MAE 210B – WQ 2018

Bluff-Body Turbulence Research Project Lit Study

Menter, F.R. and Egorov, Y. A Scale-Adaptive Simulation Model using Two-Equation Models. 2005.

* Filename: menter2005scaleadaptive
* Abstract
  + **Scale-Adaptive Simulation (SAS) concept**
  + von Karman length-scale allows SAS models to dynamically adjust to resolved structures in a URANS simulation
  + results in a LES-like behavior in unsteady regions of the flowfield
  + standard RANS capabilities in stable flow regions
  + allows the SST model to be operated in a SAS mode
* **Flow over cylinder**

Elkhoury, M. Assessment of turbulence models for the simulation of turbulent flows past bluff bodies.

* Filename: elkhoury2016assessment
* Abstract
  + Assessment of **novel one-equation turbulence model**
  + Compare to SA, SST-SAS
  + Unsteady, **3D flow over square cylinder**
  + Use case: comparable results to LES with fewer computational resources used

Hangan, H. Vickery, B.J. A wake model for two-dimensional (sharp-edged) bluff bodies.

* Filename: hangan1997wake
* Abstract
  + two-dimensional wake model for turbulence profiles is developed for (sharp-edged) bluff bodies based on similarity (self-preservation) and universality (different shapes)
  + **Empirical (experiment-based)** wake model

References from 2017

Ravindra G. Devi, Joseph Mathew, Peeush K. Bishnoi, Computations of turbulent near wakes of axisymmetric bodies

* Comparison of turbulence models over ellipsoid and sphere
  + K-epsilon, k-omega, Reynolds stress model
  + Before and after separation
  + Compare to experimental data
  + Previous studies have concerned LES and DNS
    - But RANS is an industry standard, it need its own studies
    - This paper provides that
* Solutions using CFX-5 finite volume solver
  + Grid made with unigraphics and ICEMCFD, unstructured
* Table 1 – compare global properties: drag coefficient, separation location, etc
* Turbulent intensity – Fig 4-6
  + No explanation of how calculated or which model used (probably RSM)

Catalanoa, Pietro, MengWangb, GianlucaIaccarinob, ParvizMoin, Numerical simulation of the flow around a circular cylinder at high Reynolds numbers

* Simulate flow around circular cylinder
  + Show LES is better than URANS
* Qualitative results
  + Compare wake contours
* Quantitative results
  + Compare mean flow velocities
  + Compare force coefficient time histories
* No turbulent parameter analysis

H.F. Lam\*, H.Y. Peng, Study of wake characteristics of a vertical axis wind turbine by two- and three-dimensional computational fluid dynamics simulations

* Filename: lam2016study
* Simulate flow past vertical axis wind turbine (entire structure, not just blades)
  + Transition SST (4-eqn) and DES
  + Validate with PIV data
* Previous work
  + Ferreria: PIV of real wind turbine
  + McLaren: 2-D Unsteady Reynolds Averaged Navier Stokes (URANS) with Shear Stress Transport (SST) turbulence closure on turbine blades
* Computational modeling
  + Mach < 0.3, use incompressible URANS
  + Use SST for resolving turbulent flow
    - Blends k-omega in close-wall with k-epsilon in far field
    - Transition SST: improved 4 eqn model
      * Accurately predict separated flow transition
  + Use Improved delayed DES (IDDES) to verify sensitivity to turb. Model
    - Based on SST, but also DES
  + SIMPLEC pressure-velocity coupling scheme
  + Sensitivity studies performed
    - 1st then 2nd order schemes
    - time step study
    - grid sensitivity study
    - Use wake stream velocity to check convergence – fig 6
    - Validate convergence by comparison to PIV
  + Wake profiles of SST and IDDES were identical
    - Not sensitive to turbulence model
    - Use SST for further analyses
* 3D SST Results
  + presented turbulence intensities are average of intensities in all 3 directions
  + Plot mean velocities and average turbulent intensities of 2D/3D cases
    - Plot profiles along different horizontal and vertical lines (HLs and VLs)
      * Note the orientation of the axes so that horizontal/vertical are intuitive
    - Horizontal line mean flow (fig 8, 9) and turb. Intensity (fig 10)
    - vertical line mean flow (fig 11, 12) and turb. Intensity (fig 13)