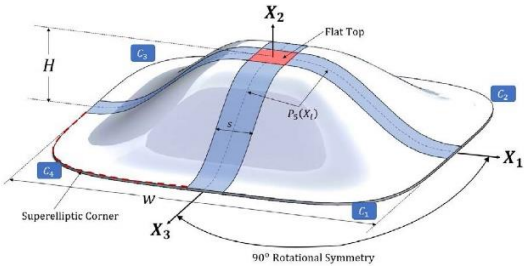
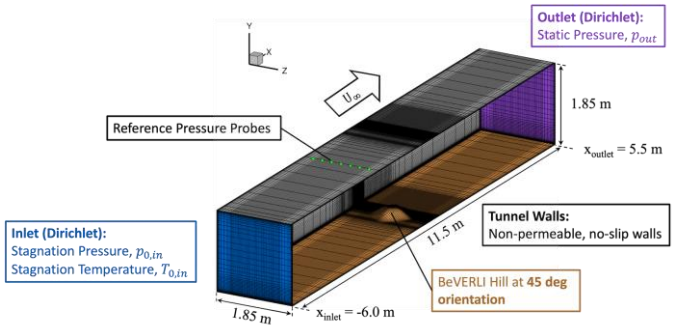
VT-NASA CFD Turbulence Model Validation Challenge

A Blind Validation CFD Challenge Case for 3D Smooth-Body Turbulent Flow Separation

Virginia Tech, with support from NASA-Langley, has recently acquired high-quality turbulence model validation data for three-dimensional smooth-body flow separation. The geometry, called the BeVERLI Hill (Benchmark Validation Experiments for RANS and LES Investigations), has been studied at height-based Reynolds numbers of 250k to 650k for subsonic flow. Experimental data have been obtained for the hill at zero and 45 degree orientations and includes extensive oil flow visualizations, surface pressures, skin friction via oil film interferometry, and mean and fluctuating velocities using particle image velocimetry, laser doppler velocimetry, and pitot-static rakes. Extensive boundary conditions and oncoming boundary layer data have also been measured. We propose a blind CFD turbulence modeling challenge case with the BeVERLI Hill oriented at 30 degrees to the oncoming freestream. Two turbulence models are strongly recommended: the standard Spalart-Allmaras model and the Menter k-ω SST model. Additional turbulence model submissions are welcome. While extensive boundary condition information will be made available to participants, the surface pressure, surface skin friction, and velocity data will be withheld until the computations have been submitted, thus making this a blind CFD challenge. A two-dimensional verification case will also be required.



BeVERLI Hill Model



Grid with Boundary Conditions and Reference Pressures

Available Information

- PDF presentation and paper from AIAA Aviation June 2023 (San Diego)
- As-designed and as-built geometry files
- Family of systematically-refined structured grids for the as-designed and as-built geometries
- Hill height (for use in the Reynolds number): H = 0.186944 m
- Inflow BCs, reference pressures, and downstream static pressure
- Boundary layer parameters and mean velocity profiles upstream of the Hill

Challenge QR Code

Timeline

- *October 2023:* final wind tunnel entry for PIV, LDV, OFI
- *November 2023:* data locations and file formats sent to participants
- *May 2024:* contributors submit data to VT for compilation and analysis
- *July 2024:* special session at AIAA Aviation with summary paper, contributor presentations, and exp. data release

VT-NASA CFD Turb. Model Challenge Web Site:
https://roy.aoe.vt.edu/vt-nasa-validation-challenge

For more information, contact: Prof. Chris Roy at cjroy@vt.edu

CREATe
Flow. Acoustics. Fluid-Structure Interaction.