Spring 2010
CSE598C: Meshing Techniques
Course Announcement

Instructor: Suzanne M. Shontz

Meeting Time and Place: Tuesdays, 2:30-5:30 PM; 223B IST Building.

Schedule number: #463087

Number of credits: 3

Prerequisites: CMPSC/MATH 451 or CMPSC/MATH 456 or instructor approval.

LIMIT: 16 students.

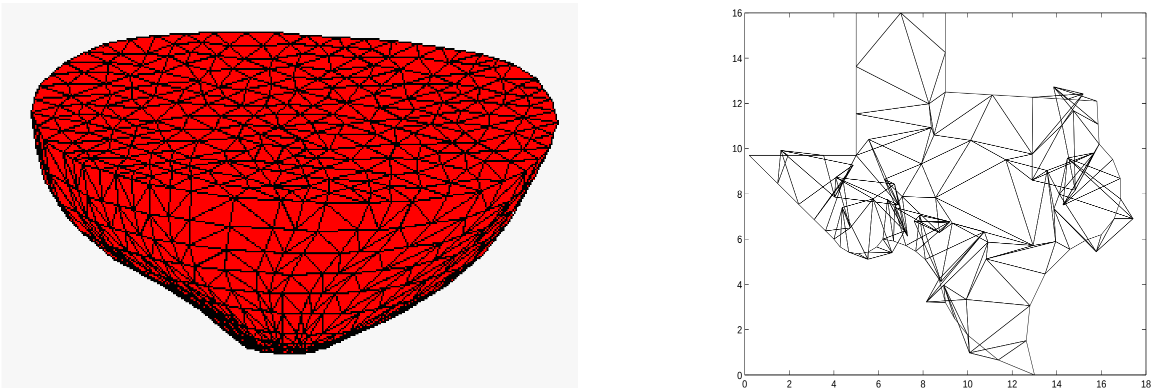

Figure 1: Left: Biomedical Mesh; Right: Tangled mesh from P. Vachal, R.V. Garimella, M.J. Shaskov. "Untangling of 2D meshes in ALE simulations", Journal of Computational Physics, 196, p. 627-644, 2004.

Syllabus: Unstructured and structured meshes occur in numerous applications including: cardiology, computer graphics and vision, bridge and building design, geological flows, climate simulation, and magneto-hydrodynamics. Such meshes are routinely used in the solution of partial differential equations (PDEs); meshes generated for computer graphics/vision are most often used for rendering or animation. A challenging open question is automatic generation of high-quality meshes for complicated geometries. We will discuss and analyze several existing mesh generation algorithms. Because meshes generated via automatic mesh generation techniques or moving mesh algorithms are not always of an acceptable quality, we will also study optimization-based mesh quality improvement methods. We will cover algorithms for other important meshing problems including mesh morphing, adaptive mesh refinement, and mesh compression. Finally, we will explore important connections to PDEs, solvers, and applications.

The course may be of interest to students and faculty from

- computer science
- applied mathematics
- mechanical or civil engineering
- other application fields dealing with meshes (such bioengineering, architectural engineering, geology, physics, biology, etc.)

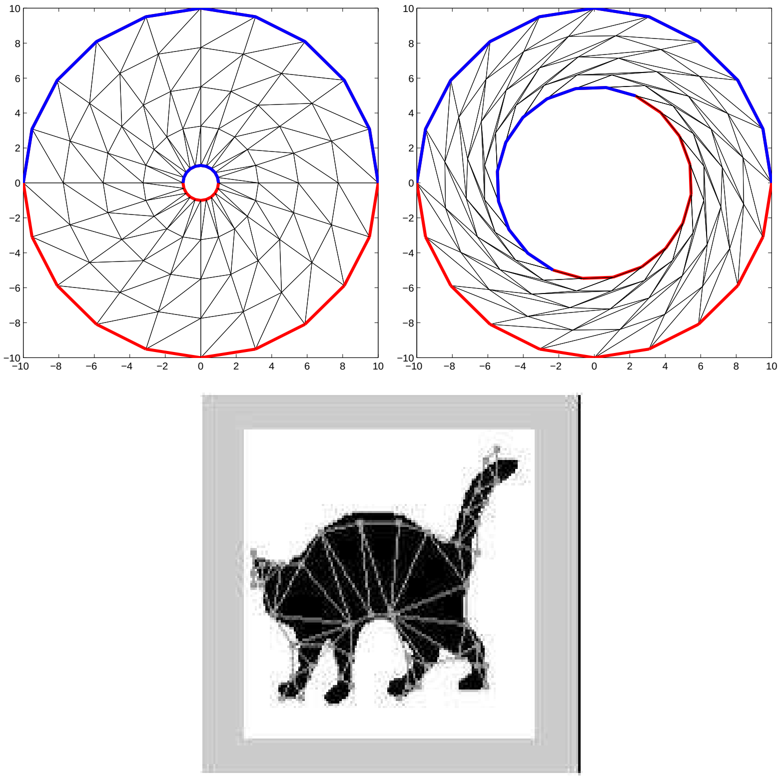

Figure 2: Top: Meshes generated using morphing; Bottom: Mesh from computer vision application, courtesy of Jibum Kim, PSU.

Course Outline:

- Connection of meshes to PDEs and applications
- Delaunay mesh generation
- Advancing front mesh generation
- Quadtree/Octree mesh generation
- Additional mesh generation techniques
- Mesh quality improvement methods
- Mesh and solver connection
- Mesh morphing
- Adaptive mesh refinement
- Mesh compression

Evaluation: Students will be evaluated according to the following scheme:

- Class Participation = 10%
- Homework = 40%
- Project = 50%
  - Material (Code, Theory, Etc.) = 35%
  - Presentation and Report = 15%