Simulation-enhanced Visual Computing for Real World Applications

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Abstract

Computer graphics techniques enable the creation of rich digital content that can react to the external environment in a physically realistic manner. Advances in digital data acquisition and portable display devices carry the promise of extending the capability of these techniques beyond animation to revolutionary new use cases, such as medical diagnosis and treatment, computational design and fabrication, and online education. To unleash the full potential of these methods, however, there is a need for computational algorithms and data structures that allow for high-fidelity simulations in interactive settings. A particularly interesting and challenging aspect of this problem is that of organizing computation on modern hardware platforms that are becoming increasingly heterogeneous, i.e., workstations equipped with several bandwidth-optimized accelerator cards. In this talk, I will detail the steps I have taken towards addressing this challenge. In particular, I will present a data structure that exploits the virtual memory management system to efficiently store and process multiple data channels on highly irregular voxelized domains with over a billion degrees of freedom on a single workstation. I will describe a numerical solver that benefits from the high memory and compute bandwidth of GPU accelerators even for problem sizes that are too large to fit entirely on GPU memory, and I will briefly summarize methods for simulating complex multi-material interactions with dynamic objects.

Bio

Dr. Mridul Aanjaneya is a postdoctoral researcher in the Department of Computer Sciences at the University of Wisconsin - Madison. Prior to joining UW Madison, he obtained his Ph. D. in Computer Science from Stanford University. While at Stanford, he also worked as a consultant in the Spatial Technologies team at the Nokia Research Center for two years. Mridul's research lies at the intersection of Computer Graphics, Scientific and High

Performance Computing, Computational Physics and Applied Mathematics. More specifically, he is interested in the design of models, computational techniques and robust numerical algorithms that can facilitate high-level tasks such as the use of simulations for medical diagnosis and treatment, computational imaging, or autonomous navigation in complex external environments.

Faculty Host: Mubbasir Kapadia and Dimitris Metaxas