

Ultrasonics – Spring 2022 Term Project

15% of Final Grade

Memo: 31 March 2022

Presentations: 3, 5 May 2022

Reports Due: 14 May 2022

Project Objectives

The field of ultrasonics is vast in scope. For that reason alone it is impossible for one course to cover even a small portion of the many specific areas of research that may be of high interest to each individual student. The course content has accordingly focused on fundamental physics describing wave propagation, acoustic sources and their resulting fields, and the basics of acoustic imaging and Non-Destructive Testing. The course project gives you the opportunity to explore a specific area of research associated with the field of ultrasonics of your choosing and to delve into levels of detail which limited course lecture time prohibits.

The project will be done in groups of two. There are two specific reasons for making this a “group” project. 1) Most projects of a practicing engineer or researcher are truly group projects that require interaction with others. The ability to coordinate research efforts and produce high level work is indispensable in the work place and in research. 2) Practically speaking, the time restriction for project presentation and the expected quality of work prohibits individual projects.

Scope

The project may be in one of two forms: (I) Literature review, representative modeling, and exposition of ultrasonic fundamentals related to a chosen application and (II) Literature review and experimentation or analysis of data. Regardless of your choice, *I expect detailed and coherent projects displaying a high level of understanding of the fundamentals introduced in this class with the specific application to the subject you have chosen for your project.* Note that some of the results of past projects have been of sufficient quality to lead to archival publication and conference presentations. I have no policy against using ongoing research projects, however, you must clearly demonstrate that the work you report for your project is not simply a facsimile of existing work.

Deliverables

1. One page Project Identification Report. Due **Thursday, March 31**
2. Project Presentations. Given **May 3, 5**
3. Project Report: Due **May 14**

The *project memo* is a very short report that should simply identify the team members, the subject of the project, and provide information on the project topic including any potential obstacles. A list of pertinent references and a reasonable assessment of what

will be undertaken to complete the project must be summarized. The length of the progress report will be limited to two pages excluding references. You do not have to fill two entire pages for this. The purpose of the progress report is to motivate early work on the project and avoid the last-minute crunch that results in poor quality project work. The progress report provides me with an understanding of how well you have done your homework regarding the topic and will guide me in prompting you to look into another topic or focus on a slightly different area.

The *project presentation* is limited to 15 minutes per team. Though this is a short time period, it is meant to reflect the time allotted for presentations at common conferences. Both group members must present a section of the presentation. The presentation must be done in a pedagogical fashion. In other words, each presentation should successfully capture the fundamentals involved with the specific research area and clearly show their implementation. Everyone in the class should learn something from every project and your presentation is the method of conveying what you learned to the class. This is your chance to show that you have gained significant knowledge in the fundamentals and how it applies to this area which has piqued your interest.

The *project report* will be limited to 15 pages not including references (1.5 spacing, 12 point font, and 1 inch margins). Think of this report as a short review giving a detailed summary of the important scientific contributions pertinent to the development of the topic you have chosen packaged together with a clear and concise analysis of an example from (i) the literature and (ii) your modeling or (iii) your experimentation. The objective is to clearly display that you understand the topic you have chosen and relate it to fundamentals we have covered (or will have covered) in class. Prove to me that you are able to take the background from class and apply it to do research.

Potential Project Subjects (You **do not** have to choose something from this list)

1. NDT in viscoelastic media
2. NDT in anisotropic media
3. NDT of elastic waveguides
4. Characterization of bone or tissue
5. Simulation of ultrasonic fields and ultrasonic images. You may use open source software (*i.e.* Field II or FOCUS) or generate your own code.
6. Scanning acoustic microscopy
7. Surface acoustic wave (SAW) devices
8. Capacitive micromachined ultrasonic transducers (CMUT)
9. High Intensity Focused Ultrasound (*non-linear acoustics*)
10. Ultrasonic acoustic metamaterials and applications
11. Tissue harmonic imaging (*requires non-linear acoustics*)
12. Correlation imaging, *a.k.a.* NDE without a source.
13. Air coupled ultrasonic measurements, transducers, and techniques
14. Ultrasonic bulk damage assessment (microcrack detection)
15. Resonant ultrasonic spectroscopy (RUS)
16. Ultrasonic corrosion monitoring
17. Ultrasonic chemical sensors
18. Contrast agents for biomedical imaging purposes
19. Acoustic radiation force and particle manipulation using acoustics