

Abstract:

My talk will present our group's activities on a high-order discontinuous Galerkin (DG) solver for turbulent flow. First, I will discuss the ingredients that provide an accurate and robust spatial discretization with suitable DG flux terms as well as their efficient implementation on modern high-performance computers. Our method is stabilized by a divergence penalty term akin the widely used grad-div stabilization and a penalty term that controls the jump of the DG solution over element boundaries. I will motivate these terms by energy considerations and show their beneficial properties as an implicit turbulence model, as demonstrated by excellent results in turbulent channel flow and for the Taylor-Green vortex.

Secondly, I will present our work on new wall models that allow for coarser meshes in boundary layers of turbulent flow. As opposed to previous approaches that typically modify boundary conditions, our method augments the usual polynomial shape functions with additional functions derived from a wall-law for the average velocity field that can better represent the steep gradients along the boundary layer. The resulting hybrid RANS/LES wall model is fully consistent and approaches wall-resolved LES with exact boundary conditions if resolution is increased. Tests on a variety of benchmark problems in turbulent flows show the capabilities of the method, in particular for flows with re-attachment.