APPM 4380/5380: Modeling in Applied Mathematics   Fall 2017

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Textbook: A preliminary book manuscript is posted on the class D2L page.

Course motivation:
The 'life-blood' of all parts of applied mathematics is applications. In spite of that, both analytical and numerical techniques are traditionally taught in very 'encyclopedic' fashions (and as two entirely separate subjects). Key techniques are often enumerated in ways that are better suited for reference works than for first introductions. In contrast, this course will be centered on examples of how one carries through all the steps: problem -> mathematical formulation -> theoretical analysis -> numerical solution.

Course Goals:
1. Provide illustrating examples of major modeling tasks of current significance.
2. Convey practical approaches of how to approach problems not originally stated in mathematical form.
3. Introduce a number of key techniques from analysis and numerics (only at the points where these are needed).

Course Topics:
These topics have been selected in such a way that, between them, they involve (and can serve as a first introduction to) a broad range of interconnected analytical and numerical methods.

· Tomographic image reconstruction: for example, as applied in medical imaging
· Freak ocean waves: isolated giant waves, which frequently damage or sink large ships
· GPS (Global Positioning System): satellite-based system for accurate navigation
· Automated facial recognition from images

Student Learning Objectives:
These learning objectives are motivated by skills sought after in industry but not often acquired in other courses – see the SIAM Report on Mathematics in Industry (these skills are also important for academic mathematicians):

1. Formulate, model, and solve problems from diverse and changing areas
   • Formulate a problem mathematically
   • Apply analytically techniques to problems where appropriate
   • Apply appropriate numerical methods for the given problem
2. Communication skills (oral and written)
3. Adeptness at working with colleagues (teamwork)

Course grading:

Project 1	50 points
Project 2	50 points
Project 3	50 points
Project Reflections	150 points
Take-home Exam	50 points
Final Project	150 points
TOTAL	500 points