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.

**Note that the geometry and meshes referred to below are for the JAXA JSM.**

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? Pointwise v18
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)? There were no problems importing the geometries into Pointwise.
  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 Changing coordinates system (z spanwise), creating gaps at the slats ends

* 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)? ~ 1 hour

# 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? Pointwise v18
   2. How long did it take (elapsed time and labor – in hours)? 8
   3. Provide a brief description of how mesh resolution was specified (explicit user inputs, sources, curvature based sizing, background distribution function, …) Mesh size is specified explicitly at intersection of edges and number of elements is specified along each edge. Anisotropic stretching is prescribed normal to leading edges, trailing edges and side edges by specifying a growth ratio and number of layers.
   4. When/how did you judge surface mesh generation to be complete? When a smooth surface grid that respects most of the gridding guidelines was obtained.
2. Volume Meshing
   1. What software tool(s) did you use to generate your initial volume mesh? Pointwise v18
   2. How long did it take (elapsed time and labor – in hours)? 2/10 (medium/fine)
   3. Provide a brief description of how mesh resolution was specified (explicit user inputs, sources, curvature based sizing, background distribution function, …) With the Pointwise TRex function, the user explicitly specifies the first layer height, growth ratio, maximum number of layers and minimum number of full layers. The growth of layers stops locally when a unit stretch ratio is attained.
   4. For resolving surface boundary layers, what cell size growth rate did you use? Was it constant or variable? If variable, describe. A constant rate was used, corresponding to the meshing guidelines.
   5. When/how did you judge volume mesh generation to be complete? Given a good surface mesh, Pointwise will normally produce a good-quality volume grid with no need for further user intervention.
3. Adherence to HiLift-PW3 meshing guidelines
   1. To what extent did your mesh(es) adhere to the HiLift-PW3 meshing guidelines? Adherence to the guidelines is almost complete, with the exception of the wake refinement and constant-height initial normal layers.
   2. Was it possible to adhere to the guidelines on the first attempt, or were there iterations involved? Yes
   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):

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? N/A
   2. What was the average and range of the metrics? N/A
   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? N/A
2. Were there any additional best practices that you used in generating the meshes? Anisotropic refinement used normal to most side edges (flaps, slats, coves) in addition to leading and trailing edges. Gaps were created at the ends of the slats to avoid the generation of pyramids where 4 surfaces with opposing normals would have otherwise intersected.
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)? N/A
2. What criteria were used for mesh adaptation (e.g., pressure, vorticity, …)? N/A
3. What, if any, further treatments (e.g. smoothing) were applied? (Please describe ) N/A

# 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? I started with the medium grid and refined it by applying a factor of 1.5 to grid size constraints and number of elements, with some local adjustments. The volume grids were regenerated with the corresponding guidelines.
2. In your opinion, what was the most time-consuming or tricky aspect of generating a family of meshes? The new sizes/numbers of edges had to be entered manually
3. How did the times (labor, CPU, etc.) needed to generate them compare? Labor time is about 25% of that required for the initial grid. CPU time for the generation of the volume grid increases significantly with refinement (question 3b).
4. Were there any problems that you encountered in one mesh resolution that you did not encounter in another resolution? Yes

# Post-Solution Mesh Modifications

1. After generating an initial flow solution, where additional mesh modifications made to improve solver convergence or solution accuracy? Yes, but the initial meshes were retained in the end
2. Describe any post solution mesh modifications that were made? Refining the volume mesh using sources, using the fine grid normal spacing specifications with the medium grid surface discretization, other local refinements
3. How long did these modifications take (elapsed time and labor – in hours)? ~3 hours per mod

# I/O

1. In which format did you export your meshes? (CGNS, Solver-native, …): CGNS
2. What are the names of the files you uploaded to the GMGW-1 server? 030-jsm-medium-nacelleoff.cgns.gz, 030-jsm-medium-nacelleon.cgns.gz, 030-jsm-fine-nacelleoff.cgns.gz, 030-jsm-fine-nacelleon.cgns.gz

# Miscellaneous

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