

## Announcing the Final Examination of Jaruwan Mesit for the degree of Doctor of Philosophy

Time & Location: November 2, 2010 at 10:30 AM in HEC 302

Title: MODELING AND SIMULATION OF SOFT BODIES

As graphics and simulations become more realistic, techniques for approximating soft body objects, that is, non-solid objects such as liquids, gases, and cloth, are becoming increasingly common. The proposed generalized soft body method encompasses some specific cases of other existing models enabling simulation of a variety of soft body materials by parameter adjustment. This research presents a general method of soft body model and simulation in which parameters for body control, surface deformation, volume control, and gravitation, can be adjusted to simulate different types of soft bodies. In this method, the soft body mesh structure maintains configuration among surface points while fluid modeling deforms the details of the surface. To maintain volume, an internal pressure is approximated by simulated molecules within the soft body. Free fall motion of soft body is generated by gravitational field. Additionally, a constraint is specified based on the property of the soft body being modeled.

There are several standard methods to control soft body volume. This work illustrates the simplicity of simulation by selecting a mass-spring system for the deformation of the connected points of a three-dimensional mesh, while an internal pressure force acts upon the surface triangles. To incorporate fluidity, smooth particles hydrodynamics (SPH) is applied where surface points are considered as free moving particles interacting with neighboring surface points within a SPH radius. Because SPH is computationally expensive, it requires an efficient method to determine neighboring surface points. Collision detection with soft bodies and other rigid body objects also requires such fast neighbor detection. To determine the neighboring surface point, Axis Aligned Bounding Box (AABB), Octree, and a partitioning and hashing schemes have been investigated and the result shows that the partitioning and hashing scheme provides the best frame rate. Thus a fast partitioning and hashing scheme is used in this research to reduce both computational time and the memory requirements.

The proposed soft body model aims to be applied in several types of soft body application depending on the specific types of soft body deformation. The work presented in this dissertation details experiments with a variety of visually appealing fluid-like surfaces and organic materials animated at interactive speeds. The algorithm is also used to implement animated space-blob creatures in the Galactic Arms Race video game and a human lung simulation, demonstrating the effectiveness of the algorithm in both an actual video game engine and a medical application. The simulation results show that the general model of the soft body can be applied to several applications by adjusting the soft body parameters according to the appearance results.

Major: Computer Science

Educational Career:

Bachelor's of Computer Science, 1996, Rajabhat Institute Phetchaburi

Master's of Computer Science, 1999, National Institute of Development Administration

Committee in Charge:

Dr. Ratan K. Guha, Chair, Electrical Engineering & Computer Science

Dr. Mostafa Bassiouni, Electrical Engineering & Computer Science

Dr. Sheau-Dong Lang, Electrical Engineering & Computer Science

Dr. Brian Goldiez, Institute for Simulation & Training

Dr. Matthias R. Brust, Electrical Engineering & Computer Science

Approved for distribution by Dr. Ratan K. Guha, Committee Chair, on September 22, 2010.

The public is welcome to attend.