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
   a. What software tool(s) did you use to import and prepare the HL-CRM geometry model for meshing? Rhinoceros
2. Import & Preparation for meshing
   a. 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)
   b. What problems, if any, did you identify immediately after importing the geometry model (eg, missing geometry, poorly translated geometry, other)? None.
   c. 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 Generate STL format data.

       d.   What was required level of user expertise (novice, intermediate, expert) for this task? intermediate

       e.   How long did import take (both elapsed time and labor required --- in hours)? 0.1 hours. This includes time needed to export STL format data for Cflow (mesh generator).

Initial Meshing

1. What type of mesh family did you generate?

☐ Structured multi-block

☐ Unstructured tetrahedra

☒ Unstructured hexahedra

☐ Hybrid

☐ Overset

☐ Cartesian

☐ other (   )

2. Surface Meshing

    a.   What software tool(s) did you use to generate your initial surface mesh? Cflow

    b.   How long did it take (elapsed time and labor – in hours)? Surface mesh was generated automatically by projecting volume mesh near walls. So time needed for generating surface mesh is not clear.

    c.   Provide a brief description of how mesh resolution was specified (explicit user inputs, sources, curvature based sizing, background distribution function, …) User specifies divide level of octree mesh explicitly.

    d.   When/how did you judge surface mesh generation to be complete? Automatically judged by Cflow.

3. Volume Meshing

    a.   What software tool(s) did you use to generate your initial volume mesh?   Cflow.

    b.   How long did it take (elapsed time and labor – in hours)? About 36 hours.

    c.   Provide a brief description of how mesh resolution was specified (explicit user inputs, sources, curvature based sizing, background distribution function, …) An user inputs divide levels of initial mesh for octree division.

    d.   For resolving surface boundary layers, what cell size growth rate did you use? Was it constant or variable? If variable, describe. Growth rate is variable as to divide level of surface mesh. Average growth rate is 1.25 for coarse mesh, 1.18 for medium mesh, 1.11 for fine mesh. These growth rate was obtained as a result of mesh generation.

    e.   When/how did you judge volume mesh generation to be complete? Automatically judged by Cflow.

4. Adherence to HiLift-PW3 meshing guidelines

a. To what extent did your mesh(es) adhere to the HiLift-PW3 meshing guidelines? Almost all guidelines were adhered except for following two points. (1)Numbers of cells on trailing edges were not adhered. (2)The ratio of the number of cells was not adhered precisely.

b. Was it possible to adhere to the guidelines on the first attempt, or were there iterations involved? Some iterations were involved. We tried 3 times at maximum.

c. 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): Our grid generator could not control the total number of cells explicitly. So we had to try several times.

5. A priori metrics (such as skew, or maximum stretching ratio, maximum deviation of mesh nodes from OML or …)

a. What a priori metrics did you apply on the initial mesh? Nothing.

b. What was the average and range of the metrics? N/A

c. 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? Skewness and stretching ratio were not big problem for Cflow. However several tries were needed if there were negative volume cells.

6. Were there any additional best practices that you used in generating the meshes? Nothing.

7. What was the required level of user expertise (novice, intermediate, expert) for this task? expert

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

1. What adaptive meshing strategy did you use (technique and software)? Software is Cflow. Background mesh for octree division was aligned manually. After that spatial mesh was automatically generated.

2. What criteria were used for mesh adaptation (e.g., pressure, vorticity, …)? User experience.

3. What, if any, further treatments (e.g. smoothing) were applied? (Please describe) Nothing

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? Medium mesh is generated first. After that coarse and fine mesh is generated by modifying medium mesh.

2. In your opinion, what was the most time-consuming or tricky aspect of generating a family of meshes? Estimating the total number of cells.

3. How did the times (labor, CPU, etc.) needed to generate them compare? Labor time was about 4days to generate the family of mesh (coarse, medium, fine). Most of the labor time was for

medium mesh to try several types of topology or control the total number of cells. CPU time was 70 hours in total.

4. Were there any problems that you encountered in one mesh resolution that you did not encounter in another resolution? Small gaps were connected in the coarsest grid due to lack of resolution. So special treatment was necessary to keep geometric fidelity in the coarsest mesh.

Post-Solution Mesh Modifications

1. After generating an initial flow solution, where additional mesh modifications made to improve solver convergence or solution accuracy? Nothing.
2. Describe any post solution mesh modifications that were made? Nothing.
3. How long did these modifications take (elapsed time and labor – in hours)? N/A

I/O

1. In which format did you export your meshes? (CGNS, Solver-native, …): CGNS, Tecplot, Solver-native
2. What are the names of the files you uploaded to the GMGW-1 server? [Coarse]: 008-hlcrm-coarse-fullgap.cgns, [Medium]: 008-hlcrm-medium-fullgap.cgns, [Fine]: 008-hlcrm-fine-fullgap.cgns

Miscellaneous

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