CROWD SIMULATION

CIS-700 Special Topics Seminar Course
Tuesday and Thursday 1:30-3PM
SIG Center Conference Room

Norman Badler
Soraia Musse (Pontifícia Universidade Católica do Rio Grande do Sul PUCRS)
Claudio Jung (Federal University of Rio Grande do Sul)
Prerequisites: Preferably CIS 460/560 and CIS462/562 or equivalents

Crowd simulation involves computational algorithms and structures to control, navigate, and animate individual virtual people acting in groups in meaningful environments. We begin with the lowest level of footstep determination to steer agents in collision-free paths. Steering choices are controlled by navigation in complex environments, including multi-domain planning with dynamically changing situations. Virtual agents are given perceptual capabilities analogous to those of real people, including sound perception, multi-sense attention, and understanding of environment semantics that affect their behavior choices. The roles and impacts of individual attributes, such as memory and personality are explored. The animation challenges of integrating a number of simultaneous behavior and movement demands on an agent are addressed through an open source software system called ADAPT. Creating stories and narratives with groups of agents involves planning and environmental constraints.

Computer graphics issues abound, including determining what details are important perceptually, scaling to thousands of agents, optimizing agent display requirements, adding secondary objects to agent models, animating specialized scenarios such as evacuation or stampedes and how injuries occur, determining how context affects behavioral choices and realism, exploiting “Artificial Intelligence” techniques for group simulations, enhancing agent perceptions and reactions to sensory stimuli, and obtaining data from real crowds (e.g., movement, density, etc.) to guide and/or validate simulation results.

The course will consist of contemporary readings, individual presentations or book chapters and research papers, assignments to utilize one or more existing simulation systems and a significant implementation project. Base code and systems will be available. Implementations will usually be grounded in the Unity3D game engine. Grades will be based on quality of presentations, class participation, assignment completion, and project work.

Visiting speakers will complement student presentations. So far these include Profs Musse and Jung, and visitors Mubbasir Kapadia from Rutgers and possibly a crowd simulation TD from Blue Sky Studio.

Resources:

N. Pelechano, J. Allbeck, and N. Badler. *Virtual Crowds, Methods, Simulation and Control*. Synthesis Lectures on Computer Graphics and Animation, Morgan & Claypool, 2008. [Free download in Penn domain]

M. Kapadia, N. Pelechano, J. Allbeck, and N. Badler. *Virtual Crowds: Steps Toward Behavioral Realism*. Morgan & Claypool, 2015. [Free download in Penn domain, as soon as it is released]

D. Thalmann and S. Musse. Crowd Simulation. Springer, Second Edition, 2013. [Free download in Penn domain]

Various papers and proceedings, online.