GMGW3 – Geometry challenges

Key questions:

- What problems are encountered when building a CFD model from its various isolated constituent component geometry files?
- What geometry-related surface meshing issues are encountered when meshing complex legacy CFD geometries?
- What are the difficulties in using 3D scan data of a physical model in the CFD mesh generation workflow?

Problem descriptions

- ### Challenge A: Build the CRM-HL

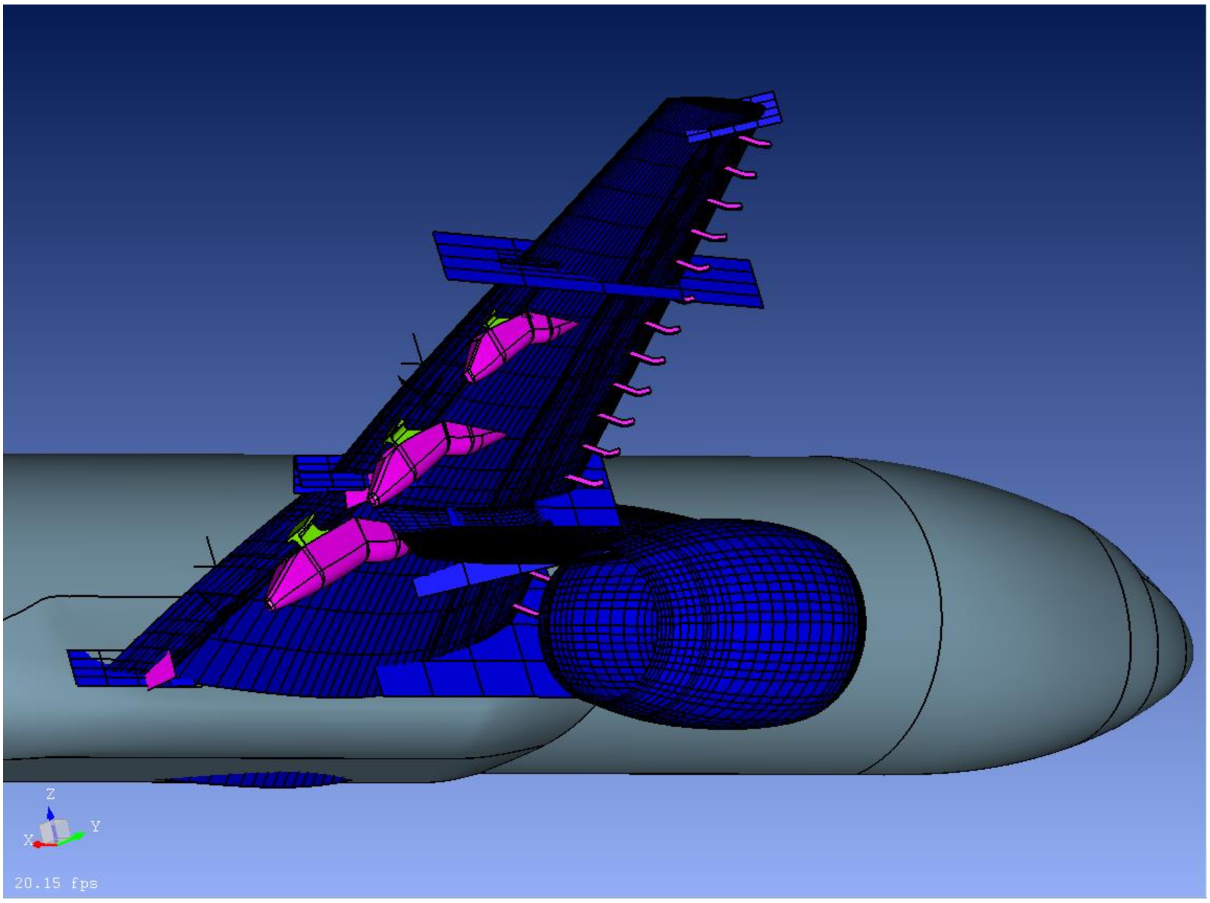
    - #### Goal

Given a collection of component geometry files of the CRM-HL model, build a valid Outer Mould Line (OML) representation of the complete configuration (with nominal slat and flap deflections) suitable for attempting a first surface mesh using your current best practices.

- #### Inputs

19 STEP files comprising the following components:

- Fuselage
- Cruise wing
- Pylon+Nacelle
- Wing root LE strake
- Nacelle chine
- Slat (stowed) + end trim surfaces
- Wing under slat surfaces (WUSS) + end trim surfaces
- IB and OB flaps (stowed) + end trim surfaces
- Slat brackets
- Flap support fairings (at 40/37)
- Flap brackets (at 40/37)
- Slat and flap deployment co-ordinate systems



Refer to the official CRM-HL workshop geometry to resolve any ambiguous areas.

