

Breakout_C-2 (can map to issue name later)

Issue: https://github.com/CFDSI/Kickoff_Workshop/issues/12

Related Issues:

Issue Statement: **How can we distinguish modeling and discretization errors in data sets produced by simulation?**

Discussion topic:

Moderator: Duane Rosenberg

Note taker: Oana Marin

Reporter: Mike Park

Group Members: Tim Barth, Mike Park, Daniel Appelo, Saikat Dey, Duane Rosenberg, Oana Marin, Paul Fischer, Mark Shephard, Andres Tejada, Riccadro Balin, John Evans, Ahsan Kareem

Please address these topics in your discussion (moderators please make sure that there is enough time to cover all three before the session ends).

1. Describe the problem:

- **Stochastic v. deterministic methods have different approaches**
- **The question must be asked carefully for Chaotic flows**
- **Beware Offsetting errors, each source should be identified**
- **Modelling error hard to track, since comparison to experiments may not hold when experiment and simulation definition differ in known and unknown ways**
- **The separation of error sources must be done during simulation, it cannot be separated post-simulation**
- **Participants had a bias toward focussing on discretization error, because they understood quantification approaches better than modeling error**
- Know and unknown differences in simulation and experiment
- Errors in boundary conditions, initial conditions
- A hierarchy of modelling errors, low fidelity to high fidelity to experiments
- Round off errors irrelevant since discretization errors always dominate
- Grid convergence for LES methods is difficult to obtain, model changes with grid refinement if not held constant
- Match the experiment as well as possible: include tunnel walls in simulation, include sting in simulation, omit wall corrections in experiment

2. What are potential solutions?

- One can't determine these errors post-simulation, provenance of discretization error should be incorporated in the simulation data.
- Give a grid convergence study, some type of history.
- **At least for RANS on simpler flows, discretization errors can be eliminated with a grid convergence study. Then what errors are left are modeling errors**

3. What can CFDSI do to help?

- Develop software tool to identify the discretization error
- Develop benchmarks
- Comparisons between codes (shorter runs with specified initial conditions, period, and statistics window)
- Proper metric for the statistical error
- Extracting structures from datasets for comparisons
- Define hierarchy of models
- **Provide recommendations and software for tracking and reporting discretization error estimates**
- **Conduit for infusing method of manufactured solutions to the broader community**
- **Support data-driven models**
- **Better dialog with experimentalist to design experiments to expose assumptions in modeling errors and modeling hierarchy**
- **Database or suite of codes for extracting statistics from simulations with different data representations.**
- **Define standards for each simulation to export to a standard, unified query methods/language (evaluators) for simulation databases**
 - **Something including but beyond just pointwise query.**

4. Misc ideas so they don't get lost (e.g., Did you find new issues? If yes, create the issues on GitHub!):

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5. Summary for report-back (Alternatively, just bold the key points above):

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