



Beyond Lab Reports: A Fresh Approach to Technical Writing

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Traditional Lab Reports

- 
- Students hate writing them
 - Not sure what is expected (different faculty have different expectations)
 - Assumed engineering (sciences?) was not about writing and feel betrayed
 - Feel that writing is not “their strength”
 - Faculty hate grading them
 - Often very poorly written
 - Many times no logical flow
 - Displays depressing lack of critical thinking



So why are Lab Reports assigned?

- Value/importance of technical writing
- Demonstrate an understanding of lab concepts, procedures, etc.
- Requires demonstration of critical thinking
- Yet, the grading is miserable because so many are so poorly done

Personal Story – EN455

EN455 – Seakeeping and Manuevering

- Lab intensive course (8-9 labs in a semester)
- Taught 3 fall semesters (2012, 2013, 2014) as a 4-credit lab course
- Student comment: *“Don’t make the lab reports so extensive. Most of what was written in the write-up was also in the lab handout. Why write it again?”*

Sabbatical

- Engaging Ideas: The Professor’s Guide to Integrating Writing, Critical Thinking, and Active Learning in the Classroom by John C. Bean
- They Say, I Say by Graff and Birkenstein (specifically Chapter 16 – “ ‘The Data Suggest’ Writing in the Sciences” by Christopher Gillen)

Personal Story – EN455

Re-vamp of lab report assignments

- Course changed to a 3-credit lab course
- Taught 3 fall semesters (2015, 2017, 2018) as a 3-credit lab course
- Altered the format of the lab report assignments and included revision
- Reduced number of lab reports from 8 (some in memo format) to 4 (with an additional 2 reflection papers)



Analysis of Original Lab Assignment - 2012

DDG-51 in Head Seas Lab:

Purpose: This lab is intended to help students better understand the effects of head seas on the pitch and heave response of a typical small combatant. A very important part of this laboratory is for the students to observe the motions of the models experiencing a variety of regular waves and then to be able to qualitatively explain the relationship between the motions and the waves.

Results: Your lab report should contain a discussion of the lab purpose, data analysis, and discussion of results. The data collected must be presented in tabular form that clearly identifies the data (including source and units). Any calculated values can also be presented in the same or similar tables.

