Special Guest Lectures

On Wall Layer Models for Large Eddy Simulation of Turbulent Flows

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Applicant for CCT's CyD IT Analyst Position

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Abstract:
Large Eddy Simulation (LES) of wall-bounded turbulent flows at high Reynolds number is prohibitively expensive if the energy-containing eddies in the near-wall region are resolved. This motivates the use of wall-layer models in which an approximate solution of the near-wall dynamics is bridged to an LES of the outer flow. The main interest of the present work is in wall-modeling strategies based on hybrid approaches that combine Reynolds-Averaged Navier-Stokes models and Large Eddy Simulation. In these approaches, the near-wall structures are modeled in a Reynolds-averaged sense and the core of the flow is computed using LES. The most well-known hybrid RANS-LES method, Detached Eddy Simulation (DES), is used as the basis for assessing several wall-layer modeling strategies. Previous attempts at wall modeling using DES have resulted in a mismatch between the modeled log layer and resolved log layer by several units in U+ and an under-prediction of the skin-friction coefficient. Predictions of turbulent channel flow using a new version of DES – Delayed Detached Eddy Simulation – performed for a range of Reynolds numbers and mesh resolutions are compared to other wall-model approaches that are based on anisotropic eddy viscosity and a different RANS-LES hybridization that uses a new definition of the turbulent lengthscale. These models, when coupled with either Detached Eddy Simulation or Delayed Detached Eddy Simulation methodologies, significantly increase the turbulent activity near the wall leading to generation of greater resolved stress. This results in the elimination of the logarithmic layer mismatch and accurate prediction of the skin-friction.

Speaker's Bio:
Sachin Badarayani received his Master of Science in Mechanical Engineering from Arizona State University, and his Bachelor of Engineering in Mechanical Engineering from Maharashtra Institute of Technology, Pune University, India. He is currently a research assistant at Arizona State University in the areas of flow solver development and turbulence model development. Sachin is an applicant for the IT Analyst position in CCT's CyD group with focus on numerical methods, algorithms development and scientific computing.

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