Advanced ADCS Bibliography Assignment

Due Date: Wednesday September 10 In Class

Assignment: Conduct a literature review of spacecraft dynamics and control problems studied in the 1960s – 1970s.

Specifics:

- Find 20 journal papers on spacecraft dynamics and control published between January 1, 1960 and December 31, 1979. At least five of these papers should be related in some way, *e.g.*, at least five papers regarding gravity-gradient stabilized spacecraft.

  Suggested journals: *Acta Astronautica*, *Journal of Spacecraft and Rockets*, *The Astronomical Journal*, *AIAA Journal*, *Journal of Applied Mechanics*, *COMSAT Technical Review*, *Journal of the British Interplanetary Society*, *Journal of the Astronautical Sciences*, *Journal of the Aerospace Sciences*, *Celestial Mechanics and Dynamical Astronomy*

- Prepare an enumerated bibliography with the 20 papers ordered in chronological order.

- Write a brief review of the five related papers, using the questions described in the attached guidelines to organize your review. The review should be a single review with discussion of the five papers, *not* a sequence of five individual reviews.

- The assignment must be typed, double-spaced, and stapled in the upperleft corner (no binders needed!).

Note: A subsequent assignment will ask you to find papers written in the 1980s and 1990s that cite the five papers you reviewed.

Conducting a Literature Review for a Research Project

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One of the most important elements in the beginning of a research project is the *literature review*. A researcher, especially one who is new to the particular problem, needs to map the landscape of relevant work done by other researchers. Some of the questions that the literature review can help answer are listed below. For each question, I have given two versions: the first is the direct question that you should attempt to answer by reading the literature, and the second is the indirect question that should influence your thinking about the research project and its directions.

1. What are the applications associated with this problem?
   Why is this problem of interest?

2. Who are the researchers who have investigated this problem, and who funded them to study it?
   Who is interested in this problem?

3. What models have been used to study this problem, and what assumptions are inherent in each?
   What model assumptions might be relaxed to obtain new and hopefully useful results?

4. What methods have others used in analyzing this problem?
   What methods are available for you to use?

5. What important questions have others raised that have not yet been answered?
   What opportunities are there to answer questions that will be of interest to the research community?

In this note, I outline how to approach your literature review with the goal of helping you to get the most value out of the time you spend searching for and reading articles relevant to your project. First I talk about the search tools available to you, then about how to search for and find the articles of interest. Since you'll likely find more articles than you have time to read in their entirety, I also give some guidelines for reading the papers. Of course, the purpose is to get the information needed for the literature review chapter and Bibliography of your thesis, so I also give some specific guidance on what information you need to collect.

1 Search Tools

There are several useful tools for searching the technical literature, and most of them are available on the internet, with connections from the VT Library webpage[2]. However, some of these internet-based tools only go back a decade or two, and many interesting engineering problems were investigated longer ago than that. Thus, you'll also need to become familiar with paper-based literature search tools in the library.

[1]Please send comments and suggestions to `cdhall@vt.edu`.

[2]`http://www.lib.vt.edu`. Go to the Research page for links to the search tools described here.

One of the more useful web-based tools for searching the recent literature is `FirstSearch`. This is a commercial service that that is paid for by the library, and includes many databases. Your first decision when you access this tool is which database to use. The three that I find most useful are `ArticleFirst`, `PapersFirst`, and `Dissertations`. `ArticleFirst` is a database of journal articles from some 12,000 technical journals, `PapersFirst` is a database of conference from a large number of technical conferences, and `Dissertations` is a database of M.S. theses and Ph.D. `Dissertations`. Generally, you'll want to find journal articles on your subject because journal articles have more credibility than conference papers. However, conference papers can be quite useful, because they frequently are somewhat longer and provide more details about the work. If you find a useful journal or conference paper that is based on a graduate student's thesis or dissertation, the `Dissertations` database will help you get more information on the source document and you can use Interlibrary Loan (ILL[3]) to borrow a copy. A useful feature of `FirstSearch` is that the search results usually identify whether our library owns the items found. This will help you select articles that you can immediately access and to identify quickly those items for which you'll need to use `ILLIAD`. Another useful feature is that you can mark found items and email the entries to yourself. This keeps you from having to take copious notes while using `FirstSearch` to find articles. Finally, note that `FirstSearch` generally does not provide any information other than what you would find in a typical bibliography entry, so you really do need to find the article and read it.