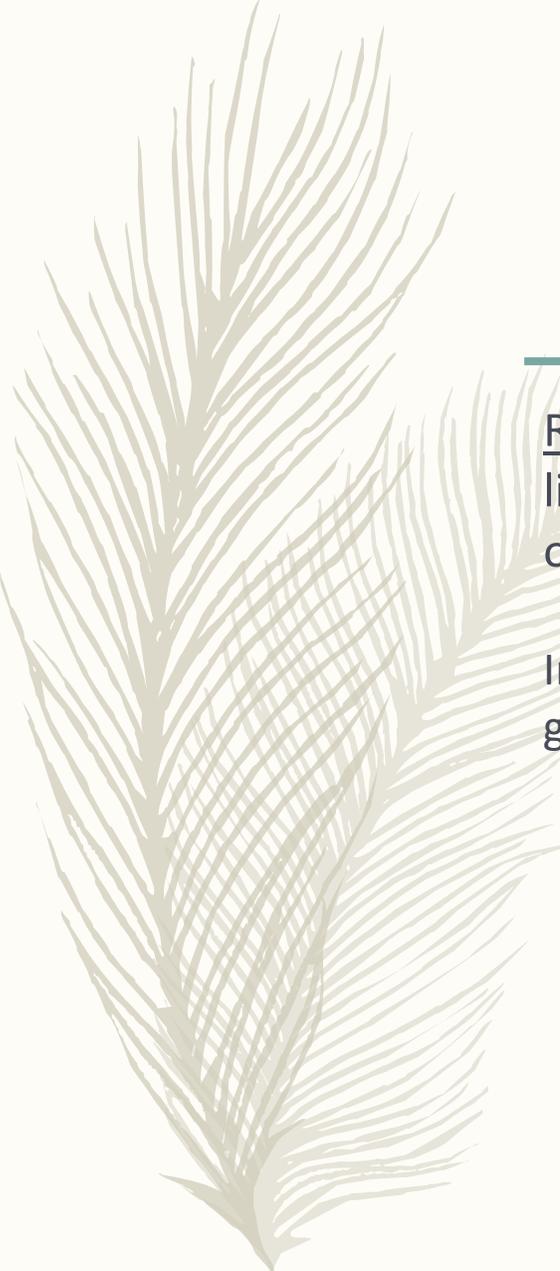


Analysis of Original Lab Assignment – evolution by 2014

Example Lab Assignment from 2014:

Goal: The objectives of this experiment are:

1. Measure the heave and pitch amplitude responses to given wave excitation
2. Measure the excitation (encounter) frequency and compare with predicted value
3. Develop a pitch and heave transfer function plot from experimental measurements
4. Describe expected heave and pitch motion responses to “short” and “long” wavelengths
5. Explain resonance and effects of damping on resonant response

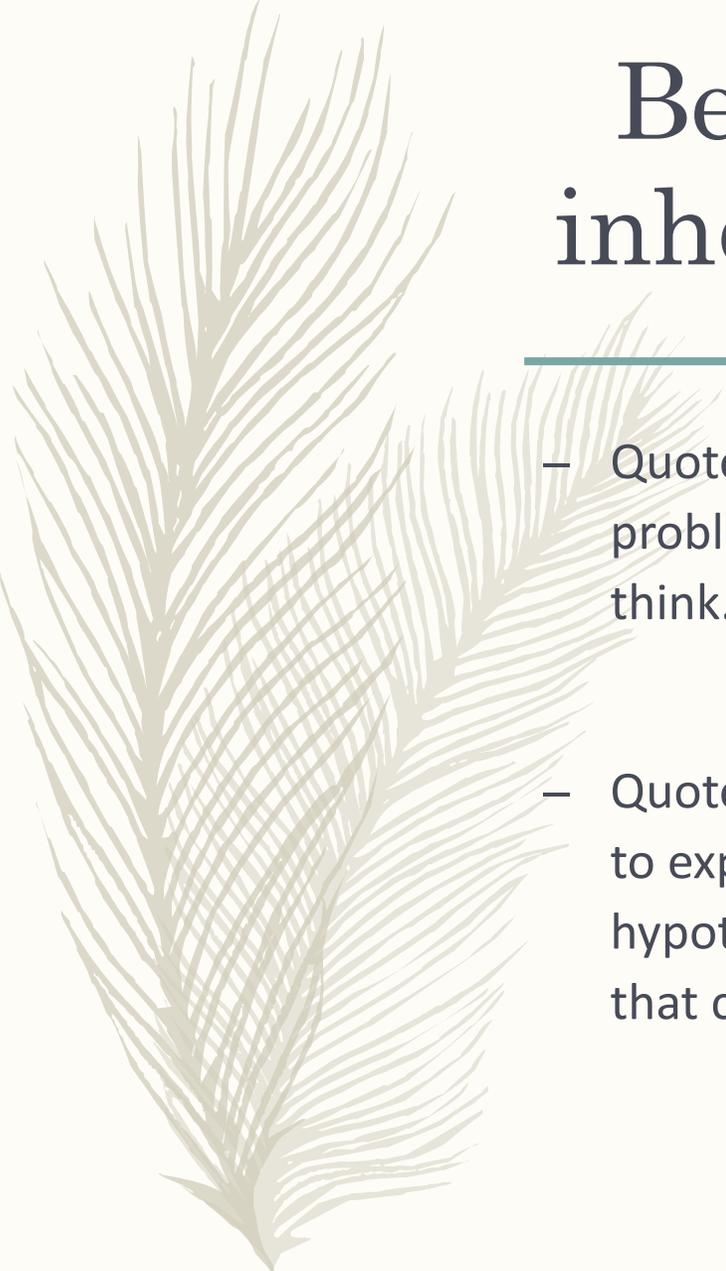


Analysis of Original Lab Assignment – evolution by 2014

Results: Your lab report should include the collected data presented in tables, the plots listed above, sample calculations, a summary of the experiment objectives, a discussion of the results, and a short conclusion summary.

