftp within a shell script can also allow you to request

Internet Gopher is a distributed document delivery service that allows users seamless access to various types of information residing on multiple hosts. The information source is generally transparent, with data supplied from world-wide locations as easily as from a local server. Gopher accomplishes this interface by presenting the user a hierarchical arrangement of documents and by using a client-server communications model. The Internet Gopher Server accepts simple queries, and responds by sending the client a document or stream of data. Typical selections available on gopher include:

- Current catalogs from libraries across the world
- Current Contents abstracts, indexing the latest scientific and engineering publications
- Up-to-the-hour weather forecasts, maps, and satellite pictures
- National Science Foundation award abstracts, publications, and information
- Phone directories of thousands of people (at least) who are somehow associated with gopher server sites
- Descriptions and “survival guides” associated with a large number of universities and cities

The gopher software for various platforms is available (free of charge) via anonymous ftp from boombox.micro.umn.edu in the gopher directory. Gopher is a creation of the University of Minnesota.
Table: Accessing SPIB

<table>
<thead>
<tr>
<th>SPIB Service</th>
<th>e-mail</th>
<th>gopher</th>
<th>ftp</th>
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<tbody>
<tr>
<td>browse directories</td>
<td>✓</td>
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<tr>
<td>search keywords</td>
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<td>retrieve data</td>
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<td>retrieve papers</td>
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*E-mail must be sent to establish data and software submission procedures.

To connect to SPIB via anonymous ftp, use:

```
prompt% ftp spib.rice.edu
Name: anonymous
Password: username@internet_address

Once connected, you can browse SPIB's directories using ftp's commands (cd, ls, dir, and so on). You can also get any .list files that correspond to directories of interest. To transfer data or papers, be sure to use ftp's binary command.
```

- The `find` command allows for keyword searches within each of the five main categories of information maintained at SPIB today.
- Announcements of recently submitted papers will be made roughly every week through the same electronic mailing lists used for Georgia Tech's Signal Processing Newsletter and through the Usenet signal processing bulletin board (comp.dsp).

- We intend to establish a SPIB column in Signal Processing Magazine, detailing updates, presenting access and information statistics, and changes in structure. A portion of this column will be devoted to informing new community members of the fundamental ways to access SPIB.

Summary

The information base should provide both applied and research signal processing workers easy access to a vast amount of data, signal processing tools, and up-to-date results. The access tools are standard, allowing anyone with an Internet connection to obtain information. We find `gopher` an exciting new way of obtaining information; in our experience, once you start using it, your workstation becomes an even more valuable tool.

We hope that the data portion of SPIB will be especially valuable. Sub-communities within the signal processing field might well settle on particular datasets as particularly challenging. Note the focus on data, not artificial signals. Although testing an algorithm on a small set of signals cannot probe its capabilities, making actual data available for evaluation should make algorithm development more pertinent, even inspiring algorithms that can encompass a wider variety of situations. Furthermore, researchers should be able to mix datasets to create quasi-artificial ones. Noise data can be added to speech in a controllable, easily specified way so that other workers can reproduce to test their algorithms. One consequence of this mixing is avoiding the emptying over defining the signal-to-noise ratio of a given dataset: the resultant SNR could be quoted, but specifying the explicit gains applied to each SPIB dataset constitutes a precise description of how the test signal was created.

SPIB will not house all types of data. Because the speech processing community already has a well-established database, only selections of speech data will be maintained at SPIB for the general community. Furthermore, images will not be housed at SPIB. The image processing community is working to establish an Internet-accessible repository of a variety of images, the size of which would easily swamp SPIB's envisioned 10 Gb storage capacity. However, `gopher` does offer mechanisms for linking databases to appear as portions of one. If `gopher` does become more commonly used, perhaps the various databases should consider unifying under this access mechanism while maintaining separate identities. What we do want are single- and multi-channel data from a wide variety of sources. If you have data of potential interest to the community, don't hesitate to submit

Electronic mail

Electronic mail (e-mail) is the most pervasive way the technical community accesses the Internet. Thus, we allow access to nearly all SPIB services through e-mail. Though it is tedious to send sequences of e-mail messages to browse and acquire information, SPIB can be accessed in this way.

Binary files are transferred by the `uuencode` routine. Upon receipt of an e-mail message containing a paper, for example, the user must then `uudecode` the message, then `uncompress` and `untar` the result. Statistical studies show that the size of the e-mail message is actually about 30 percent of the final file's size.

SPIB Announcements

We have established several information mechanisms to keep the signal processing community informed of what resides at SPIB and what new has been added.

- The `list` command available through electronic mail and `gopher` allow users to obtain complete listings of a given directory's contents.
it to SPIB. We are establishing a dataset review mechanism through the Society’s Technical Committees to reduce redundancy.

Our concept is that data should be as referential as papers, with reference made to the precise portion of a particular dataset used in algorithm evaluation. We have written a set of Matlab programs for previewing datasets in elementary ways. For example, short-time Fourier analysis and waveform displays would be provided. In writing these programs, we have adopted a Matlab-inspired convention for referring to data segments: If `filename` is the dataset’s name, `filename(m1:m2)` refers to samples `m1` through `m2` inclusively in one-dimensional signals and `filename(m1:m2,n1:n2)` refer to samples `m1` through `m2` inclusively of channels `n1` through `n2`.

Although not all kinds of data are maintained at SPIB, papers from throughout the signal processing community are welcomed. We have used the Society’s EDICS categories to organize papers; this choice does not imply that only papers being considered by the Society’s various Transactions are welcome. Rather, technical reports and preprints of papers submitted to or accepted by any journal are welcome, so long as they pertain to signal processing.

We will not review papers. In fact, transmitting papers to SPIB is limited to electronic mail because software completely handles the files, reading the header, creating the `abs` file, placing each paper in the proper directory, and creating the list of recent submissions. We can handle a rather large submission volume this way and should have enough disk space to store papers for the next several years.

One side effect of maintaining a repository for papers in standard formats is imposing a word processing environment (TeX) on the community. Informal polls of Associate Editors of the Transactions suggest that a large majority of submitted papers have been formatted that way (the Computer Modern font is quite revealing). Because we do want to serve the entire community, we will support the somewhat less restrictive, but “fatter” PostScript post-formatted output. Pre-formatted source will always be smaller and the same material can be more efficiently stored that way.
However, papers expressed in WYSIWYG formatting systems common on personal computers can also be maintained if they produce PostScript. Over time, we will accumulate statistics and perform surveys to determine which, if any, format the community prefers.

By endorsing the NSF proposal that supports SPIB, your Society’s elected AdCom representatives have implicitly recognized the community’s needs for timeliness and access to data. Although SPIB is not an official part of the Society, we will report SPIB’s activities to AdCom. If you use the information base, please let us know what you think of it and how it could be improved; send mail to spib@rice.edu with a subject line containing the word “comment” and the body expressing your thoughts. To learn how to submit or acquire material, send mail to spib@rice.edu with the subject line containing “help.”

Acknowledgment

This work was supported by NSF Grant MIP-9301646.

Prof. Don H. Johnson and Patrick Nabeel Shami are with the Department of Electrical and Computer Engineering at Rice University, Houston, TX.

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