Digital humans, virtual surgery and fast fluids; do they have more in common than their hunger for performance?

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Abstract: Physics-based modeling research in graphics has been consistently conscious of advances in modern parallel hardware, leveraging new performance capabilities to improve the scope and scale of simulation techniques. An exciting consequence of such developments is that a number of performance-hungry emerging applications, including computer-aided healthcare and medical training, can now hope to be accommodated in interactive systems. Nevertheless, while large-scale simulation for production-grade visual effects always had the option of clustering computer resources to keep up with growing needs, realtime or near-interactive applications face a more complex set of challenges. In fact, extracting competitive levels of efficiency out of modern parallel platforms is more often than not the result of interventions across the spectrum of theory, modeling, numerics and software engineering.

In this talk I will present a number of examples, mostly drawn from biomechanical modeling, virtual surgery and anatomical simulation tasks, where fresh perspectives on discretization, geometrical modeling, data-parallel programming or even the formulation of the governing PDEs for a physical system were instrumental in boosting parallel efficiency. Finally, I will discuss important lessons learned from simulations of human anatomy, and how those pertain to the design of solvers for computational physics at large.

Bio: Eftychios Sifakis is an Assistant Professor of Computer Sciences and (by courtesy) Mechanical Engineering and Mathematics at the University of Wisconsin-Madison. He obtained his Ph.D. degree in Computer Science (2007) from Stanford University. Between 2007-2010 he was a postdoctoral researcher in the University of California Los Angeles, with a joint appointment in Computer Science and Mathematics. His research focuses on scientific computing, physics based modeling and computer graphics. He is particularly interested in biomechanical modeling for applications such as character animation, medical simulations and virtual surgical environments. Eftychios has served as a research consultant with Intel Corporation, Walt Disney Animation Studios and SimQuest LLC, and is a recipient of the NSF CAREER award (2013-2018).