In the discussion of the data analysis for the lab report, be sure to discuss each of the plots generated for the results. Topics of discussion should include:

- The phase relationship between the wave profile and the two ship responses
- The relationship between the natural frequencies shown in your table and what you see in the transfer function plots
- The effect of wave frequency and ship speed on the magnitude of the ship's response in heave and pitch
- The effects of wave frequency and ship speed on the apparent natural frequency
- From your observations on the carriage, what can you say about the phase relationship of the motions at different wavelengths?
- How does this experiment relate to the concept of seakeeping?



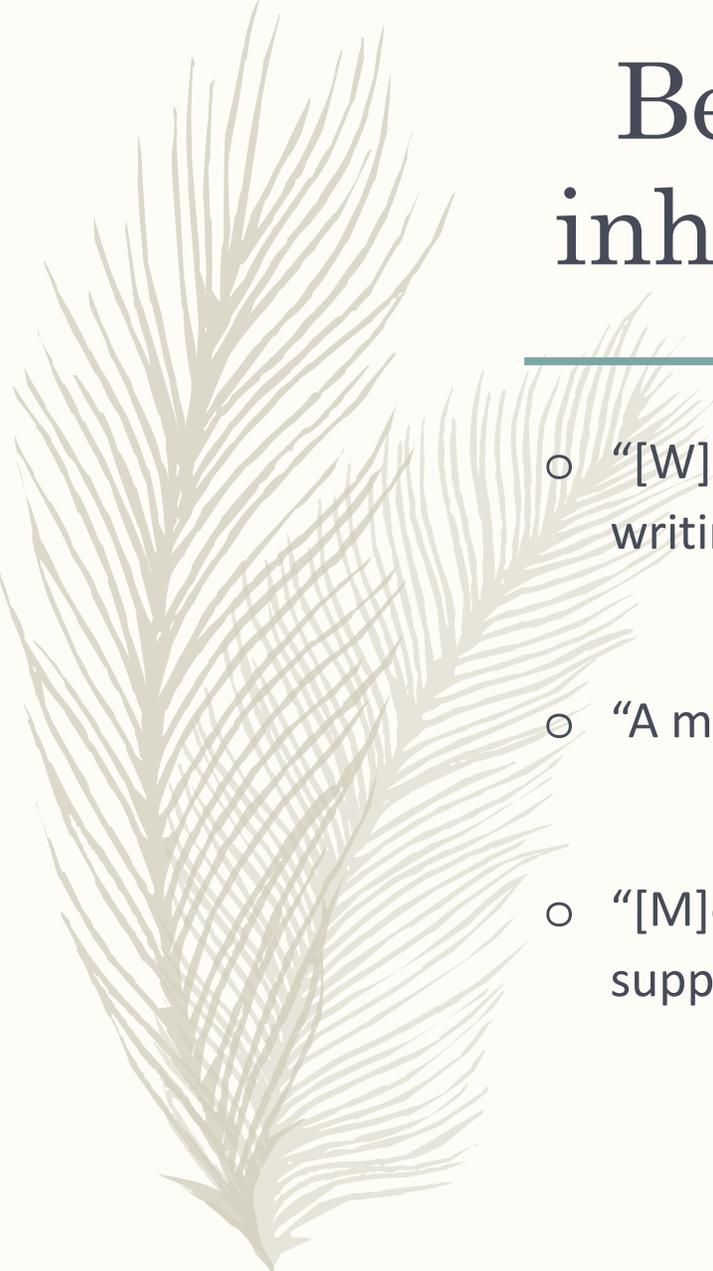
Bean makes the case that writing inherently requires critical thinking

- Quote from Dewey (1916): “Only by wrestling with the conditions of the problem at first hand, seeking and finding his own way out, does [the student] think.”
- Quote from Kurfiss (1988): critical thinking is “an investigation whose purpose is to explore a situation, phenomenon, question, or problem to arrive at a hypothesis or conclusion about it that integrates all available information and that can therefore be convincingly justified.”



