Structural Engineering Seminar Series

CEE 595 S & CEE 595 SO

The Shifted Boundary Method: An Immersed Approach for Computational Mechanics

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Abstract:

Immersed/embedded//unfitted boundary methods obviate the need for continual re-meshing in many applications involving rapid prototyping and design. Unfortunately, many finite element embedded boundary methods are also difficult to implement due to the need to perform complex cell cutting operations at boundaries, and the consequences that these operations may have on the overall conditioning of the ensuing algebraic problems. We present a new, stable, and simple embedded boundary method, named “shifted boundary method” (SBM), which eliminates the need to perform cell cutting. Boundary conditions are imposed on a surrogate discrete boundary, lying on the interior of the true boundary interface. We then construct appropriate field extension operators, by way of Taylor expansions, with the purpose of preserving accuracy when imposing the boundary conditions. We demonstrate the SBM on large-scale solid and fracture mechanics problems; thermomechanics problems; porous media flow problems; incompressible flow problems governed by the Navier-Stokes equations (also including free surfaces); and problems governed by hyperbolic conservation laws.

Bio:

Guglielmo Scovazzi is Professor of Civil & Environmental Engineering and Mechanical Engineering & Materials Science at Duke University. His interests are in the general area of computational mechanics, and specifically in CFD, computational solid mechanics, fluid/structure interaction, computational geomechanics, flow through porous media.

He earned B.S./M.S. Degrees in Aerospace Engineering at Politecnico di Torino in 1998. He received a M.S. in 2001 and a Ph.D. in 2004, both from the Mechanical Engineering Department at Stanford University. Between 2004 and 2012, he held a position as Senior Member of the Technical Staff at Sandia National Laboratories, Albuquerque (New Mexico).

Guglielmo Scovazzi is a recipient of the 2014 Early Career Award from the Office of Science of the US Department of Energy (ASCR program), and the 2017 Presidential Early Career Award for Scientists and Engineers (PECASE). In February 2018, he was named Kavli Fellow by the National Academy of Sciences and the Kavli Foundation. The Kavli Fellowship acknowledges contributions of U.S. scientists under the age of 45.

He is an associate editor of the Journal of Computational Physics and in the editorial board of the International Journal on Numerical Methods for Fluids and Engineering with Computers Journal. He is a member of the executive board of the US Association for Computational Mechanics and a member of SIAM and ASME.

Monday, October 4th, 2021 4:00 – 5:20 p.m.

1310 Yeh Student Center