Motivation:

The purpose of this course is to provide a good background in computational acoustics, as complete as is possible in one semester. The two major themes of the course are to provide

A. instruction in using modern commercial packages for solving acoustics problems and

B. a good understanding of the fundamental background knowledge so that you can use the commercial packages correctly and effectively.

Another goal of the course is to provide exposure to many of the important tools in acoustics available today including:

• symbolic manipulation programs such as Mathematica,
• finite differences, finite elements, and boundary elements,
• scientific visualization, and
• sound propagation algorithms.

Hands-on use of SYSNOISE (LMS) and demonstration of COMET/Acoustics (Collins and Aikman) packages is emphasized for solving noise and vibration problems with the acoustic finite element and boundary element methods. Guidelines are given for choosing the right numerical approach, generating meshes, and solving problems in areas such as product noise, structural acoustics, aeroacoustics, and automobile and aircraft interior noise. Time domain, frequency domain, and fluid-structure interaction problems are all addressed.

Some of the Topics Covered:

1. Using PCs and UNIX workstations -- important commands and numerical analysis issues
2. Visualizing and postprocessing acoustic data -- integrated symbolic/graphics packages
3. Transient analysis of acoustic waves -- fundamentals of discretization and meshing for waves
4. Modal and forced responses of arbitrary cavities using finite elements -- for example an automobile or airplane interior
5. Acoustic radiation and scattering predicted using boundary elements -- for example product noise control approaches to minimizing radiation, barrier design, underwater scattering
6. Acoustic contribution analysis and sensitivity analysis -- for acoustic design optimization
7. Additional topics of student interest – high frequency approaches, fuzzy structures analysis, acoustic infinite elements, h-p adaptive approaches, and acoustics and the Internet
Organization:

Class usually meets in 214 Applied Science Bldg. MWF from 11:15 AM to 12:05 PM. In addition, numerous make up classes will need to be scheduled due to instructor travel conflicts. (For example, most classes on Fridays in February will need to be rescheduled.) The class meets for 15 weeks for a total of 45 class hours. The first day of class is January 7, and the last day of class is April 26. Class prerequisite: ACS 502, or ACS 510, or instructor consent.

This class was called ACS 597D or 597C in previous semesters, so you will see ACS 597D or ACS 597C on many of the class handouts.

If you have not passed your Ph.D. comprehensive exam, and wish to sit in on this course, you must take it for AUDIT credit. Many students have done this in previous semesters. See the PSU Schedule of Courses for additional information.

If you have passed your Ph.D. comprehensive exam or are a faculty or postdoc., you are welcome to simply “sit in” on the course. Only students taking this course for credit or audit will be given specialized computer accounts associated with the course.

Books:


*I-DEAS Student Guide*, by Mark H. Lawry. Structural Dynamics Research Corporation, Milford, OH, 1999, www.sdrc.com. [This is still being finalized --- but probably will be required. It won’t be needed for several weeks.]

Selected reprints in a course packet at the Penn State Bookstore on campus. These will be ready in a few weeks and are printed on an as-needed basis by PSU business services, so ask for one if they are sold out. [Required.]

SYSNOISE theoretical/user manual photocopies. These will appear at Gnomon Copy Service, 130 W. College Ave., later in the semester. [Required.]


Computational Facilities:

HP 9000/720, sabine.acs.psu.edu, DEC Alpha AXP600, evelyn.acs.psu.edu, New SUN workstation, thales.acs.psu.edu, 2nd floor of Applied Science Building


Keepers of Computational Facilities:

Germain (a.k.a. Yong-Sin Hwang), system administrator: yuh104 @ psu.edu

Andy Doller, system administrator emeritus: andy @ sabine.acs.psu.edu
Rough Outline: (not necessarily in order)

<table>
<thead>
<tr>
<th>Number of lectures</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Getting Organized</td>
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<td>2</td>
<td>Numerical Analysis Issues</td>
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<td>2</td>
<td>Symbolic Methods</td>
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<td>5</td>
<td>Finite Difference Methods</td>
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<td>The Fast Field Program</td>
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<td>The Parabolic Equation</td>
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<td>1</td>
<td>Propagation Summary</td>
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<tr>
<td>3</td>
<td>Acoustic Finite Elements</td>
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<td>2</td>
<td>Grid Generation</td>
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<td>4</td>
<td>Acoustic Boundary Elements</td>
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<tr>
<td>4</td>
<td>Boundary Element Applications</td>
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<tr>
<td>2</td>
<td>Coupled FE and BE</td>
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<tr>
<td>1</td>
<td>Infinite Elements</td>
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<tr>
<td>2</td>
<td>Scientific Visualization</td>
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<tr>
<td>1</td>
<td>Programming RISC/parallel Machines</td>
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<tr>
<td>several</td>
<td>Current Trends in Computational Acoustics</td>
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</tbody>
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Grading:

- 2 Quizzes (on theory), (10% each) 20%
- Homeworks, (5 to 10% each) 45%
- Project: - class presentation 5%
- handed in portion 30%

100%

There is no final exam. All quizzes are open book. For unexcused late homeworks, 20 percent will be deducted for every day the homework is late. 20 percent also will be deducted for every day that the final project is late.

Some mild computer programming will be required in this class. The computer languages used in this class include Fortran, C, MATLAB, and Mathematica. Others languages may also appear. For certain homework assignments the class will receive code fragments in a particular language, such as Fortran, and students will be expected to finish the assignment using that programming language. The instructor will be glad to help you here.

Class Homepage:

A WWW homepage has been set up for this class (think Computational ACS):
http://www.acs.psu.edu/users/sparrow/classes/spring2002CACS.html

Please tell me what additional information you would like to see there.

Suggestions for doing well in the course:

Ask lots of questions, and ask them as soon the topics come up. It is very important that you fully understand the earlier material before we move on. Do the homework, and do it on time! That is where you actually learn the material.