- Required output
    - Single closed model (IGES or STEP file) of the assembled configuration containing all components supplied. Uploaded to supplied location.
    - Statement on whether any meshes were generated on the resulting geometry and any issues they revealed (included in the PQ response)

Questions for PQ

1. What process/tools did you use?
2. How much human and computer resources were required?
3. What were the most challenging aspects?
4. Please describe any particular action(s) you took to address the following areas; supplement your answers with images as required:
    - Pinch-points at the downstream end of each WUSS end-wall surface,
    - FSF/Wing
    - FSF/bracket/Flap
    - Flap cove IB/OB joint
    - Spoiler TE IB/OB joint
    - Flap/Flap partial gap closure
        - IB and OB flaps should be joined over first ~30% of their chord only using the supplied trim surface
    - IB flap should be joined to fuselage over first ~30% of chord using the supplied trim surface

- Nacelle closed surfaces
- Fuselage tail closure
- What other modifications/tweaks were made, once a valid closed model had been built, to support mesh generation and/or post-processing
    - LE splits

5. Please describe any other specific action(s) you took to prepare the OML

- ## Challenge B: Build the CRM-HL flap deflection geometries
    - ### Goal

Given the definitions of the additional deflected flap positions (43/40 & 37/34), build the two additional models.

- ### Inputs

(i) STEP files of the stowed flaps
(ii) STEP file of the nominal (40/37) deployed flap brackets
(iii) STEP file of the nominal (40/37) deployed flap support fairing, rear portion
(iv) Definitions of flap deflection transforms (as STEP).

- ### Required output
    - Single closed model (IGES or STEP file) of the assembled configuration containing all components supplied. Uploaded to supplied location.
    - Statement on whether any meshes were generated on the resulting geometry and any issues they revealed

Questions for PQ

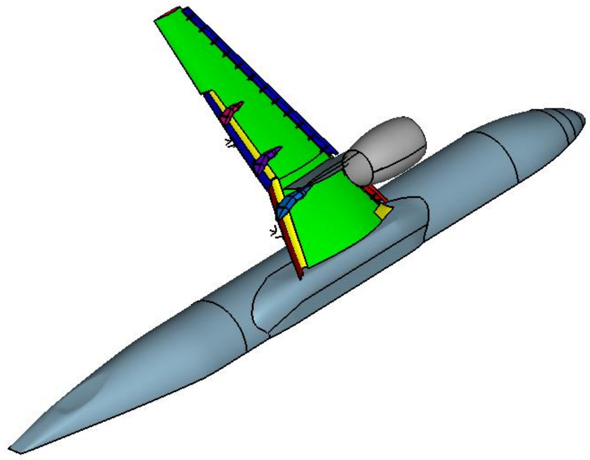
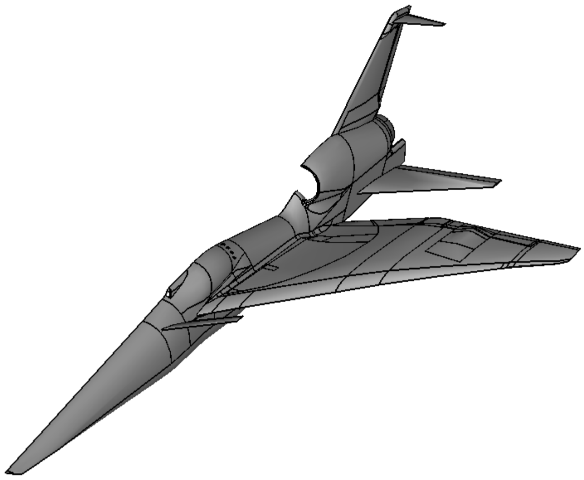
1. What process/tools did you use?
2. How much human and computer resources were required?
3. What were the most challenging aspects?
4. Please describe any specific action(s) you took to prepare the OML
5. How much of what you did in part A was reusable?

- ## Challenge C: OML-related mesh generation problems
    - ### Goal

Generate surface meshes using your best practices and report on meshing issues caused by the supplied OMLs.

- ### Inputs

IGES or STEP files of:
(i) the nominal CRM-HL (committee built)
(ii) sonic boom (c608) OML.

- Required output

  An assessment of the surface (and volume) meshes generated, covering issues revealed and resolutions applied (included in the PQ response).

Questions for PQ

1. What process/tools did you use?
2. How much human and computer resources were required?
3. What were the biggest problems you faced in each case?
    a. How did you identify it/them?
    b. Were the problems associated with curve, surfaces, or both?
    c. Did you locally modify the shape of the geometry to resolve the issue? If so, how?
    d. Did you locally modify the representation of the geometry (such as simplifying B-spline surfaces) to resolve the issue? If so, how?
    e. Did you encounter any problems when generating a volume grid that were caused by inappropriate surface meshing?

