MOVING GRIDS FOR PROBLEMS OF GAS DYNAMICS

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Goal of this presentation is to derive and analyze more accurate and robust (black-box) numerical methods for grid adaptation. The goal is inspired by the fact that the great number of engineering computations nowadays rely on ability to generate grids adapted to the solution peculiarities. The main research direction lies in studying moving grids (both structured and unstructured) with application to problems of gas dynamics. This approach is most appealing in numerical simulation of time dependent problems where the adaptive grids change slightly during one step of a time integration.

A natural way to generate an adaptive grid is via a minimization problem for an error functional. The preliminary analysis of 1D nonlinear hyperbolic problems shows that the optimal grid may result in unstable computations and should be smoothed. The effect of a grid smoothing, data interpolation and a time integration on the accuracy of the solution has been studied for 1D hyperbolic problems. It was proved that under certain natural conditions, the approximation error dominates in the error functional allowing us to simplify the minimization problem. In 1D case, the simplified problem is equivalent to the principle of the error equidistribution and results in a non-linear elliptic equation. This gives us a new set of numerical methods for generating adaptive grids.

Generalization of the elaborated algorithms in two and three dimensions is the challenging problem and it will be also addressed in our presentation.