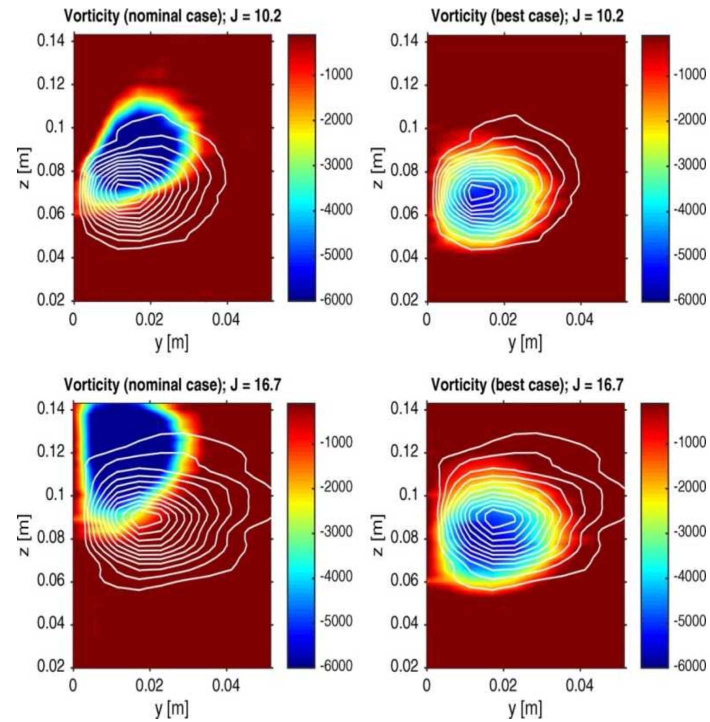
SAND2016-9204PE

Bayesian Calibration of Turbulence Model Parameters (UUR)

Tracking# (SAND, PR): **529821**

- Computations to perform Bayesian calibration of turbulence models.
  - Predict counter-torque more accurately by improving the jet-in-crossflow problem using experimental data.
- Posterior PDFs as a function of Mach number and momentum ratio J.
  - Over 9000 training calculations performed using ATCC1.
  - Linear eddy viscosity model superior to quadratic eddy viscosity model.
  - Analytical confirmation ensured that model form error is separate from the calibrated parameters.

JIC cross-plane vorticity improvement



Vorticity field in the cross-plane of a Mach 0.8 jet-in-crossflow (JIC) interaction. On the left: uncalibrated predictions for two different jet strengths, i.e. momentum ratios J. On the right: improved calibrated predictions. Contours denote experimental results for comparison. (J. Ray et al, AIAA Journal, http://dx.doi.org/10.2514/1.J054758)

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Code / Platform: Sigma-CFD / Sequoia
Usage: 3.82 days, ATCC1-121
Program: ASC

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- Sandia researchers developed a novel Bayesian method to infer Reynolds Averaged Navier Stokes (RANS) parameters for compressible jet-in-crossflow interactions using experimental data. A Markov Chain Monte Carlo procedure was used to develop a probability density distribution for the parameters thus capturing the uncertainty in the estimated parameters. Machine Learning and V&V techniques such as response surfaces, shrinkage and classifiers were used to construct emulators of the RANS simulator; about 100 million CPU hours on Sequoia (LLNL) were used to generate training data for this purpose.
- The team also developed an analytical approximation for the parameters as a function of the Mach number. This work is the most complex Bayesian calibration done to date in the fluid dynamics community. The use of the calibrated parameters will result in more accurate predictions of vortical flows.

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