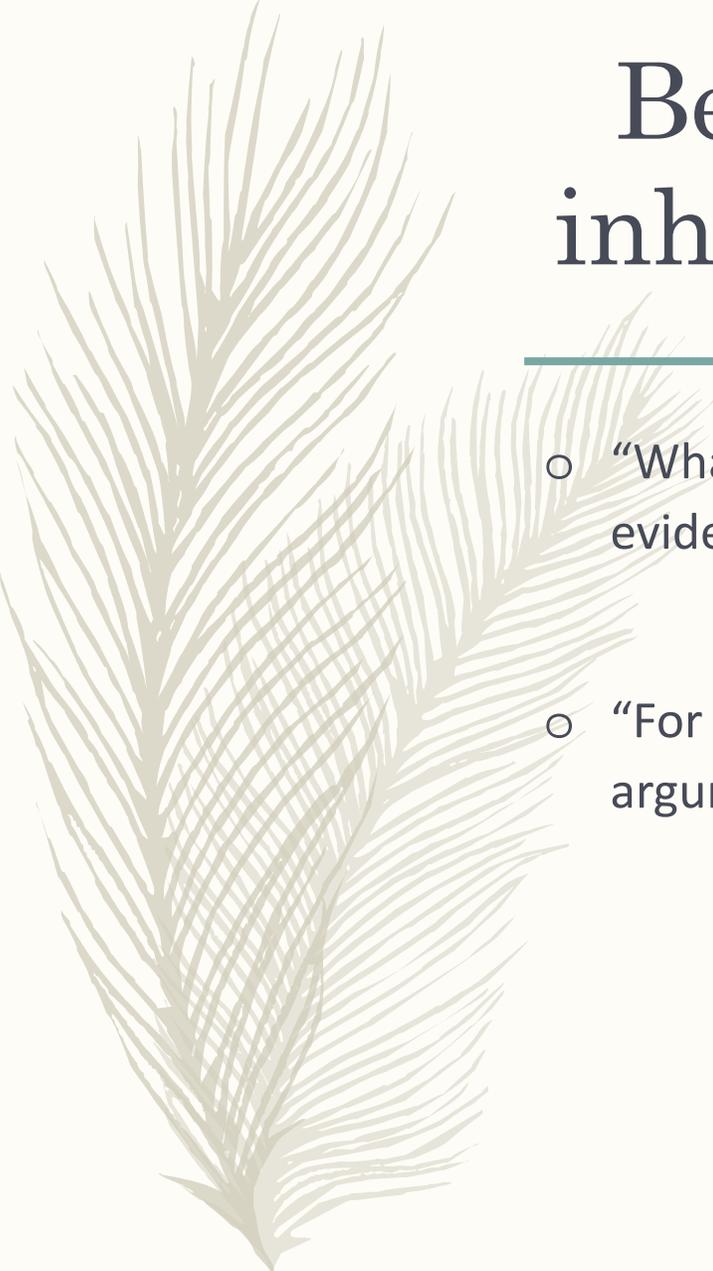
Bean makes the case that writing inherently requires critical thinking

- “To grow as critical thinkers, students need to learn how different disciplines use evidence to support arguments.”
- “[I]ntegrating writing and critical thinking components into a course can increase the amount of subject matter that students actually learn.”
- “Critical thinking tasks – which require students to *use* their expanding knowledge of subject matter to address disciplinary problems – motivate better study habits by helping students see their learning as ***purposeful*** and ***interesting.***”



Bean makes the case that writing inherently requires critical thinking

- “[W]hat matters in using writing to promote deep learning is not the amount of writing in a course but the quality of the writing assignments themselves.”
- “A main key to teaching writing...is teaching students how to revise.”
- “[M]odel for students a view of knowledge in which inquirers must develop and support provisional answers to disciplinary problems.”