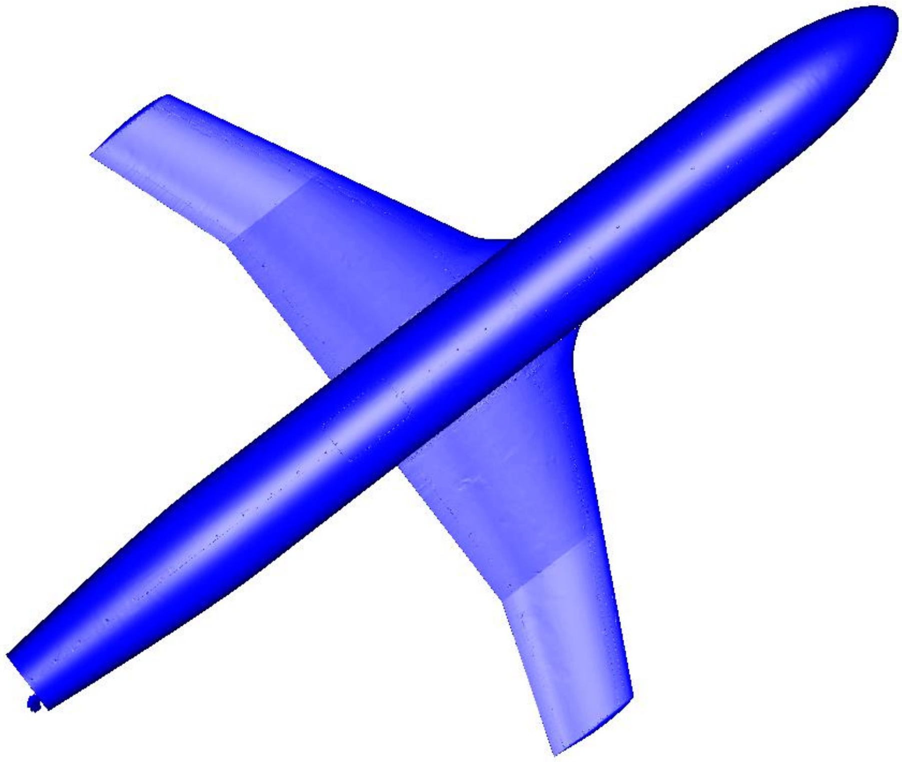
- **Challenge D: Generating a surface mesh incorporating 3D scan data**
  - Goal

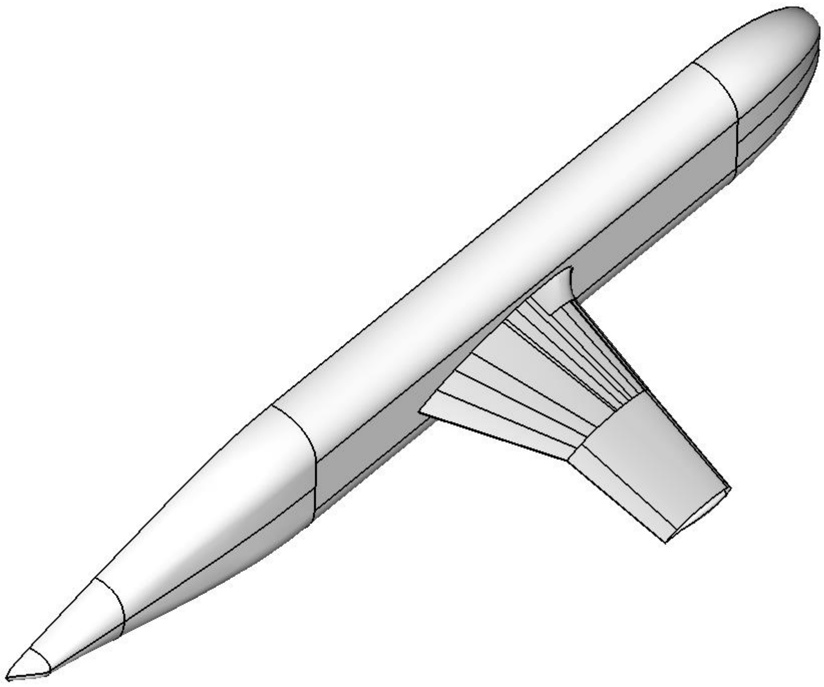
i) Given the STL file of a non-closed 3D scan of the JFM wind tunnel model, generate a closed manifold OML and then generate a CFD surface mesh.

and/or

ii) Given the STEP or IGES of the JFM generate a surface mesh and update/modify the mesh to closely reflect the as-manufactured geometry contained in the 3D scan STL data

  - Inputs
    - STL file of 3D scan of the JFM.
    - IGES or STEP files of the JFM





- Required output
    - i) The closed OML generated as STL/STEP/IGES. Uploaded to supplied location.
    - ii) A quantitative assessment of how close the surface grid is from the points specified in the .stl file

Questions for PQ

1. For challenge i:

   a. What process/tools did you use
   b. how did you identify the deficiencies in the .stl file?
   c. how did you "make up geometry" in order to get a manifold representation?
2. For challenge ii:
   a. What process/tools did you use?
   b. How was surface mesh updated to match the STL scan?
   c. How was comparison to scan done?
3. For either challenge I or ii, how much human and computer resources were required?
4. What were the biggest problems you faced?