

## Chapter 43

# LITERATURE SEARCHES

A design, development, or research engineer often must search for information on existing know-how to solve a problem efficiently. The most current information is generally found not in textbooks, but in technical journals. The search for this information involves several techniques: initial search, systematic search, backward search, and forward search.

### 43.1 Initial Search

Before you can do a successful systematic search, you have to survey the terrain and figure out a search strategy. This is the hardest and most discouraging part of the search—because progress is sporadic—but will pay off sooner or later. It involves prowling around in libraries or on the Internet:

- Ask colleagues whether they know of recent literature on your subject, in the hope of finding a book or a paper which helps you identify the **technical community** or **conferences** dealing with your problem.
- Search library catalogs, on-site or via the Internet,<sup>1</sup> and book sellers<sup>2</sup> for books from which you can learn the technical background, current **terminology**, and **subject headings** used in describing your problem.
- Skim through the subject area in index journals and bibliographies. The *Engineering Index* in bound volumes goes back to 1884, and for recent years is available electronically and on CD-ROM as the *Compendex* database. *Science Citations Index—Subject Index* goes back to 1955. You may stumble across an important paper, but the main objective at this stage is to identify **key terms** used in the titles, and/or recurring **authors** in your field, and/or core **journals** publishing on your subject.

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<sup>1</sup> e.g., <http://www.library.okstate.edu/liblink.htm>

<sup>2</sup> e.g., <http://www.crcpress.com/>

- Look for bibliographies within textbooks, articles in the *Annual Review of Fluid Mechanics*, etc., feature review articles in *Applied Mechanics Reviews*, and other abstracts journals; if you are lucky and find your subject, you will have a whole list of references.
- Skim through the tables of contents of recent journals in the appropriate general area; this can be done most easily through *Current Contents*. Appropriate journals might include *Trans. ASME Journals*, *AIAA Journal*, *J. Sound & Vibration*, etc.

By the end of the initial search, you might have found some interesting papers; you will certainly have become familiar with words and names that might make good search terms.

## 43.2 Systematic Search

The techniques used in the initial search required you to skim through a lot of material, because the classification of that material into subject headings is rather general. The next step is to focus on specific terms, keywords, authors, and/or journals.

Since the early 1970s it has been possible to carry out computer searches of literature databases (such as *Compendex*<sup>3</sup> in engineering) much more precisely—not only by author or tabulated keyword, but also by any word used in the title or abstract. This capability was first brought to libraries over telephone modems by providers like *Dialog*<sup>4</sup> (and to individuals by *Knowledge Index*). More recently, many libraries acquired databases on CD-ROM for convenient on-site searching. *Compendex* is now also available on the Internet for subscribers to *Engineering Information Village*.<sup>5</sup> In addition, you should search for dissertations.

Finding the right search terms is a trial-and-error process. The database search engine maintains a thesaurus listing all the available search terms. You will save a lot of wasted effort by using the command for looking up search words so that you can examine the ones next to them in the thesaurus, to make sure you don't miss slight variants of the words. At this point, you want to be sure you have broadened the search sufficiently to include almost all pertinent papers.

You should also find out whether you can use asterisks or question marks as “wild-card” letters which allow alternative endings to search words, so you don't miss a paper just because it uses the plural of a search word.

If you use only a single search term, you will often get far too many “hits” for you to look at. If that happens, you should refine the search by using the code for

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<sup>3</sup><http://ei.telebase.com/m/cpx.htm>

<sup>4</sup><http://www.dialog.com/>

<sup>5</sup><http://www.ei.org/>

the Boolean “**and**” command. For example, if you are interested in “flow-induced vibrations in heat-exchanger tube bundles,” you might search “vibration **and** tube” so that only papers using *both* of these terms in the front matter will be listed in the output; obviously you should try several other combinations and examine which one gives the best yield of truly pertinent papers. On the other hand, if you include all possible terms “flow **and** vibration **and** heat-exchanger **and** tube **and** bundle,” you will probably get hardly any hits at all, and miss many papers that don’t happen to use all of these words. A good search phrase yields most of the pertinent papers, without too much chaff. There will always be some chaff: a search phrase that yields papers on active-suspension systems for automobiles and railcars, may also get you a paper on the settling-out of solutions and suspensions of chemicals in railway tank-cars.

Your Initial Search in Section 43.1 should have alerted you to the fact that different research groups use different language for describing the same problem. One man’s “tube bundle” is another man’s “cylindrical array;” you can include both by using the code for the Boolean operator “**or**” combined with parenthesis symbols. For example, an improved search phrase might read “(vibrations or whirling) **and** (tubes or arrays).”

When you have developed a suitable search combination, you will obtain a manageable set of pertinent papers. Reading the titles will narrow it down some; downloading and reading selected abstracts will narrow it down further.

The systematic search process will give you a solid body of references; but it will not include classic papers because few electronic databases go back to before 1970; it will also not include the latest papers that have not been typed into the database yet.

### 43.3 Obtaining Papers

If you are at a university library, you can usually find the journals in the stacks, or request the papers through inter-library loan. If you use the Internet, database information providers can refer you to Document Delivery services which will mail, fax, or download papers to you for a fee.

