The Department of Mechanical Engineering / College of Engineering and Applied Sciences
Stony Brook University

Mechanical Engineering Seminar
Faculty Candidate

Dr. Christoph Brehm

Research Professor
Department of Aerospace and Mechanical Engineering, University of Arizona

"A Locally Stabilized Higher-Order Immersed Boundary Method and its Application to NASA Relevant Flow Problems"

Wednesday, May 11, 2016 at 1:30PM, Room 173 Light Engineering Building

Abstract

A higher-order immersed boundary method for solving the compressible Navier-Stokes equations will be presented. The distinguishing feature of this new immersed boundary method is that the coefficients of the irregular finite difference stencils in the vicinity of the immersed boundary are locally stabilized by solving a local optimization problem. The concept was first introduced in a previous publication by the presenter for the advection step in the projection method used to solve the incompressible Navier-Stokes equations. This presentation extends the original idea to the compressible Navier-Stokes equations considering flux vector splitting schemes and viscous wall boundary conditions at the immersed geometry. Key aspects, such as imposing higher-order accurate flux boundary conditions at the immersed boundary and the higher-order discretization of the viscous fluxes in the vicinity of the boundary, will be presented. In the presentation, linear stability investigations are employed to confirm that the immersed boundary method is linearly stable. The method of manufactured solutions is used to confirm the expected higher-order accuracy and to study the error convergence properties of this new method. The second part of this presentation focuses on the application of the higher-order immersed boundary method to NASA relevant flow problems, such as launch environment flows, a rocket plume jet impingement problem, and the flow past a contra-rotating open rotor.

Biography

Dr. Christoph Brehm is currently a research professor in the Department of Aerospace and Mechanical Engineering at the University of Arizona. Since 2012, he is also a senior research scientist of the Launch Ascent & Vehicle Aerodynamics (LAVA) group in the Aerosciences Branch at NASA Ames Research Center. He has been working in the LAVA group with special emphasis on unsteady, multi-physics flow simulations. Recently, he started an effort in developing fluid structure interaction and computational aeroacoustics capabilities within the LAVA solver framework. He received a B.S./M.S. equivalent degree at the University of Stuttgart (Germany) and a Ph.D. at the University of Arizona under the supervision of Professor H.F. Fasel working on active flow control, immersed boundary methods and transition research.

Stony Brook University