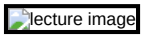

Special Guest Lectures

Resampling & Reanimating Free-Form Surfaces

Michael Garland

Johnston Hall 338
May 15, 2006 - 03:00 pm

Abstract:
Free-form polygon meshes are the one near-universal representation of 3-D shape. Their use is prevalent in diverse application areas ranging from video games to airplane design. Though ubiquitous and undeniably useful, free-form meshes also have their drawbacks. In particular, they represent a low-level representation that samples a shape at a single fixed resolution. In this talk, I will discuss some of my ongoing work aimed at making it possible to easily resample free-form meshes and retouch free-form animation. First, I will discuss an efficient scheme for automatically reducing the complexity of triangulated surface models. This makes it possible to adapt the complexity of a given surface model to the needs of any intended application, and is generic enough to be applied to piecewise-linear curves and tetrahedral volume data as well. A much more challenging problem is to resample a surface with a quadrilateral mesh. This is a problem of fundamental importance in surface parameterization, subdivision surface modeling, and computational fluid dynamics, among other applications. I will describe a method for solving this problem that is both efficient and flexible, and produces an output mesh composed entirely of well-shaped quadrilaterals with very few extraordinary points. We achieve this by using a topological construction -- the Morse-Smale complex -- to uncover the structure of the eigenfunctions of the Laplace operator on the surface. This induces a decomposition of the surface into quadrangular patches that arises quite naturally from its intrinsic geometry. As with images, one of our primary motivations for resampling surfaces is to create a hierarchical structure that can make shape signal processing and editing much more tractable. I'll conclude by showing how we use such a hierarchy, and a novel time-varying transform technique, to both compress and edit free-form surface animation such as might be produced by cloth simulation or motion capture.

Speaker's Bio:
Michael Garland holds a B.S. in Mathematics/Computer Science and a Ph.D. in Computer Science, both from Carnegie Mellon University. He joined the Department of Computer Science of the University of Illinois at Urbana-Champaign as an assistant professor in 1999. He is also an affiliate of the Computational Science and Engineering Program and a member of the Center for Process Simulation and Design. His research is primarily in the field of computer graphics, specifically on the design of algorithms for creating, editing, processing, and rendering complex mesh models. He has been actively engaged in work on the problems of surface simplification, remeshing, texture synthesis, novice-friendly modeling, free-form animation, scientific visualization, and visualizing complex graphs.

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