



Vermont Complex Systems Center

“The Virtual Scalpel: Surgery Simulations with Finite Elements and Fast Matrix Algorithms”

The Complex Systems Center is pleased to invite you to the following seminar by Alex Pothen from Purdue University.



Alex Pothen
Purdue University
Professor of Computer Science

Abstract: Eye surgeons learn their craft on animal models, but these models differ from human eyes in their viscoelastic properties. Simulators based on haptics and computer graphics have the potential to provide better training tools for surgery. These simulators need to update images of the eye from ten to hundred times per second to provide realistic visualization. We present fast matrix computation algorithms to support interactive visualization of solid finite element models of human organs. Integrating support for cutting with real-time finite element solution methods is a computational challenge due to two reasons: First, high update rates are required for graphical and haptic rendering; Second, the connectivity changes due to the cutting (removal and insertion of nodes and elements, and re-meshing around the cut) necessitate corresponding changes to the underlying system of linear equations. We describe an algorithm that provides a fast visualization functionality through an augmented matrix approach, a hybrid linear equation solver, and sophisticated exploitation of sparsity in the matrices. We are able to provide ten to hundreds of updates per second for meshes with hundreds of thousands of nodes. To the best of our knowledge, this is the first such result for meshes of this size.

Bio: Alex Pothen is a Professor of Computer Science at Purdue University. His research interests are in combinatorial scientific computing, parallel computing, and bioinformatics. He has made contributions to algorithms for sparse matrix computations, graph matching and coloring, spectral graph theory, Automatic Differentiation, and single-cell bioinformatics. He helped to found a community of researchers in Combinatorial Scientific Computing (CSC) in 2001, and the Sixth SIAM Workshop on CSC will be held in Lyons, France in July 2014. Alex serves as an editor of the flagship journals of the ACM and SIAM, the Journal of the ACM and SIAM Review, and of the SIAM Books series.

<https://www.cs.purdue.edu/homes/apothen/>

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THURSDAY, March 20TH at 10am
Perkins 101

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