1135-VN-417 **Rebecca Conley***, rconley@saintpeters.edu, and **Tristan J. Delaney** and **Xiangmin Jiao**.
High-Order Adaptive Extended Finite Element Method (AES-FEM) and Direct Treatment of Neumann Boundary Conditions on Curved Boundaries. Preliminary report.

The finite element methods (FEM) are important and powerful tools for solving partial differential equations. Their high-order generalizations pose significant challenges for curved geometries, because the geometry must be represented accurately. It is very difficult to generate high-quality meshes with curved elements that guarantee positive Jacobian everywhere, which is important for the convergence of FEM. Here we present a high-order Adaptive Extended Stencil Finite Element Method (AES-FEM), which requires only high-order surface elements along with piecewise-linear volumetric elements. AES-FEM is a generalization of the FEM that is insensitive to mesh quality. It replaces the traditional finite-element basis function with a set of generalized Lagrange polynomial basis functions computed using weighed least squares. To impose Neumann boundary conditions, which in general require curved volumetric elements in the isoparametric finite-element methods, we introduce test functions defined over the surface elements so that only high-order surface integrals are involved. This significantly simplifies mesh generation for curved geometry without compromising accuracy. We present numerical results to demonstrate the high-order convergence of AES-FEM for elliptic PDEs in 2D and 3D. (Received September 01, 2017)