Presentation Abstract

While the development of polygonal and polyhedral finite element interpolants has had a long history, their application for solving partial differential equations is fairly new. In this talk, we will discuss attractive features of such discretizations, chief among them is the greater flexibility they offer in mesh generation. For example, recently-developed meshing algorithms utilize Voronoi diagrams to generate polyhedral grids with desired regularity and size distribution for complex geometries. Furthermore, the availability of arbitrarily-shaped elements can simplify mesh adaption procedures (e.g. local refinement and coarsening) as hanging nodes are naturally accommodated. We will also present several examples of primal and mixed variational problems in which discretization methods on polygonal and polyhedral grids exhibit improved accuracy and stability compared to their simplicial and cubical counterparts.

In addition to finite elements, a class of mimetic finite difference schemes has been recently developed for arbitrary meshes. The main feature of these methods, and their Galerkin-type parallels, is that they do not require an explicit knowledge of the underlying approximation spaces. A major theme that will be explored in this talk is that concepts from the mimetic methods can be used to address challenges that arise in constructing convergent polygonal and polyhedral finite elements. We will discuss two successful examples of such a strategy. We will present an approach for alleviating the burden of numerical integration for polygonal finite elements while maintaining optimal convergence rates. We will also discuss the development of a low-order edge-based element that is stable and consistent for mixed Darcy flow. We will conclude by examining the implications of these developments in the broader context of compatible or structure-preserving discretizations.

Speaker Profile

Dr. Cameron Talischi obtained his B.S./M.S. in Civil and Environmental Engineering and his Ph.D. in Civil Engineering, from University of Illinois at Urbana-Champaign. He also holds a B.S. in Mathematics and an M.S. in Applied Mathematics from Illinois. He is currently a post-doctoral fellow as a part of the collaboration between University of Illinois and Pontifical Catholic University of Rio de Janeiro. His research interests include PDE-constrained optimization, relaxation and regularization of ill-posed inverse problems, and discretization methods based on polygonal and polyhedral grids. He was a recipient of the Department of Energy Computational Science Graduate Fellowship.

Computational Science and Engineering
cordially invites you to attend our
Fall 2013 Seminar Series Kick-Off

Compatible discretizations on polygonal and polyhedral grids

Speaker: Cameron Talischi, PhD
Civil and Environmental Engineering

When: Wednesday, August 28, 2013

Where: 2240 Digital Computer Lab

Time: Noon - 1pm

Lunch will be provided!

We look forward to seeing you there!

COMPUTATIONAL SCIENCE AND ENGINEERING
1304 West Springfield, Room 2270, Urbana, Illinois 61801
Main Office: 217.333.3247 Fax: 217.333.1910
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