2005 Graphics and Visualization Student Symposium Agenda

Date: Tuesday, December 6
Time: 8:00 AM – 6:00 PM
Location: GN-K35, IBM TJ Watson Research Center, Hawthorne, NY

8:00 – 8:30 AM:	Students Arrive at IBM Research Continental Breakfast GN-K35
8:30 – 8:40 AM:	Welcome, *Chris Morris* GN-K35
8:40 – 9:00 AM:	IBM Research Overview, *Jay Murdock* GN-K35
9:00 – 10:30 AM:	Industry Solutions Lab Tour ISL
10:30 – 12:20 PM:	**Student Presentation Session I** GN-K35

10:30 – 10:55 AM: **Wei Shao**, New York University
Animating Autonomous Pedestrians

We address the difficult open problem of emulating the rich complexity of real pedestrians in urban environments. Our artificial life approach integrates motor, perceptual, behavioral, and cognitive components within a model of pedestrians as individuals. Our comprehensive model features innovations in these components, as well as in their combination, yielding results of unprecedented fidelity and complexity for fully autonomous multi-human simulation in a large urban environment. We represent the environment using hierarchical data structures, which efficiently support the perceptual queries of the autonomous pedestrians that drive their behavioral responses and sustain their ability to plan their actions on local and global scales.

10:55 – 11:20 AM: **Erdan Gu**, University of Pennsylvania
Multiple Influences on Attention Behavior for Embodied Agents

Our objective is to develop a computational model of the multiple influences on eye gaze behavior for an embodied (human-like) computer graphics agent in a dynamic environment. An embodied agent should possess human attention attributes so that its eyes and resultant body movements convey appropriate attending behaviors. Suppressed or inappropriate eye movements

can damage the visual effectiveness of an embodied agent. Visual attention models may be the key to leading animated agents out of the “uncanny valley” where increasing visual appearance accuracy results in a ghoulish appearance when animated. Attention and eye gaze behaviors are influenced by visual perceptual capability, human-like imperfect cognitive ability, as well as some aspects of internal cognitive state. Visual perceptual capability starts with an early vision process that exhibits changes in visual sensitivity such as night vision and flash blindness under changing scene illumination. Visual attention directs the limited gaze resource to resolve visual competition with the cooperation of top-down attention and conspicuous bottom-up guidance. The attention architecture first operates at the image level to automatically generate fixation sequences, and then extends to deal with dynamic image sequences. This model has four factors -- conspicuity, mental workload, expectation and capacity -- that determine successful attention allocation. The attention model replicates many aspects of normal human function as well as some of its imperfect behaviors, such as inattentional blindness. We will implement and integrate the attentional models into a virtual security guard environment, possibly transplanted into a virtual cab driver and a virtual teacher environment, in which gaze role is not only modeled based on the cognitive task, but also driven by peripheral events and their abrupt onset. Experiments with an agent-human collaborative system consisting of virtual agents and real subjects will help evaluate the plausibility of these models. The proposed research is to develop a computational attention model, quantify the inattention factors, add them to a general eye gaze model, apply the completed model to animated agents, and empirically evaluate the resulting naturalness and effectiveness of the agents. This comprehensive model should have broad application to improve embodied agent realism in diverse applications such as game characters, interpersonal training, and educational environments.

11:20 – 11:30 AM: Break

11:30 – 11:55 AM: **Pin Ren**, Northwestern University
IDGraphs: NetFlow Visualization for Intrusion Detection and Analysis

Traffic anomalies and attacks are commonplace in today's networks and identifying them rapidly and accurately is critical for operators of large networks. However, existing IDS systems offer only limited support for interactively examining detected intrusions and anomalies, analyzing worm propagation patterns, and discovering correlated attacks. These problems are becoming even more acute as the traffic on today's high-speed routers continues to grow.

IDGraphs is an interactive visualization system for intrusion detection that addresses these challenges. The central visualization in the system is a flow-level trace plotted with time on the horizontal axis and the total number of unsuccessful connections (indicating suspicious traffic) on the vertical axis. We then summarize a stack of tens or hundreds of thousands of these traces using the Histographs technique, which composites the traces and maps data density at each pixel to brightness. Users may then zoom into or interactively query the summary view, performing analysis by highlighting subsets of the traces. We apply IDGraphs to a real network router data-set with millions of flow-level records representing a total traffic in the terabyte range. The system successfully detects and analyzes a variety of attacks and anomalies.

11:55 – 12:20 PM: **Liliya Kharevych**, California Institute of Technology
Discrete Conformal Maps via Circle Patterns

In this talk I will introduce a novel method for the construction of discrete conformal mappings from surface meshes of arbitrary topology to the plane. Our approach is based on circle patterns, i.e., arrangements of circles - one for each face - with prescribed intersection angles. Given these angles the circle radii follow as the unique minimizer of a convex energy. The method supports very flexible boundary conditions ranging from free boundaries to control of the boundary shape via prescribed curvatures. To parameterize higher genus meshes we introduce cone singularities at designated vertices. The parameter domain is then a piecewise Euclidean surface. Cone singularities can also help to reduce the often very large area distortion of global conformal maps to moderate levels.

12:20 – 1:20 PM: Lunch
GN-K35

1:20 – 2:10 PM: Visual Technologies Lab Tour
4S-F34

2:10 – 3:25 PM: **Student Presentation Session II**
GN-K35

2:10 – 2:35 PM: **Carlos Scheidegger**, University of Utah
Advances in Point-Set Surface Processing

Recent developments in range-finder technology have made point set representations very popular. It is possible to define a smooth surface from point samples taken directly from a laser scanner, and the resulting surface is amenable to subsequent processing. We will talk about recent work that we have being doing in the area with different collaborators. First, we will describe a recently-published technique for meshing point-set surfaces that generates high-quality triangles and bounded error from the original surface.

