

High Order Mimetic Discretizations of Continuum Mechanics

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Abstract: Mimetic Operators satisfy a discrete analog of the divergence theorem and they are used to create/design conservative/reliable numerical representations to continuous models. We will present a methodology to construct mimetic versions of the divergence and gradient operators which exhibit high order of accuracy at the grid interior as well as at the boundaries. As a case of study, we will show the construction of fourth order operators in a one-dimensional staggered grid. Mimetic conditions on discrete operators are stated using matrix analysis and the overall high order of accuracy determines the bandwidth parameter. This contributes to a marked clarity with respect to earlier approaches of construction. As test cases, we will solve 2-D elliptic equations with full tensor coefficients arising from oil reservoir models. Additionally, applications to elastic wave propagation under free surface and shear rupture boundary conditions will be given.