A useful tool for aerospace-related literature searches is the NASA Technical Reports Server (NTRS[4]). This search tool provides a lot of information about each found item, and in some cases includes the complete article in PDF format. Usually, however, only the abstract and bibliographic information are provided.

Science Citation Index (SCI[5]) is extremely useful when trying to complete a literature review, but is not as useful in the beginning stages. This tool permits you to find all the articles that have cited a particular article of interest. Thus, suppose you have found a great article written in 1957 on the application of a gyroscope for pointing a spacecraft. You're curious about whether this is the first paper on this topic, and if so, you want to be able to cite it as such in the literature review of your thesis. None of the paper's references are about this subject, but that doesn't quite answer the question. Using SCI, you can identify all the "future" papers that have cited your target paper. Unfortunately, the online version of SCI doesn't go back to 1957, so you'll need to use the paper version[6]. Once you've found all the papers that cite your target, you can look at each of these to see what other papers they cited. Did they cite any earlier papers that treated this particular application? If so, bingo! If not, you have a better case that your target paper is in fact the first (you still don't have a proof though). Now, this may not seem all that important, but it is. A convincing literature review adds substantially to the credibility of any research doc-

[3]The library has an online ILL service called `ILLIAD`. You need to register, but then you can ILL without having to go fill out paperwork. In some cases they'll get the item as a PDF file and email it to you, but in any case, as soon as it's been received, they will send you a copy in campus mail.

[4]http://techreports.larc.nasa.gov/cgi-bin/NTRS.

[5]Institute for Scientific Information, Web of Science Citation Databases. URL: `http://www.webofscience.com/`

[6]Call number: `Q1 S368`

ument, including M.S. thesis, Ph.D. dissertation, conference paper, or journal article. Another benefit of using SCI to find these "future" papers is that some of them may also be quite useful in your literature review. Frequently someone will find a way to apply results from one field in another unrelated field. So, someone working in the field of stabilizing kayaks may find that gyroscopes have some application and may cite that 1957 paper. While you may not be interested in kayak stabilization, this is a useful piece of information for answering Question 1 above.

2 Finding the Papers

Using the tools described above is part science and part art. For example, if you use `FirstSearch` and search for the keyword `space`, you will find too many items to be of any use. Thus you must be careful when searching. I highly recommend learning to use the Boolean[7] search options of the various tools. Your goal is to find a reasonably large set of candidate articles before going up to the 5th floor of the library to begin your reading. Once you find a set of candidate articles, you'll need to find the actual paper or electronic versions of them. Assuming that the search tool didn't provide an electronic version, there are four basic possibilities: 1) the library owns the item and it is easy to find, 2) the library owns the item and it is difficult to find, 3) the library owns the item and it is in storage, and 4) the library does not own the item. Case 1 is self-explanatory; if it isn't, then it's really Case 2. For Case 2, ask a reference librarian for assistance. If you still can't find it, then put in an ILL request for the item. When they cancel your request because the item is in the library, the cancel notification will usually tell you where the item is. For Case 3, you need to request the item from a reference librarian. Although this might at first seem to be a hassle, in this case, the library will make a free copy of the item for you, so it's actually better than Case 1, and certainly better than Case 2. It usually only takes a couple of days to get the item. For Case 4, put in an ILL request and you'll usually get a free paper copy of the item within a few days. Since the delay is longer than for Cases 1-3, you should put in the ILL requests as soon as you identify the particular papers in Case 4.

3 Reading the Papers

Many technical papers, especially journal articles, are fairly short, typically 5–10 pages. However, they are usually written in such concise style that reading them can be fairly challenging. Also, you'll have a lot of papers that you'll need to read, so it's important to develop a system for reading them and getting the gist of them as quickly as possible. Here's what I recommend: First, read Abstract, Introduction, and Conclusions to determine whether the paper is actually useful to you. These 3 sections are usually just 3 different versions of the same information, but written from a different perspective. The Abstract is a one-paragraph synopsis of the entire paper. The Introduction varies in length but usually includes the motivation for the

[7]Boolean searches use `AND`, `OR`, and so forth. For example, some tools allow you to search for `space and (tether or umbilical)`. This would find articles with `space` *and* `tether` as well as articles with `space` *and* `umbilical`.

problem being discussed as well as the background literature review. The Conclusions is usually one or two paragraphs and is intended to state the conclusions that can be drawn from the work presented in the paper. Quite often, however, this section is actually written as a summary of the paper.