Bean makes the case that writing inherently requires critical thinking

- “What new students don’t see is how these different kinds of data function as evidence in support of a claim.”
- “For the most part, formal academic writing requires analytical or argumentative thinking.”



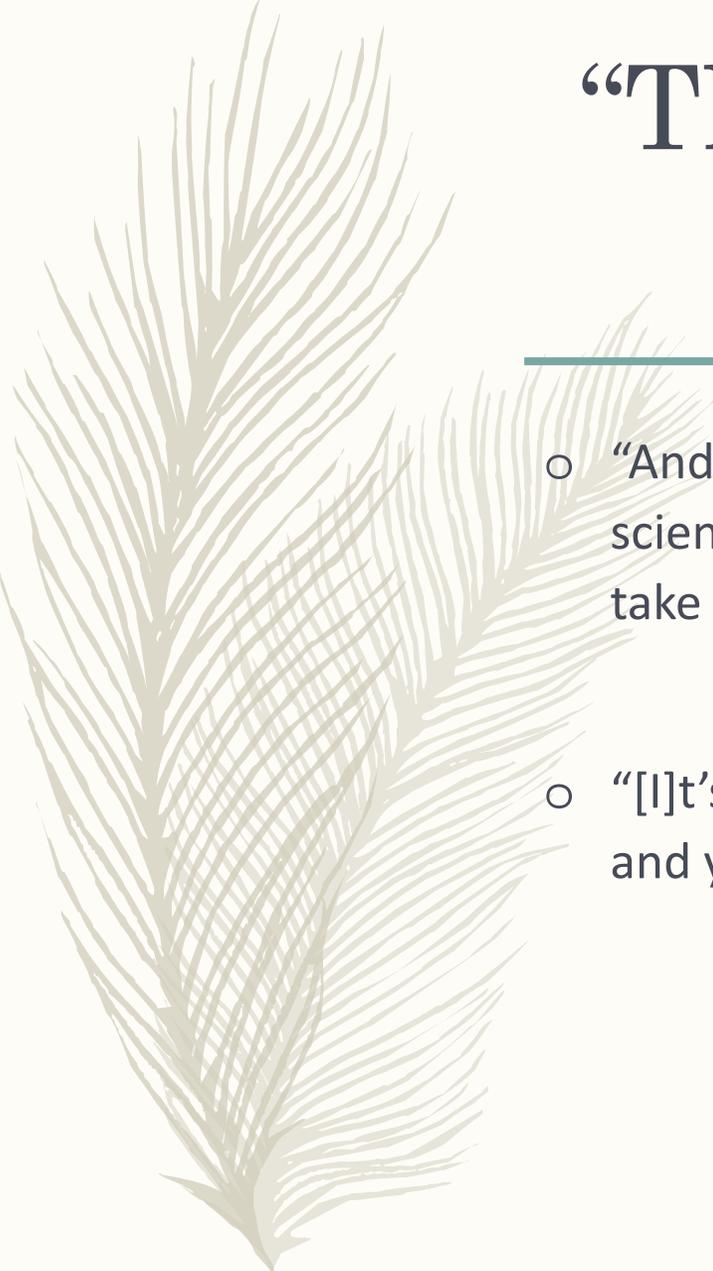
“The Data Suggest” approach to technical writing

- “[S]cientific writing is *fundamentally argumentative*. Like all academic writers, scientists make and defend claims. They address disagreements and explore unanswered questions.”
- “And they advance certain explanations and reject others.”
- “Despite the importance of argument in scientific writing, newcomers to the genre often see it solely as a means for communicating uncontroversial, objective facts.”