We will then show how this technique easily generalizes to different and important problems. We have adapted the algorithm to compute an approximation to the point-set surface's Morse complex, a topological concept that has many geometric applications. By examining the Morse complex, we can for the first time perform quantitative comparisons between different point set surface definitions. We will also show how the same algorithm can be used for remeshing triangulated surfaces. Because of the local nature of the technique, we can perform both global and local remeshing, essential for many digital geometry processing techniques. Finally, we will discuss some future work, related to the underlying mathematics of the point-set surface definition and its shortcomings.

2:35 – 3:00 PM: **Xiaohu Guo**, Stony Brook University
Meshless Modeling, Animating, and Simulating Point-Based Geometry

In this talk, I will present a new geometric modeling, animation and simulation paradigm for point-based geometry: Dynamic Points, which are the unification of point geometry and physics-based modeling. At the geometric level, discussion will be focused on the issue of global conformal parameterization of the point-set surfaces. The point-based global parameterization is founded upon the rigorous mathematics of Riemann surface theory and Hodge theory. Within our parameterization framework, any well-sampled point surface is functionally equivalent to a manifold, enabling popular and powerful surface-based modeling and physically-based simulation tools to be readily adapted for point geometry processing and animation. At the physics level, I will demonstrate how physics can be integrated with point geometry for interactive simulation and animation in graphics. Specific applications include shape deformation based on the thin-shell finite element formulation, crack generation and propagation, etc. Some other applications in physics-based shape morphing, real-time large-scale dynamic volumetric deformation, dynamic surface editing, and surface completion will also be briefly introduced.

3:00 – 3:25 PM: **Peter Sibley**, Brown University
Vector Field Isosurface-based Reconstruction from Oriented Points

Extrapolating missing and noisy sensor data, and integrating multiple scans are challenging problems and active areas of research in the computer graphics and vision communities. In this talk we consider the problem of reconstructing implicit surfaces from oriented point clouds. We'll present some preliminary results using a new and simple formulation for the surface reconstruction problem. We'll also discuss some of the future directions we'd like to pursue in particular applications and acquisition methods.

3:25 – 3:50 PM: Intelligent Multimedia Interaction Lab Tour
1N-F20

3:50 – 4:15 PM: Everywhere Displays Demonstration
2S-K10

4:15 – 5:30 PM: **Student Presentation Session III**
GN-K35

4:15 – 4:40 PM: **Carlos Correa**, Rutgers University
Hands-In Visualization: An Active Approach for Interactive Manipulation of Volumetric Objects

Many scientific visualizations in medical illustration, surgical planning, dataset exploration and education, require an active approach, where the scientist is more an actor rather than a passive observer. By manipulating datasets, visualizations can be improved to allow the scientist gain understanding of 3D structures. We propose a more active or ``hands-in'' approach to data visualization, where scientists can manipulate their data just as if they were handling a physical model. These actions include moving, poking, pulling, stretching, peeling, opening and highlighting. By manipulating the model, one can overcome the occlusion, clutter and noise problems introduced during the

acquisition or generation process and elucidate the structural complexity that arises in many three dimensional objects. In this talk, I will describe two mechanisms that enhance current visualizations to allow visibility of interesting features and understanding of structure: highlighting and peeling. I will show how they can be implemented efficiently using GPU acceleration techniques in texture-based volume rendering systems, with the aid of a structure-based decomposition of the volumetric object. Our approach to visualization has wide applications in scientific visualization, as well as in illustration, exploration of large datasets, education and training.

4:40 – 5:05 PM: **Lujin Wang**, Stony Brook University
The Magic Volume Lens

In this talk, I will present our semantic zoom approach and volume lens framework. The size and resolution of images and volume datasets in science and medicine are increasing rapidly. A common deficiency of discretized datasets is that detail beyond the resolution of the dataset has been irrecoverably lost. We provide a method that generates the missing detail from any available and plausible high-resolution data, using constrained texture synthesis. Regular zooms become semantic zooms, where each level of detail stems from a data source attuned to that resolution. Another issue is that the amount of volume data that can be viewed simultaneous is limited. Therefore, we propose a volume lens framework, which is a focus+context technique that utilizes various magnification lens rendering techniques to magnify the features of interest, while compressing the remaining volume regions without clipping them away completely. All our lenses are accelerated on the GPU. They allow the user to interactively manage the available screen area, dedicating more area to the more resolution-important features.

5:05 – 5:30 PM: **Alark Joshi**, University of Maryland – Baltimore County
Effective Visualization of Time-Varying Data Using Illustration-Inspired Techniques

Traditionally, time-varying data has been visualized using snapshots of the individual time steps or an animation of the snapshots shown in a sequential manner. We propose new techniques inspired from the illustration literature to convey change over time more effectively in a time-varying dataset. Speedlines are used extensively by cartoonists to convey motion, speed, or change over different panels. Flow ribbons are another technique used by cartoonists to depict motion in a single frame. Strobe silhouettes are used to depict previous positions of an object to convey the previous positions of the object to the user. These illustration-inspired techniques can be used in conjunction with animation to convey change over time. We will also look at application domains where such techniques produce effective visualizations.

5:30 – 6:00 PM: Wrap Up and Final Comments
GN-K35

6:00 PM: Dinner
Tramonto’s