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On Multigrid Methods for Generalized Finite Element Methods on unstructured grids

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We consider the symmetric positive semi-definite problems arising from generalized finite element discretizations on unstructured grids. The focus will be on a simple two level approach, in which the coarse grid problem corresponds to the space spanned by the partition of unity functions. We characterize the kernel components of the stiffness matrix for GFEM discretizations in two and three spatial dimensions. With this characterization in hand, we can derive a stable decomposition of the underlying GFEM space, using as an auxiliary coarse space the piece-wise linear and continuous functions and prove a uniform convergence result for the resulting two level method.