Arising in the study of vibration, resonance, and stability phenomena in many physical systems, eigenvalues are a fundamental tool. Yet most researchers focus on one or two of the numerous steps necessary to move from physical system to numerically computed eigenvalues. In this informal seminar we shall intentionally study these various steps, considering the compromises made along the way, and the steps we take to ensure the numbers that result from this process bear some physical significance. These steps roughly encompass:

- physical system → mathematical model
- mathematical model → infinite dimensional linear system
- infinite dimensional linear system → large discretization matrix
- large discretization matrix → small projected matrix
- small projected matrix → eigenvalues (ideally with high relative accuracy)

Syllabus

Objectives: Students in the Eigenvalue Clinic learn the various steps required to convert a physical problem into an eigenvalue, which can then be solved numerically to high precision.

Outcomes: Upon completing this course, students should be able to:
  1. Appreciate the physical origin of eigenvalue problems;
  2. Understand how discretization can introduce spurious/inaccurate eigenvalues;
  3. Evaluate the merits of eigenvalue algorithms for a given problem.

Meetings: Monday, 11-11:50 am, Duncan Hall 2014

Instructor: Mark Embree (embree@rice.edu); Duncan Hall 3019/Abercrombie 101, (713) 348-6160
Office Hours: TBA, or by appointment

Credits: 1 credit

Grades: Students will be evaluated on their active participation in their seminar, which includes weekly attendance, engagement with recommended reading, and occasional numerical experiments to further the goals of the seminar (50% of grade).

Each student will complete a final paper (50% of grade) focusing on experiments with one particular topic or model problem described in the seminar. Details of this assignment (roughly 5–10 pages in duration, including plots and references) will be provided by February 22. This paper will be due on the last day of final exams (May 1).

Honor Code: Most work will be performed by the seminar as a whole; students are welcome to use outside resources (published material, software, other researchers) for the final paper. The final write-up must be each student’s individual work.

Text Book: There is no text book for this course. We will consult a variety of papers and research monographs throughout the semester.

Any student with a disability requiring accommodation in this course is encouraged to contact to contact the instructors, and also to contact Disability Support Services in the Ley Student Center.