APPLIED MATHEMATICS COLLOQUIUM:

RECENT ADVANCES IN MODELING ADVECTION, SUBDUCTION, AND VISCOELASTOPLASTIC FLOW IN GEODYNAMIC COMPUTATIONS

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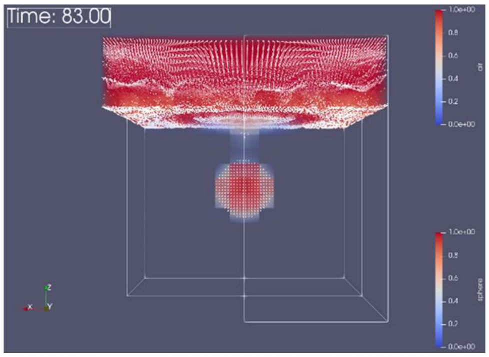

Date:
10/28/2022

Time:
3:00 PM-5:20 PM

Location:
SSB 170

About The Speaker:

Professor Puckett is an applied mathematician and computational scientist. His research interests include computational geodynamics, shock physics, computational methods for tracking fluid and material interfaces, and particle methods. He received a PhD in Mathematics from U.C. Berkeley in 1987. He was a DOE Applied Mathematical Sciences Postdoctoral Fellow at the Lawrence Livermore National Laboratory and is presently a Professor of Mathematics at UC Davis. He has been the Chair of the Graduate Group in Applied Mathematics at U.C. Davis, a Consultant for the Applied Mathematics Group at Lawrence Livermore National Laboratory, later at the Lawrence Berkeley National Laboratory, an NSF University-Industry Cooperative Research Fellow in the Mathematical Sciences at Xerox Corporate Research Center, NY, a Hudnell Distinguished Lecturer at the Department of Geophysical Sciences, University of Chicago, a Research Fellow at the Institute of Fluid Science, Tohoku University Sen dai, Japan, and a Research Fellow at the Centre for Math Analysis, Australian National University, Canberra, Australia.

Abstract:

We will describe three separate methodologies that have been implemented in the open source, finite element code ASPECT (Advanced Simulator for Problems in Earth Convection and Tectonics), which computational geophysicists use to model a wide variety of problems that arise in Earth and Planetary geophysics. The first technique is a volume-of-fluid (VOF) interface tracking algorithm that we originally designed to model the subduction of the oceanic lithosphere of a tectonic plate beneath the less dense lithosphere of a continental plate. However, we have since used this VOF methodology to model some basic laboratory experiments in order to benchmark some of the rheological models that have been implemented in ASPECT. The second technique is a particle or particle-in-cell (PIC) algorithm that we have been developing and benchmarking for use in ASPECT for the past seven years or so. This PIC methodology has been shown to have excellent weak and strong scaling over at least three orders of magnitude of model size on a uniform grid. In addition, our PIC algorithm shows that strong scaling for the adaptive grid case is nearly as good as for the uniform grid case, decreasing the total runtime essentially linearly from 100 up to 40,000 or 50,000 cores. The third methodology is a DG (Discontinuous Galerkin) method with a bound preserving limiter that, among other things, provides a foundation that enables the accurate and efficient computation of the VOF and PIC algorithms. We will briefly show a collection of benchmarks we have used to assess the accuracy of these three methodologies and conclude with videos of computations of some of these benchmarks as well as preliminary computations of a fundamental Earth process: subduction.

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