Dr. Per-Olof Persson (persson@berkeley.edu)

University of California, Berkeley

USA

Per-Olof Persson is a Professor of Mathematics at the University of California, Berkeley, since July 2008. Before then, he was an Instructor of Applied Mathematics at the Massachusetts Institute of Technology, from where he also received his PhD in 2005. In his thesis, Persson developed the DistMesh algorithm which is now a widely used unstructured meshing technique for implicit geometries and deforming domains. He has also worked for several years with the development of commercial numerical software, in the finite element package Comsol Multiphysics. His current research interests are in high-order discontinuous Galerkin methods for computational fluid and solid mechanics. He has developed new efficient numerical discretizations, scalable parallel preconditioners and nonlinear solvers, space-time and curved mesh generators, adjoint formulations for optimization, and IMEX schemes for high-order partitioned multiphysics solvers. He has applied his methods to important real-world problems such as the simulation of turbulent flow problems in flapping flight and vertical axis wind-turbines, quality factor predictions for micromechanical resonators, and noise prediction for aeroacoustic phenomena.

Title: Half-Closed Discontinuous Galerkin Discretisations

Abstract:

We introduce the concept of half-closed nodes for nodal Discontinuous Galerkin (DG) discretisations. This is in contrast to more commonly used closed nodes in DG where in each element nodes are placed on every boundary. Half-closed nodes relax this constraint by only requiring nodes on a subset of the boundaries in each element, with this extra freedom in node placement allowing for increased efficiency in the assembly of DG operators. To determine which element boundaries half-closed nodes are placed on we outline a simple procedure based on switch functions. We examine the effect on operator sparsity from using the different types of nodes and show that in particular for the Laplace operator for there to be no difference in the sparsity from using half-closed or closed nodes. We also discuss in this work some linear solver techniques commonly used for Finite Element or Discontinuous Galerkin methods such as static condensation and block-based methods, and how they can be applied to half-closed DG discretisations. Finally we demonstrate its use on a range of test problems including in CFD, and benchmark its performance on these numerical examples.