Literature Searches and Reviews: Keeping on Top of Your Field

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CFD Research Group Meeting

http://www.math.sfu.ca/~stockie/research/cfdgroup.html

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(this document is hyperlinked!)

Outline

1. Introduction
2. Getting Informed
3. Staying Informed
4. Writing a Literature Review

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1 Introduction

2 Getting Informed

3 Staying Informed

4 Writing a Literature Review

Motivation

- A primary aim of any academic researcher is to become an **expert** in at least one field.
- To do so, it's essential to stay on top of past and current literature.
- A **literature search** is an important task for:
  - theses
  - journal papers
  - grant proposals
  - scholarship applications
  - course projects
- This expands on my mantra: *Read often, and broadly!*

  (one must read deeply in certain areas)
- Being able to write a good **literature review** is also an essential skill for a researcher.

Advice from Snieder & Larner

- "One usually does not just stumble into an interesting research problem without having carefully investigated the state of research in a field."
- Learning to pose a good question is essential for doing research . . . and you learn this skill through **carefully** reviewing the literature.
- "Your quality as a researcher depends primarily on **your ability to ask the right questions**, but that can happen only if you pose lots of questions, many of which will subsequently be discarded." Notice that outstanding researchers ask lots of questions!
- Consider carefully whether the problem is doable – don't aim too high, nor too low.

Source: R. Snieder and K. Larner, *The Art of Being a Scientist: A Guide for Graduate Students and Their Mentors*, CUP, 2009.

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Getting Informed: Literature Searches

- When you are starting to study a new field or area of research, you must get yourself informed about:
  - what has been done before?
  - what is old and what is more recent?
  - who is doing it and where is it being done?
  - what is "hot"?
  - what questions haven't been answered yet? and which of those are the most interesting/important?
- With the flood of information being published in academia, it is often difficult to know where to start.

Primary Sources

The main sources in order of respectability/reliability are:

- books and research monographs (from reputable publishers like AMS, SIAM, Springer, . . .)
- articles published in journals (top tier, middle tier, . . .)
- papers in reputable conference proceedings (refereed vs. non-refereed)
- web sites of academic professionals
- other theses, through ProQuest
- technical reports: in the "old days" much of the hottest research was often hidden in (confidential) technical reports from national labs (ORNL, LANL, Argonne, . . .) or their private counterparts (IBM, AT&T, Exxon, Microsoft, . . .)
- preprints: especially at www.arXiv.org
- Wikipedia, other unreliable web sources

The Anatomy of a Search

- Look up subject/keywords on:
  - MathSciNet (through the SFU library)
  - Google Scholar
  - Publisher portals: Science Direct (Elsevier), SpringerLink (Springer Verlag), etc.
  - I find (plain) Google relatively useless for literature searches.
- Once you find one relevant paper:
  - Read the bibliography carefully and identify sources with interesting titles. Recurse.
  - (Reverse) Do a **citation search** to find out who cites this paper. Recurse.
- For more "classical" work that's not online, look up books or articles in the library and do the same.
- If the book or paper you want isn't available, then order it through Interlibrary Loans (ILL): PDF copy within 1–2 days, hardcopy in 1 week.

What to Focus on

If you're feeling overwhelmed, then start with

- reputable people
- reputable journals

Ask if you don't know!

And don't give up if you can't find an on-line PDF version. If a paper sounds like it's in just the right topic area, then request it from the publisher, lab or author!!!

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Library resources

There is a nice overview of the "research process", with resources available through the SFU Library at

http://www.lib.sfu.ca/help/research-assistance/tutorials/start-research

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Staying Informed: Keeping Up To Date

A single literature search is insufficient – you need to follow an area continuously over a (long) period of time by . . .

- Joining a society, reading newsletters and journals, participating in events: CAIMS, SIAM, AMS, CMS, SMB, etc.
- Subscribing to NA-Digest and other email lists.
- Going to specialist workshops as well as more general conferences (ICIAM). If you can't attend, then at least look at a list of invitees and topics.
- Watching for special thematic programs at the mathematics institutes: PIMS, Fields and CRM in Canada; IMA, MSRI, IPAM, AIM in USA; Newton Institute in UK; etc.
- Visiting other experts.
- Joining or starting a "reading club".
- Agreeing to review papers and grant proposals.
- Requesting automatic updates from publishers. . . .

Ensuring You Intercept Newly Published Sources

- The old-fashioned method: Go to the library and read your favourite journals (at least the table of contents).
- Electronic content alerts from your favourite journals, as well as subject, author and keyword alerts.
- arXiv subject alerts.
- Google alerts.
- ResearchGate.

Which Journals To Read

(a very biased and personal list . . . if I was stranded on a desert island and had only 20 subscriptions to keep me occupied, then what would they be?)

- Applied mathematics: *SIAM J Appl Math**, *SIAM Review*
- Numerical analysis and scientific computing: *J Comput Phys**, *SIAM J Sci Comput**, *SIAM J Numer Anal*, *Acta Numerica*
- Fluid mechanics: *J Fluid Mech**, *Computers & Fluids*, *Phys Fluids*
- Mathematical biology: *J Math Biol*, *Bull Math Biol*
- Magazines: *SIAM News*, *Significance**
- Teaching: *Math Intelligencer*, *Amer J Phys**, *Phys Teacher*
- General science: *PNAS*, *Science*, *Nature*, *Phys Rev E**, *Annu Rev of* {*Fluid Mech**, *Biomed Eng*, . . . }

$\Longrightarrow$ Side benefits: a source of ideas for new problems

How to Remember All You've Discovered

- Over time, the work you collect will become difficult to handle.
- Keep an annotated bibliography (BibTeX, EndNote?) that contains notes detailing:
  - what is the main result?
  - what did I like or not?
  - how does it relate to my work or interests?
  - does the author(s) identify any open problems?

  (I have 7000 BibTeX entries and counting . . .)
- Store an annotated paper copy or (preferably) PDF file.

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Writing a Literature Review

When writing a review of the literature, there are several main stages:

1. Collecting and organizing all relevant papers. Reading and generating summary notes.
2. Identifying the most important works, and becoming very familiar with those.
3. Summarizing the key ideas and results in "important" papers identified in the previous step, and drawing connections with other relevant work. The decision about what to leave out is **crucial!**
4. Identifying gaps in current knowledge, formulating interesting open research questions, and justifying the relevance of your work.

Some thoughts and advice

- I find the literature review to be the most difficult aspect of paper-writing. This is because it requires not only **reading** and **understanding** a wide range of other people's work, but also **synthesizing**.
- Take note of papers with particularly good/bad reviews of the literature. Save these as examples.
- How to start? Begin by making an itemized list of key papers and important points. Leave it sit. Then repeatedly return to it, expanding and reorganizing. In time, it will take shape.
- If you don't take great care in keeping up to date with the literature, you will not only damage your own reputation, but also harm your students!

Questions?

References I

R. Snieder and K. Larner.
The Art of Being a Scientist: A Guide for Graduate Students and Their Mentors.
Cambridge University Press, 2009.