Moving Mesh Finite Difference Schemes for Nonlinear Time-Dependent PDE

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Abstract

This is a review of some recently designed velocity-based moving mesh (MM) numerical methods. We are interested in schemes that, with an available fixed number of nodes, are able to adjust to the evolution of the solution and track moving boundaries and other singular solution behaviour like large solution variations.

We consider PDE problems that are scale-invariant and mass conserving and describe several MM finite difference schemes based on a conservation principle to control the mesh evolution. Two coupled equations need to be solved, the PDE and an equation for the mesh and we analyse some implicit and semi-implicit time-stepping schemes for the latter.

Since these MM methods aim to preserve either local or distributed properties in time it is important to represent the initial data in the best possible way in the L_2-norm. We compare several algorithms in 1 and 2D that choose an initial mesh with an optimal node distribution for the given initial conditions.