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**MOHAMMED NYUYDINI KIVEN**, Memorial University of Newfoundland

*VARIATIONAL MOVING MESH METHODS FOR DIFFERENTIABLE NUMERICAL SOLVERS*

Moving mesh methods for partial differential equations (PDEs) are a class of adaptive schemes aiming to optimize accuracy with a fixed number of degrees of freedom by allowing the spatial domain to transform with the solution. Optimal mesh transformations can often require nonlinear equations, even for linear problems, introducing significant computational overhead. Concessions to the mesh optimality can compromise the advantages of these approaches. In this work, we introduce a mesh adaptation strategy leveraging an automatically differentiable moving mesh solver to define schemes which depends on the continuous PDE and its discretization directly. Differentiating through the solver allows for the definition of novel schemes which are parsimonious in their design and exhibit orders of magnitude higher accuracy compared to standard r-adaptive monitor functions. We describe two numerical schemes: (i) using an a posteriori error indicator based on a reference solution, and (ii) a self-supervised scheme based on a prescribed mesh quality function and a parametric mesh transformation. Our methods are applied to several partial differential equations where we study their numerical properties and accuracy benefits.