GMGW-1 Participant Questionnaire

1st AIAA Geometry and Mesh Generation Workshop

The purpose of this document is to collect data for an assessment of the current state of the art in mesh generation for a variety of mesh types and a variety of software tools. The comparisons will be made in terms of the quality of each mesh submitted (either from a priori metrics or from the quality of the CFD solutions that were produced using the mesh) as well as the resources (human and computer) required to generate the meshes.

For GMGW-1, the geometry and meshes referred to below are for the NASA High Lift Common Research Model (HL-CRM).

Completion of this questionnaire is required of all participants in GMGW-1 and participants in the 3rd High Lift Prediction Workshop (HiLift-PW3) who generate their own meshes (versus using the supplied baseline meshes). A separate copy of this Questionnaire should be completed for each family of meshes.

# Geometry

1. Software
   1. What software tool(s) did you use to import and prepare the HL-CRM geometry model for meshing? Boeing in-house tool AGPS (Aero Grid and Paneling System)
2. Import & Preparation for meshing
   1. Which of the supplied geometry files did you use:

Native: NX (prt) file (HL-CRM gapped config)

CREO file (HL-CRM gapped config)

IGS file (HL-CRM gapped config)

STP file (HL-CRM gapped config)

Parasolid (x\_t) (HL-CRM gapped config)

Native: NX (prt) file (HL-CRM partially-sealed config)

CREO file (HL-CRM partially-sealed config)

IGS file (HL-CRM partially-sealed config)

STP file (HL-CRM partially-sealed config)

Parasolid (x\_t) (HL-CRM partially-sealed config)

* 1. What problems, if any, did you identify immediately after importing the geometry model (eg, missing geometry, poorly translated geometry, other)?
  2. What steps did you take after import to make the geometry model ready for meshing? (Choose all that apply)

None

Layering (hiding components)

Simplification/defeaturing (removing components)

Repair (fixing/recreating components that didn’t import properly)

Modification (changing components)

Shrink-wrapping

Other

* 1. What was required level of user expertise (novice, intermediate, expert) for this task? intermediate
  2. How long did import take (both elapsed time and labor required --- in hours)? 8 hrs

# Initial Meshing

1. What type of mesh family did you generate?

Structured multi-block

Unstructured tetrahedra

Unstructured hexahedra

Hybrid

Overset

Cartesian

other (please specify      )

1. Surface Meshing
   1. What software tool(s) did you use to generate your initial surface mesh? AGPS
   2. How long did it take (elapsed time and labor – in hours)? 80 hrs for 4 HLCRM grids
   3. Provide a brief description of how mesh resolution was specified (explicit user inputs, sources, curvature based sizing, background distribution function, …) by specifying edge spacing distribution and interior surface meshing properties, including chord-height tolerance, stretching ratio, etc.
   4. When/how did you judge surface mesh generation to be complete? Visualize entire surface mesh, and preform some quality check
2. Volume Meshing
   1. What software tool(s) did you use to generate your initial volume mesh? AFLR
   2. How long did it take (elapsed time and labor – in hours)? 15 hrs for fine mesh
   3. Provide a brief description of how mesh resolution was specified (explicit user inputs, sources, curvature based sizing, background distribution function, …) by specifying BL grid initial spacing, stretching ratio, tetrahedral meshing properties, wakesheet location and distribution, etc.
   4. For resolving surface boundary layers, what cell size growth rate did you use? Was it constant or variable? If variable, describe. Geometric growth with the 1st 5 layers constant
   5. When/how did you judge volume mesh generation to be complete? Perform grid quality check with several metrics, and run flow solver for verification
3. Adherence to HiLift-PW3 meshing guidelines
   1. To what extent did your mesh(es) adhere to the HiLift-PW3 meshing guidelines? 90%
   2. Was it possible to adhere to the guidelines on the first attempt, or were there iterations involved? A couple of iterations involved
   3. What were the reasons that you did not adhere to the guidelines? (chose all that apply)

The guideline does not pertain to the type of mesh generated

The guidelines were (locally) inconsistent and therefore could not all be satisfied

The tools used do not give enough control to adhere to the guideline

Adhering to the guideline would have required more resources than were available

The guidelines were not appropriate for the CFD solver being used

Other (describe): Some guidelines like grid size growth of ~3X between each grid level is not easy to adhere for unstructured mesh. I think the cell size near body nose and tail should be based on the body max diameter, instead of Cref. The TE chordwise spacing could be released to 2X LE spacing.

1. A priori metrics (such as skew, or maximum stretching ratio, maximum deviation of mesh nodes from OML or …)
   1. What a priori metrics did you apply on the initial mesh? Used the quality metrics inside AFLR3, like Max dihedral angle, face angle, BL cell aspect ratio, etc.
   2. What was the average and range of the metrics? Angle: 90-170 deg. AR: < 0.7
   3. Did the a priori metrics point out any problems that needed to be fixed? If so, which metric and how many times did you need to re-mesh? No
2. Were there any additional best practices that you used in generating the meshes? Yes
3. What was the required level of user expertise (novice, intermediate, expert) for this task? intermediate

# Adaptive Meshes (Only answer if you generated an adapted mesh)

1. What adaptive meshing strategy did you use (technique and software)?
2. What criteria were used for mesh adaptation (e.g., pressure, vorticity, …)?
3. What, if any, further treatments (e.g. smoothing) were applied? (Please describe )

# Mesh Families

1. What strategy did you use to generate the family of meshes (coarse, medium, fine, extra fine)? For example, did you generate the coarse mesh first and refine it, or did you start each mesh generation task essentially from the beginning? Generated the medium mesh first based on the SLUGG-type mesh family created first (Ref. AIAA 2017-0361), then coarsened it and refined it.
2. In your opinion, what was the most time-consuming or tricky aspect of generating a family of meshes? Specify all the edge spacing distributions and interior surface meshing properties differently for each grid level
3. How did the times (labor, CPU, etc.) needed to generate them compare? About same for surface meshing, but the AFLR execution time increased as mesh is refined.
4. Were there any problems that you encountered in one mesh resolution that you did not encounter in another resolution? No

# Post-Solution Mesh Modifications

1. After generating an initial flow solution, where additional mesh modifications made to improve solver convergence or solution accuracy? Yes, mostly related to wakesheet definition
2. Describe any post solution mesh modifications that were made? Modify wakesheet locations and wake surface meshes
3. How long did these modifications take (elapsed time and labor – in hours)? 6 hrs

# I/O

1. In which format did you export your meshes? (CGNS, Solver-native, …): AFLR UGRID format
2. What are the names of the files you uploaded to the GMGW-1 server? e1-HLCRM\_UnstrTet\_AGPS+AFLR and e2- HLCRM\_UnstrPrismTet\_AGPS+AFLR

# Miscellaneous

1. Are there any other aspects of your HL-CRM mesh generation experience that you would like to draw our attention to?