TEMPLE UNIVERSITY
Department of Mathematics

Applied Mathematics and Scientific Computing Seminar

Room 617 Wachman Hall

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Meshfree Finite Difference Methods with Minimal Positive Stencils

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Abstract.

The finite difference method is one approach to approximate a partial differential equation by a finite dimensional system. An important example is the approximation of the Poisson equation by a large, sparse linear system. While finite differences are well established for friendly geometries with regular grids, the approach can also be generalized to fully unstructured geometries, and even to disconnected "clouds" of points, which frequently arise in particle methods. Two new aspects come into the game here: first, there are many possible consistent finite difference approximations, and there is no simple principle that defines a "best" one; second, with many classical meshfree approaches, the arising linear systems are in general non-symmetric, do not have an M-matrix structure, and are significantly less sparse than finite difference matrices on regular geometries. All of the latter aspects are detrimental for the performance of linear solvers. I will present an approach, based on ℓ^1 optimization, that selects minimal positive stencils, and thus generates optimally sparse M-matrices.