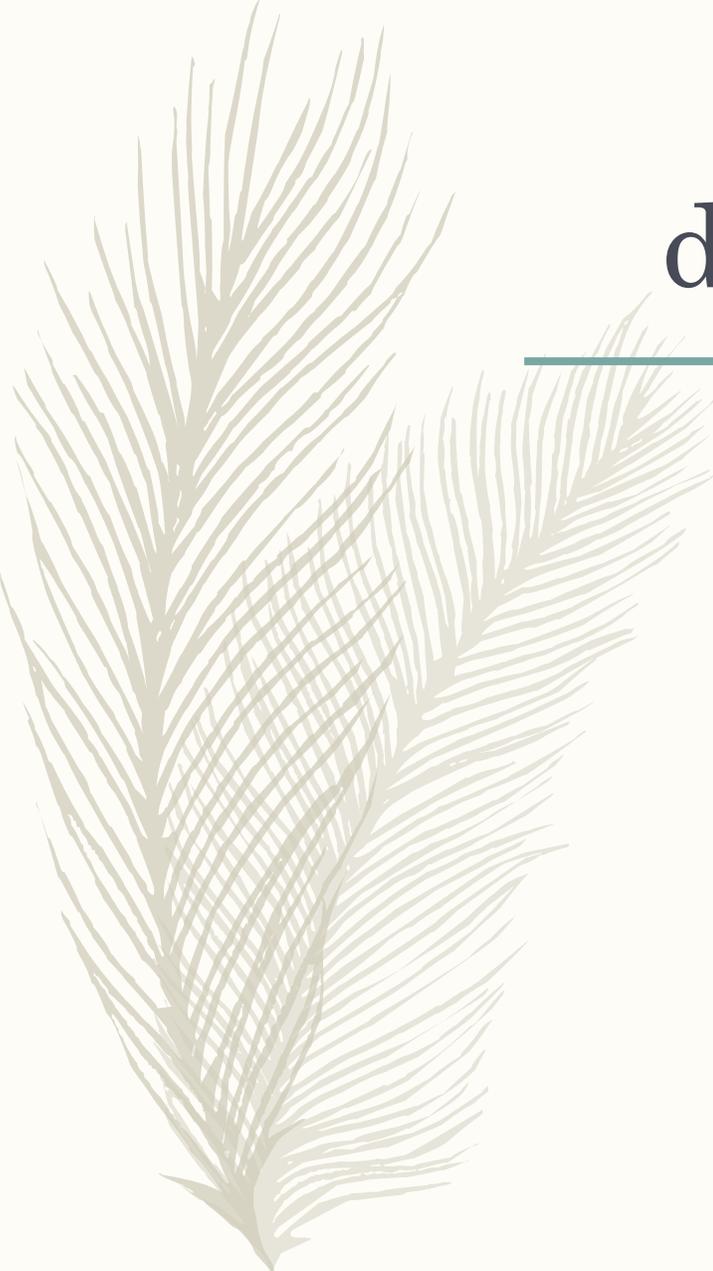
“The Data Suggest” approach to technical writing

- “Given important new data, scientists assess their quality, draw conclusions from them, and ponder their implications. They synthesize new data with existing information, propose novel theories, and design the next experiments.”
- “Data are the fundamental currency of scientific argument.”



“The Data Suggest” approach to technical writing

- “And in fact the culture of science depends on vigorous debate in which scientists defend their own findings and challenge those of others – a give and take that helps improve science’s reliability.”
- “[I]t’s essential when you enter a scientific conversation to say why the work – and your arguments about it – matter.”



