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Efficiency of a Moving Mesh System with a Curvature-type Monitor Applied to Burgers' Equation

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Abstract of Report Talk: Moving Mesh Methods are adaptive techniques to approximate solutions to partial differential equations numerically. A moving mesh system consists of a discretized physical PDE that evolves in time together with a PDE that adapts the discretization mesh using a monitor function. The moving mesh PDE is viewed as a mapping from a computational to physical domain. In this project, we explore properties of the moving mesh system when the physical solution has a steep gradient and large curvature, depending on parameter ϵ, over a small interval in the domain. Using a curvature-type monitor, we prove an explicit dependence of the derivatives of mappings between the computational and physical domains on ϵ. In addition, we show a similar dependence for the mesh spacing, which is important in quantifying discretization errors. These results are verified numerically for a known physical solution. Numerical evidence also suggests a significant reduction in steep gradients when using moving mesh with this type of monitor. These estimates show an explicit reduction of the number of equations needed to approximate the physical PDE with the moving mesh. We can further control mesh spacing and steepness of derivatives by adjusting parameters in the monitor function. As an application, we use our moving mesh system to model Burgers' Equation, which satisfies the hypothesis of our theorem.

[Joint work with Taima Younes]

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