Since 1999, some university libraries subscribe to comprehensive search services such as *ScienceDirect*,<sup>6</sup> which incorporates full-text papers for viewing or printing in HTML (for browsers) or PDF (for Adobe Acrobat Reader).

### 43.4 Backward Expansion

When you have obtained one or more appropriate papers, you can examine their reference lists or bibliographies for promising titles, in order to search backwards for older papers. This is your opportunity to find the key papers in the field, classic papers that made a big impact on the technical community and laid the

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<sup>6</sup><http://www.sciencedirect.com/>

foundation for current research. Key papers may also be found in the reference or bibliography sections of specialized textbooks and monographs.

## 43.5 Forward Expansion

When you have identified key papers from the Systematic Search and the Backward Expansion, you can search forward to the best and most recent papers:

- Since the 1950s, reverse lists of references have been compiled and listed in the *Science Citations Index—Citations Index*,<sup>7</sup> which is available at libraries and through services like *Dialog* and *Web of Science*. Look for papers which cite your key papers among their references. In the paper volumes, new papers are listed here only by author and journal, you need to go on and look up the titles in the *Science Citations Index—Author Index*. If the titles sound promising, you can then look up or order these papers.
- You should also check the most recent papers by those authors which have shown up favorably in your search activities, by looking up their names in the *Science Citations Index—Author Index*.

Only when you have gone through all of the search steps can you be reasonably certain that you have located the most important papers.

## 43.6 Documentation

Throughout your searches you must keep up with the important job of documenting the results, so that you won't have to return and repeat the process as questions arise! (Every professor is familiar with the plaint of a student holding a copy of a paper or chapter that he can't cite because he failed to record the source.) You should have in hand:

- a list of all related papers you found;
- short summaries of the more pertinent papers, noting whether they cover theory, experiment, and/or computer simulation; and
- a summary of the state-of-the-art, with conclusions, graphs, and formulas.

This is much easier if you have kept 3×5 index cards of *all* references *throughout* the process, writing down author, year, title, journal, issue, and page numbers in standard style on the front of each card, and a note about the publication's content on the back.

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<sup>7</sup><http://www.isinet.com/>

Many professionals enter all their search results into a computerized database to make sure that they can properly cite any references they have used. In addition to commercial programs like *EndNote*<sup>8</sup> from *ISI ResearchSoft*,<sup>9</sup> there is the application  $\text{BIB}\text{T}\text{E}\text{X}$  which is used by the  $\text{L}\text{A}\text{T}\text{E}\text{X}$  systems mentioned in Chapter 1.

## 43.7 Staying Current

Once a basic search has been completed, keeping up with new developments is relatively easy; you can:

- rerun your search phrase and look for new “hits;”
- check the latest *Science Citation Index—Citations Index* for new papers citing your sources;
- check the latest *Science Citation Index—Author Index* for new papers from active authors; and
- check core journals for new papers in *Current Contents*.<sup>10</sup>

This is an ongoing process for as long as you work in an area. Some services, e.g. *ScienceDirect*,<sup>11</sup> permit a search to be kept open, with weekly e-mail notices of new publications in a field.

## 43.8 New Developments

Internet tools are constantly improved; for example *Web of Science*<sup>12</sup> provides easy access to *Institute for Scientific Information* databases such as *Science Citations Index*.

**Exercise 43.1** *How many publications by the author of this text can you find, from 1965 to the present? Does it make any difference whether you use the first name or only initials? How could you weed out papers by a namesake with the same last name and first initial? If you have more than one search resource at your disposal, which one gives you the best return?*

**Problem 43.2** *Find up-to-date papers on methods for computing the power spectrum of stationary random vibrations from short data records. Partial answer: Look for phrases like discrete Fourier transform (DFT), Cooley-Tukey fast*

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<sup>8</sup><http://www.endnote.com/>

<sup>9</sup><http://www.isiresearchsoft.com/>

<sup>10</sup><http://www.isinet.com/products/products.html>

<sup>11</sup><http://www.sciencedirect.com/>

<sup>12</sup><http://www.isinet.com/isi/demos/webofscience/demo.html>

*Fourier transform (FFT), auto-regressive (AR) model, maximum entropy spectral analysis, Burg algorithm, Marple least-square method, smoothness priors long AR model, and digital filtering.*

**Problem 43.3** *Find a few classic papers on the “wavelet” approach for obtaining trends in non-stationary random vibrations. Hint: Some of them antedate electronic databases, so you may have to look at the lists of references in current papers on wavelets.*

**Problem 43.4** *Do a literature survey on waving motions of flags. Hint: You may have to look for alternate wording, e.g., “instability of an elastic strip hanging in an airstream.” Partial answer: Some classic papers are international: Fairthorne, ARC Report No. 1345, 1930; Thoma, (German) ZAMM, 1939; Sparenberg, Proc. Nederland Acad. Sci., 1962; Uno, J. Textile Mach. Soc. Japan, 1973; Watanabe, Proc. First. Internat. Conf. Web Handling, 1991. The latest papers are likely to cite these classic papers.*