Once you've read these 3 sections, you should have a pretty good idea of what the paper is about and whether it will be useful in your own project. Let's call this the AIC filter. If the paper doesn't pass the AIC filter, you might still want to include it in your literature review. Furthermore, you want to document your reading so that you don't accidentally end up reading the paper again in a year or so. So, whether it passes or not, you should make a complete bibliography entry and make some detailed notes about what you read.

If the paper does pass the AIC filter, you'll want to take even more detailed notes, and of course make a complete bibliography entry so you don't have to go back and look for the paper again later. Here are typical questions you want to answer in your note-taking:

1. What type of system is the motivation for the paper? (*e.g.*, EVA, Hubble solar panel vibrations, control moment gyro failures, *etc.*) This information is important in establishing the significance of your work.

2. What system model is used? (*e.g.*, string model of tether, point mass model of spacecraft, rigid body model of spacecraft, gyrostat model of spacecraft, flat earth, spherical earth, oblate earth, *etc.*) This will help you to identify models you can use as well as to identify what models have not been studied.

3. What analysis methods are used? (*e.g.*, numerical integration, Lyapunov stability, linear stability, LQR control synthesis, *etc.*) This will help you identify potential methods for you to use, as well as to identify methods that have not been used.

4. What results are obtained? (*e.g.*, stability criteria, design guidelines, *etc.*) This will help you identify what is known about the problem (subject to the simplifying assumptions arising from the authors' model choice).

5. Do the authors raise any interesting unanswered questions? (*e.g.*, in a recent paper by Barden and Howell on halo orbits, the authors state that no analytical solution has been found for the amplitude of periodic orbits for which halo orbits exist. This statement could be viewed as a challenge.) This will help you to identify what is not known about the problem.

6. Are there any great figures? Identifying really great graphics in others' articles will give you some ideas about creating great graphics of your own.

7. How many references are there and how good is the discussion of them? Identify any references that look particularly relevant and find them. The importance of this information in developing your own literature review is obvious.

8. Where do the authors work and who funded the research? This will help you to understand who is interested in this problem.

4 Bibliography Entries

Eventually you will need to put all your notes into the form of a literature review chapter in your thesis. This chapter is typically either the 2nd chapter of the thesis or a section of the 1st chapter. To do this, you need to collect the bibliographic information as you go, so you won't have to go back and find the items again later. The way that you record this information depends on how you're planning to prepare your thesis. The two most common word-processing tools for thesis preparation are Microsoft Word and LaTeX (pronounced lah-teck'). I highly recommend using LaTeX, as it will save you substantial heartache and headache during the revisions of your thesis.

4.1 Word

If you use Word, you should create a bibliography file now, and start to add items to it. You should create a numbered bibliography list in the file, with each entry in a standard and consistent format. You should also document your notes in this file, with a separate paragraph for each reference. Eventually you'll edit this file to prepare your literature review. Here are three examples of a book (Ref. 1), a journal article[2], and a conference paper[3]:

1. P. C. Hughes, *Spacecraft Attitude Dynamics*, Wiley, New York, 1986

2. J. A. Beck and C. D. Hall, "Relative Equilibria of a Rigid Satellite in a Circular Keplerian Orbit," *Journal of the Astronautical Sciences*, Vol. 46, No. 3, 1998, pp. 215-247

3. M. R. Long and C. D. Hall, "Attitude Tracking Control for Spacecraft Formation Flying," *Proceedings of the 1999 Flight Mechanics Symposium*, Goddard Space Flight Center, Greenbelt, MD, May 18-20, 1999, pp. 319-332

Notice the use of italics instead of underline for book and journal titles. Also, notice the two methods of citing references: Ref. # or paper[#]. These are the two most common styles. You don't have to use them, but you do have to be consistent.

