

Status and future prospects of turbulence modeling in CFD

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Today's Reynolds-averaged Navier-Stokes (RANS) models are believed to be particularly inadequate for off-design aerodynamic flowfield predictions, especially when separation is present. Scale-resolving simulations such as Large Eddy Simulation (LES) generally perform significantly better for such cases, but are still considered too expensive/time consuming for most industrial or design-type applications. Hybrid RANS/LES methods are promising, but not fully understood, and are dependent on a high level of user expertise. However, other factors – including inadequate grid resolution, imperfect geometric fidelity, boundary condition uncertainty, and lack of code verification – also contribute to CFD prediction uncertainties and can easily mask the true deficiencies of turbulence models. This talk addresses the current status and future prospects of turbulence modeling for aerodynamic flow predictions. Results from a recent Turbulence Modeling Symposium co-sponsored by the University of Michigan and NASA will be highlighted, including the important unanswered question of whether significant improvements in RANS models are still possible. Lessons from other recent workshops will also be summarized. The important role of code verification will be discussed, and some thoughts on the way forward will be offered.