Bean's guidance for a well-designed writing assignment

- **RAFT**
 - ✓ *Role (or purpose)*
 - ✓ *Audience*
 - ✓ *Format*
 - ✓ *Task*
- **TIP**
 - ✓ *Task as*
 - ✓ *Intriguing*
 - ✓ *Problem*
- **Encourage Revision**



Bean's guidance for a well-designed writing assignment

RAFT

- Role (or purpose): helps students understand the kind of change they hope to bring about in their audience's view of the subject matter
- Audience: sets the rhetorical context. Allows students to write from a position of power – to audiences that know less about the topic than the writer. Or of equality – to audiences whose views on the topic differ from the writer's.
- Format: helps students transfer earlier genre knowledge to the current task and make decisions about document design, organization, and style
- Task: sets forth the subject matter dimension of the assignment

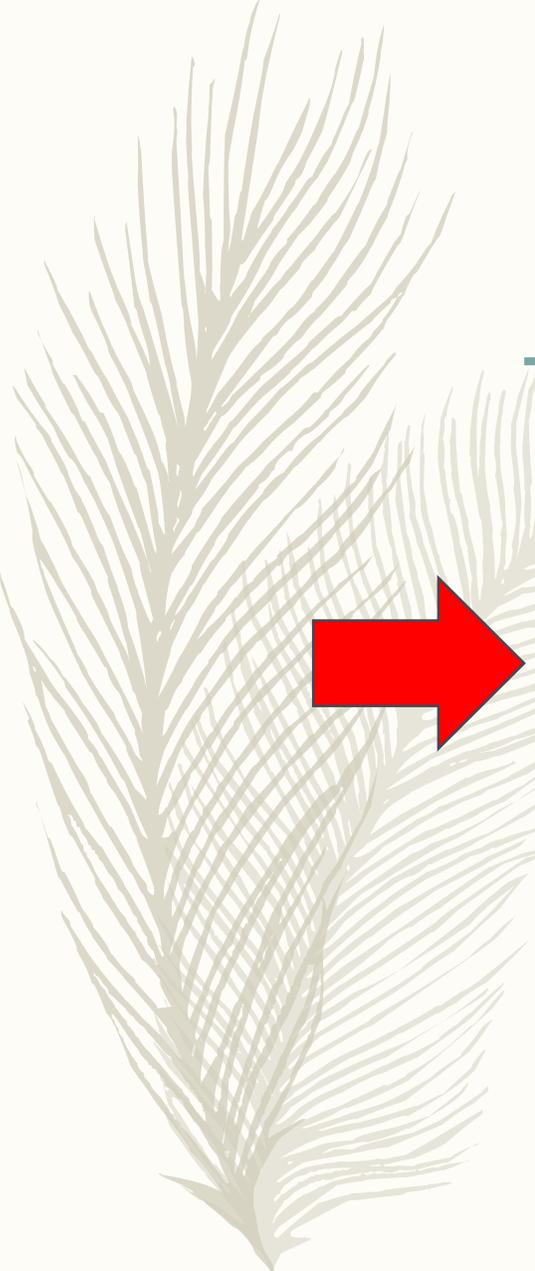


Analysis of Original Lab Assignment – evolution by 2014

Goal: The objectives of this experiment are:

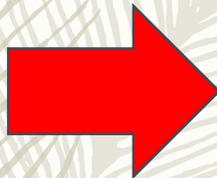
1. Measure the heave and pitch amplitude responses to given wave excitation
2. Measure the excitation (encounter) frequency and compare with predicted value
3. Develop a pitch and heave transfer function plot from experimental measurements
4. Describe expected heave and pitch motion responses to “small” and “long” wavelengths
5. Explain resonance and effects of damping on resonant response

What is the Role? Who is the audience? What is the task (and is it an intriguing problem)? *(Format is provided in the lab assignment)*



Analysis of Original Lab Assignment – evolution by 2014

In the discussion of the data analysis for the lab report, be sure to discuss each of the plots generated for the results. Topics of discussion should include:

- 
- The phase relationship between the wave profile and the two ship responses
 - The relationship between the natural frequencies shown in your table and what you see in the transfer function plots
 - The effect of wave frequency and ship speed on the magnitude of the ship's response in heave and pitch
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 - From your observations on the carriage, what can you say about the phase relationship of the motions at different wavelengths?
 - How does this experiment relate to the concept of seakeeping?

“Some instructors, in an understandable effort to stimulate students' thinking, include in their assignments a whole series of 'you might want to think about' questions instead of a single focusing question.”