4.2 LaTeX

If you use LaTeX, you should create a bibliography file now, and start to add items to it. The format for a LaTeXbibliography file is somewhat different from what you'd prepare in Word, but will make your life much easier when you're writing your thesis. Name your bibliography file "`litreview.bib`" (or something like this) and make it a plain text file. You can put the items in the file in any order you like, but I recommend putting them in alphabetical order by last name of the first author. Later you can use LaTeXto put them in any order you like. Here are the same three examples as above, in "`.bib`" format:

```
@book{hughes:86,
    author = { P. C. Hughes },
    title = {Spacecraft Attitude Dynamics},
    publisher = {Wiley}, address = {New York}, year = 1986 }
@article{beck:hall:98,
```

```
    author = {J. A. Beck and C. D. Hall}, year = 1998,
    title = {Relative Equilibria of a Rigid Satellite in a
        Circular Keplerian Orbit},
    journal = {Journal of the Astronautical Sciences},
    volume = 46, number = 3, pages = {215--247}}
@inproceedings{long:hall:99,
    author = {M. R. Long and C. D. Hall}, year = 1999,
    title = { Attitude Tracking Control for Spacecraft
        Formation Flying},
    booktitle = { Proceedings of the 1999 Flight
        Mechanics Symposium},
    address = {NASA Goddard Space Flight Center,
        Greenbelt, Maryland},
    date = { May 18--20, 1999}, pages={319--332}}
```

The information should all be available from your note-taking. Always spell everything out. There are some exceptions: NASA, AIAA, IEEE, and the like. However, when in doubt, spell it out. The "key" (*e.g.*, `hughes:86`, `beck:hall:98`, `long:hall:99`) is something that you assign so that you can cite the item in your thesis, conference paper, or journal article. I have been using the format shown here for several years and have several bibliographic databases that I can make available to you. The form is `lastname1:lastname2:year`. Of course if there's only one author, then `lastname2` is omitted. If there's more than 2 authors, I use `lastname1:etal:year`, and if the same author (or authors) has more than one paper in a given year, I use `lastname:yeara`, `lastname:yearb`, and so forth.

You should also prepare a file called `lrnotes.tex` (or something like this) for your literature review notes. Make this file a plain text file, and have a separate paragraph for each bibliography entry. To cite the bibliography entries, use one of the LaTeXcommands from the following examples:

```
Hughes\cite{hughes:86},
Hughes' book (Ref.~\citen{hughes:86}),
Beck and Hall\cite{beck:hall:98},
Long and Hall\cite{long:hall:99},
or Long and Hall's approach is described in Ref.~\citen{long:hall:99}.
```

These references will show up like this:

> Hughes,[1] Hughes' book (Ref. 1), Beck and Hall,[2] Long and Hall,[3] or Long and Hall's approach is described in Ref. 3.

At this point, don't worry about the details of this syntax. As you learn LaTeX, the details will all become clear.

5 Writing the Literature Review

As I stated at the beginning, a review of the literature is an important part of any research project. For the research leading to an M.S. or Ph.D., this review is especially important. Candidates for the M.S. and Ph.D. degrees are expected to be learning how to conduct a research project. Whereas the advisor might be able to give the researcher all the required information, the lessons learned by conducting the literature

review are irreplaceable. You, the student, should embrace the opportunity to learn how to gather the information and to write the literature review section or chapter of your thesis. By making yourself an expert in the problem, you make it difficult for anyone to question your knowledge of the subject and prior investigations.

So, how do you write the review? If you've followed the suggestions above, you've practically finished already. You've read a lot of papers (at least through the AIC step). You've collected a lot of information (bibliographic, and the answers to the questions posed above. Now you just need to organize it a bit. There are several possibilities. You can organize the review chronologically: if the literature review topic is fairly focused, you can begin with the earliest relevant publications and proceed in order of publication. You can organize topically: if there are a variety of topics involved in your review, you can make each topic correspond to a section or subsection.

References

[1] P. C. Hughes, *Spacecraft Attitude Dynamics*, Wiley, New York, 1986

[2] J. A. Beck and C. D. Hall, "Relative Equilibria of a Rigid Satellite in a Circular Keplerian Orbit," *Journal of the Astronautical Sciences*, Vol. 46, No. 3, 1998, pp. 215–247

[3] M. R. Long and C. D. Hall, "Attitude Tracking Control for Spacecraft Formation Flying," *Proceedings of the 1999 Flight Mechanics Symposium*, NASA Goddard Space Flight Center, Greenbelt, Maryland, May 18–20, 1999, pp. 319–332