Adaptive and higher order methods in computational fluid dynamics

Jens Lang[1]

In this talk, I will summarize our recent activities in constructing higher order variable timestep integrators for computational fluid dynamics and adaptive moving meshes in large eddy simulation (LES) for turbulent flows.

I will focus on two-step peer methods which were first developed for ODEs and subsequently applied to parabolic PDEs. Their main advantage over one-step methods lies in the fact that even in the application to PDEs no order reduction is observed. Our aim is to investigate whether the higher order of convergence of the two-step peer methods equipped with variable timesteps pays off in practically relevant CFD computations. In turbulent flows, the characteristic length scale of the turbulent fluctuation varies substantially over the computational domain and has to be resolved by an appropriate numerical grid. We propose to adjust the grid size in an LES by adaptive moving meshes. The main advantage of mesh moving methods is that during the integration process the mesh topology is preserved and no new degrees of freedom are added and therefore the data structures are preserved as well. This makes the method an attractive add-on for the many fluid flow solvers available. I will present results for meteorological applications.

[1] Technische Universität Darmstadt, Mathematics, Darmstadt, Germany,
lang@mathematik.tu-darmstadt.de