“students are apt to produce a series of short answers, addressing each question in turn, rather than a unified essay.”

New Lab Assignment #1 - 2018

- Added a simulation portion (simulated using a standard software package the same results a measured in the lab experiment) and the same lab procedure as previous for the DDG-51 in Head Seas Lab

You will be presenting seakeeping results on your capstone designs to a panel of naval architecture and marine engineering professionals. The software package used, Maxsurf Motions, depends on a simplified analysis method (known as strip theory). In previous years, several panel members have expressed skepticism that such a simplified approach can produce realistic results. Your assignment is to write a paper addressing these concerns and argue in favor of or against the use of this program for capstone seakeeping analysis.

New Lab Assignment #2 - 2018

- Roll Motion in Beam Seas Lab – added simulation portion to the lab
- Complication: no electronic model available for the hull shape used in the experiment

This report is about the effect of damping on roll motion. You have completed two investigations into how damping changes the roll response of a ship. Your team must select an audience (high school students, EN400 students, 2/C ENM majors, sailors serving on surface vessels, etc.) and a message (what about the effect of damping do you want to communicate). Write a paper that uses the two plots generated (one from simulation and one from the experiment) and make your case for why the audience should be interested in this topic and then use the plots to explain what they need to know.

New Lab Assignment #3 - 2018

- Added simulation investigation to Ship Motions in Irregular seas Experiment

The EN455 class has been tasked with determining the answer to the following question:

- Does the motion of a DDG-51 allow for theoretical flight operations when operating in reasonable sea state conditions (SS4 through SS5)?

There is great interest in performing model tests. However, only head seas can be considered and there is only funding for one sea state to be considered. Therefore, you have been asked to investigate additional operating conditions using simulations. Your assignment is to conduct these investigations and give a report back to the customers with a description of your actions on their behalf and a summary of your findings.

New Lab Assignment #4 - 2018

- Combined final two experimental labs (Static Planar Motion Mechanism and Dynamic Planar Motion Mechanism) into one lab report

Your team has been asked to evaluate the directional stability of the FFG-7. In particular, you have been tasked to carry out appropriate experiments and calculations to determine:

1. the straight-line stability of the hull
2. the steady turning radius of the hull for a rudder angle of 20°

Your team will need to explain the details of the experiments carried out, explain the results from those experiments and the relevant calculations, and complete the task assigned.

Incorporating Revisions



Draft due dates – bring draft to class about 1 week before final report is due

- Peer reviews
 - Peer interviews
 - Conference meetings
- Required to include all feedback from revision meetings with final report

Reflection Papers (I now have 4 -5 reflection papers per semester)



Data showing improved results

From the first three semesters: 2012, 2013, and 2014

- Mentions Labs as most effective learning experience in this course: **33**
- Mentions Lab Reports as most effective learning experience: **1**

From the last three semesters: 2016, 2017, and 2018

- Mentions Labs as most effective learning experience: **26**
- Mentions Lab Reports as most effective learning experience: **13**

Still working on...

Rubrics! Currently I use a series of questions about the structure/content of the report:

- Does the introduction effectively present the issue and the hypothesis, while evoking reader interests?
- Is there appropriate and sufficient evidence? Is the argument well-developed with appropriate details? Does it follow the principle of independent redundancy (tells in words the same story told by the graphic)?
- Is the data correctly analyzed? Are the graphics appealing and easy to read? Do the graphics have effective labels and/or legends? Are the graphics referenced in the text?



Still working on...

Rubrics! Bean has a model rubric (p. 271) that I hope to modify and try next year

- Groups topics by content/ideas, organization, vocabulary/word choice, voice, sentence fluency, and conventions.
- Rates by Does Not Meet, Partially Meets, Does Not Fully Meet, Meets, More Than Meets, and Exceeds.

Questions?

- You can do this – start small (one assignment) and see what happens!
- It has made my life SO much better!

