Department of Structural Engineering
University of California, San Diego
SE 290 Seminar

Dr. Pavel Bochev
Center for computing research
Sandia National Laboratories

"Compatible Meshfree Methods"
Wednesday, November 15, 2017
1:00 pm - 1:50 pm, Pepper Canyon Hall, Room 122

Abstract

Particle and meshfree methods offer significant computational advantages in settings where quality mesh generation required for many compatible PDE discretizations may be expensive or even intractable.

At the same time, the lack of underlying geometric grid structure makes it more difficult to construct mesh-free methods mirroring the discrete vector calculus properties of mesh-based compatible and mimetic discretization methods.

In this talk we survey ongoing efforts at Sandia National Laboratories to develop new classes of locally and globally compatible meshfree methods that attempt to recover some of the key properties of mimetic discretization methods.

One of the approaches that will be described is motivated by classical staggered discretization methods. We use the local connectivity graph of a discretization particle to define locally compatible discrete operators. In particular, the edge-to-vertex connectivity matrix of the local graph provides a topological gradient, whereas a generalized moving least-squares (GMLS) reconstruction from the edge midpoints defines a divergence operator.

The talk will also review some of the ongoing work to build a modern software toolkit for mesh-free and particle discretizations that leverages Sandia's Trillinos library and performance tools such as Kokkos.

This is joint work with P. Bosler, P. Kuberry, M. Perego, K. Peterson and N. Trask

Biography

Pavel is a Distinguished Member of the Technical Staff at Sandia National Laboratories in Albuquerque where he works in the Center for Computing Research. Pavel's research interests include compatible discretizations for partial differential equations, optimization and control problems, and the development of new, property preserving heterogeneous numerical methods for complex applications relevant to the mission of the US Department of Energy and the National Nuclear Security Administration.

Pavel earned his Magister of Mathematics degree from the University of Sofia, Bulgaria in 1987 and his PhD in Mathematics in 1994 from Virginia Tech. His thesis was awarded the SIAM Student paper prize for 1994. In 2012 Pavel was elected a Fellow of the Society for Industrial and Applied Mathematics.

Pavel is a recipient of 2014 US Department of Energy's E. O. Lawrence Medal in the category of "Computer, information and knowledge sciences". This award honors U.S. scientists and engineers, at mid-career, for exceptional contributions in research and development supporting the Department of Energy and its mission to advance the national, economic and energy security of the United States. In 2017 Pavel was awarded the Thomas J.R. Hughes Medal by the U.S. Association for Computational Mechanics for his contributions to the field of numerical partial differential equations.

Pavel has authored and co-authored over 100 research papers, two books and several book chapters, and has given numerous plenary and invited lectures in the US and abroad. He served two terms as Editor-in-Chief of the SIAM Journal on Numerical Analysis and is currently member of the editorial board of SINUM.