CSE621: PHYSICS-BASED MODELING AND SIMULATION FOR VISUAL COMPUTING
(Course Syllabus, Spring Semester, 2005)

- **INSTRUCTOR:** Professor Hong Qin
- **OFFICE:** Room 2426, Computer Science Building
- **CONTACT INFORMATION:** qin@cs.sunysb.edu, 631-632-8450
- **LECTURES:** MW 2:20pm — 3:40pm, Social and Behavioral Sciences N107 (it is possible that we will move our lecture back to our CS Seminar Room (Rm.1306) after the first lecture)!
- **OFFICE HOURS:** Monday 9:00am — 11:00am, Wednesday 12:00pm — 2:00pm or by appointment!
- **CREDITS:** 3

SYNOPSIS:

The central theme of this advanced graduate course is on physics-based modeling and dynamic simulation, as well as their widespread applications in the entire spectrum of visual computing discipline. Throughout this course, we take a unique, unified, physical approach to various visual computing fields such as graphics (image synthesis), visualization, computer-aided geometric design, biomedical image processing, vision (image analysis), human-computer interaction, and virtual environment. Our objective is to demonstrate that physics-based modeling and computing is a fundamental and enabling computational framework that can facilitate visual information processing in general. Towards this goal, the course will explore research topics centered on physics-based modeling and simulation methodology and associated computational methods for tackling theoretical and practical problems in widespread areas of visual computing. The specific emphasis will be on: the rich theory of mathematical physics, geometric and solid modeling based on PDEs and energy optimization, deformation-centered geometric design techniques, wavelets and multi-resolution analysis, deformable models for shape estimation and reverse engineering, variational analysis, optimization methods, level-set methods, numerical techniques with finite-difference and finite-element algorithms, differential equations for initial-value and boundary-value problems, force-driven haptic interaction, constraint satisfaction methods, dynamic sculpting system, animation of flexible objects, simulation of physical worlds, and a large variety of applications for visual computing.

PREREQUISITES:

CSE328, or CSE528, or permission of the instructor.

Computer Science background: programming, graphics/visualization.

Mathematics sophistication: calculus, algebra, geometry.

MAJOR TOPICS:

Mathematical Physics, Energy Optimization, and Variational Analysis

PDE-based Geometric and Solid Modeling

Deformable Models and Level-set Methods

Interactive and Dynamic Geometric Design

Numerical Techniques and Analysis

Graphics, Vision, Visualization, and Virtual Environments

Visual Computing Applications

REFERENCES and LECTURING:

There are **no** particular textbooks for this course because it is an advanced graduate course! The majority of the course material will come from research papers and relevant reference books. Numerous slides and video tapes will be shown. Students are advised to attend the class and follow the lecturing notes closely! **Class attendance is critical!**

PAPER RESOURCES:

Relevant journals and conferences' proceedings (most of them available in our CS library and other libraries on campus) are primary resources. Typical journals relevant to this course include, but are not limited to, ACM TOG, IEEE TVCG, IEEE CG&A, CAD, CAGD, Graphical Models, The Visual Computer, Computer Graphics Forum, IEEE PAMI, IJCV, IEEE Transactions on Medical Imaging, etc. Major conferences include Siggraph, Vis, Eurographics, Pacific Graphics, Graphics Interface, Solid Modeling, Shape Modeling, ACM I3D Symposium, ICCV, CVPR.

GRADING SCHEMES:

There are no midterm tests! There is no final exam, either! However, this course is a project-oriented course, emphasizing a "hands-on" approach to both **the better understanding of fundamental concepts and techniques** and the improved programming and problem-solving capabilities through paper presentation and course projects. Each student is required to present one or two papers throughout this semester, finish one programming assignment, and complete a course project. Consult with the instructor for relevant papers that you need to present in the class. The programming assignment and course project require basic knowledge of C/C++/OpenGL or other relevant programming languages and environments. You are expected to become a competent programmer in C/C++ at the end of this course. The entire 100% of the course grade will be allocated as follows: (1) 15% for paper reading and presentation of other people's work; (2) 5% for one assignment; and (3) 80% for course project. The grade for course project, in particular, consists of: (1) two-page project proposal (10%), (2) preliminary demonstration at the middle of the semester (10%), (3) oral presentation and final demonstration (20%), (4) the working prototype system along with all the software codes (20%), and (5) final project report (10–15 pages) (20%). The deadlines to finish the above checking points will be announced later. However, my advice to everyone is: **start early!** Note that, there are two ways to finish your course project: (1) you can work on your own **(individual project)**; or (2) you can team up with another student **(group project)**. Detailed mechanism to grade your project for the above two approaches will be discussed in the lecture.

The work submitted should be your own! Late assignments will be penalized 25% per day. Furthermore, because a primary goal of the course is to teach professionalism, any academic dishonesty (e.g. plagiarism) will be viewed as a serious academic offense, thus as an evidence that the above goal has not been achieved and will be grounds for receiving a grade of F (Please refer to CEAS Procedures and Guidelines Governing Academic Dishonesty (1/81) for details).

Machine failure should not be a reason to delay assignment due dates unless there is a **massive catastrophe**, which will be announced by the instructor. Consider the possibility that machine failure may happen and then contention for machines will occur, my advice to all of you is that please start projects as early as possible!

All graduate students should have access to the Grad PC Lab (located in Rm. 1239). The version of OpenGL in the Grad PC lab is V1.1, the same as the TransLab. If you don't have access to the lab, please talk to the instructor and email to root requesting the (grad) course accounts.

INFORMATION DISTRIBUTION

The syllabus and other detailed information are also available on-line at the CSE621 course website. The instructor is working hard to put all of the course material on the course website!

SPECIAL NOTES:

If you have a physical, psychological, medical or learning disability that may impact on your ability to carry out assigned course work, I would urge that you contact the staff in the Disabled Student Services office (DSS), Room 133, Humanities, 632-6748v/TDD. DSS will review your concerns and determine with you what accommodations are necessary and appropriate. All information and documentation of disability are confidential.