SCHOOL OF INFORMATICS AND COMPUTING

Computer Science Colloquium Series

Endre Somogyi

School of Informatics and Computing

Friday, April 14, 2017

3:00 PM

Lindley Hall, Rm. 102

Interactive Simulation and Knowledge Sharing of Active Soft-Matter Physics Models

Abstract: From flocks of starlings to schools of fish, nature is full of intricate dynamics that emerge from the collective behavior of individuals. In recent years, interest has grown in trying to formalize and understand this type of dynamics to make self-assembling materials from so-called "active matter." Active matter is composed of a large number of discrete, active components, each of which consumes energy and interacts with its local environment with chemical, electrical and mechanical processes. (Examples of active matter include self-organizing bio-polymers such as microtubules and actin, biological cells, tissues, flocks of birds, and artificial self-propelled vehicles)

Modeling and simulation of active matter poses a number of computational challenges. We need to describe, capture and share model specifications. Though we have made significant progress formalizing structural knowledge such as protein structure and imaging, formalizing behaviors, dynamics, and interactions is still a challenge. Active matter simulations model interactions between deformable objects and either solid or deformable objects, and require fast computational methods for deformable meshes and efficient collision handling techniques.

In this talk, I will introduce the Mechanica simulation environment which will enable construction and real-time simulation of physics-based models of interacting solids and deformable objects.

This talk will discuss how we build on my previous work, and give an overview of how we: 1) formalize and represent physical concepts such as chemical transformations, force, geometry, elasticity, fibers, membranes, and volumes, 2) enable model sharing of physics-based models that describe both structure and dynamics, 3) separate model specification from computational implementation, 4) translate high level physics concepts into real-time interactive simulations, 5) perform interactive physics simulations utilizing CPU and GPU, and 5) integrate into existing applications.

Biography: Andy Somogyi is a postdoctoral research scientist in Intelligent Systems Engineering, and a lecturer in Computer Science. He has an undergraduate degree in Electrical and Computer Engineering from University of Colorado and a PhD in Physics from Indiana University. Andy developed the first and only Just In Time compiler for the Systems Biology Modeling Language as part of his PhD research. This resulted in the fastest known SBML simulation engine and has enabled research ranging from synaptic cleft up to virtual liver simulations. Previously he worked as a Galileo International (now Orbitz.com) where he architected large-scale client server applications and designed custom scripting languages which enabled users without any formal training to automate airline reservation workflows. Andy's research combines and builds on his previous work in real-time physics simulations, chemical reaction modeling and language design to build simulation environments for interactive simulation of active, visco-elastic matter.

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