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? Pointwise
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)? The geometry was clean when imported into Pointwise. But we were not able to import it into Catia as it is our practice.
  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: Naming CAD features (Fuselage, Wing..etc)

* 1. What was required level of user expertise (novice, intermediate, expert) for this task? Intermediate to make the mesh , expert to make the template
  2. How long did import take (both elapsed time and labor required --- in hours)? 30min to 1h

# 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)? 2 hours (6 automatic iterations + some manual work)
   3. Provide a brief description of how mesh resolution was specified (explicit user inputs, sources, curvature based sizing, background distribution function, …) The user set predefined mesh resolution on CAD features (Quilts). An automated script compute the mesh sizing/distribution to apply on connectors and create anisotropic layers (TRex) on predefined regions based on a template.
   4. When/how did you judge surface mesh generation to be complete? Mesh sizing as close as possible as described in the HiLiftPW-3's gridding guidelines and maximum cell angle < 140 deg.
2. Volume Meshing
   1. What software tool(s) did you use to generate your initial volume mesh? Pointwise
   2. How long did it take (elapsed time and labor – in hours)? 2h (for medium mesh)
   3. Provide a brief description of how mesh resolution was specified (explicit user inputs, sources, curvature based sizing, background distribution function, …) User define the volume mesher boundary condition (Wall/Match), the first layer height, number of maximum layers, number of full layers, growth rate and boundary decay.
   4. For resolving surface boundary layers, what cell size growth rate did you use? Was it constant or variable? If variable, describe. 1.2
   5. When/how did you judge volume mesh generation to be complete? Starting with a good quality surface mesh (as described in 2.d.), Pointwise usually produce good quality volume mesh. Nothing to do here.
3. Adherence to HiLift-PW3 meshing guidelines
   1. To what extent did your mesh(es) adhere to the HiLift-PW3 meshing guidelines? Very close, except the wake requirement and the 2 layers of constant cell spacing normal to the viscous walls option.
   2. Was it possible to adhere to the guidelines on the first attempt, or were there iterations involved? Some iterations (about 6) were needed to adjust the template. See 2.c.
   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): Wake guidelines very difficult to achieve for an unstructured solver. Also the wake definition should change with AoA. This is very difficult to achieve without adaptation or overset.

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? Maximum angle
   2. What was the average and range of the metrics? Max is 140 deg
   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? When having a collision between 2 Trex on a domains (slats and flaps sides) I had to refine the mesh to stop Trex before colliding.
2. Were there any additional best practices that you used in generating the meshes? At each mesh point, all constraints should be equal or very close.
3. What was the required level of user expertise (novice, intermediate, expert) for this task? Intermediate to make the mesh , expert to make the template

# 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? I started with the Medium mesh. The automated meshing make it very easy to go from one level to another.
2. In your opinion, what was the most time-consuming or tricky aspect of generating a family of meshes? Scripting
3. How did the times (labor, CPU, etc.) needed to generate them compare? Labor time is small compared to CPU time when including volume mesh. For surface mesh only, labor time is about 50% or less for the first mesh (making the Template) then it is all automated for other levels.
4. Were there any problems that you encountered in one mesh resolution that you did not encounter in another resolution? Coarse mesh is tricky because you need to capture the Cad features with a minimum refinement and aslo because of the Trex collision as discussed in 5.c.

# Post-Solution Mesh Modifications

1. After generating an initial flow solution, where additional mesh modifications made to improve solver convergence or solution accuracy? No
2. Describe any post solution mesh modifications that were made? N/O
3. How long did these modifications take (elapsed time and labor – in hours)?

# 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? GMGW-1\_CRMHL\_GappedFlaps\_BOMBARDIER\_PW\_\*.tar

# Miscellaneous

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