Radial Basis Function Generated Finite Differences (RBF-FD): New Computational Opportunities for Solving PDEs.  
  
  
Abstract:  
  
   Finite difference methods were first used for solving PDEs over a century ago. Ever since then, FD stencils have typically been based on Cartesian grids, and the coefficients in the stencils have been obtained by requiring results to be exact for polynomials of as high degree as permitted by the stencil size. When the polynomials are either supplemented with or altogether replaced by RBFs, grids become unnecessary. Such RBF-FD approximations combine high levels of accuracy with much improved geometric flexibility, essential both for local refinement and also to accurately handle curved boundaries and material interfaces. Additional benefits include high computational efficiency, short and simple codes, and excellent opportunities for distributed computing. We will in this presentation highlight some recent RBF-FD calculations, mostly from the geosciences and, in particular, for seismic exploration.  
  
   Seismic exploration is used to map out hydrocarbon deposits. In forward modeling, subsurface structures are assumed to be known, and the task is to simulate elastic wave propagation through the medium. Inversion programs then update subsurface assumptions in order to reconcile model responses with actual measurements. RBF-FD spatial discretization offers outstanding accuracy and algebraic simplicity for simulating the elastic wave propagation, especially in layered media with large numbers of irregularly shaped interfaces.