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MIMETIC LEAST-SQUARES: A LEAST-SQUARES FORMULATION WITH EXACT CONSERVATION PROPERTIES

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To a casual observer, compatible (or mimetic) methods, [1] and least squares principles for PDEs are polar opposites. Mimetic methods inherit key conservation properties of the PDE, can be related to a naturally occurring optimization problem, and require specially selected, dispersed degrees of freedom. The conventional wisdom about least squares is that they rely on artificial energy principles, are only approximately conservative, but can work with standard C^0 nodal (or collocated) degrees of freedom. The latter is considered to be among the chief reasons to use least squares methods.

In this talk we demonstrate that exactly the opposite is true about least-squares methods. First, we will argue that nodal elements, while admissible in least squares, do not allow them to realize their full potential, should be avoided and are, perhaps, the least important reason to use least squares! Conservation can be trivially satisfied by using variables associated to nodes, edges, faces and volumes, [2]. The price paid for gaining favorable conservation properties is that one has to give up what is arguably the least important advantage attributed to least squares methods: one can no longer use C^0 nodal elements for all variables, [3].

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