Simulation Intent: Capturing mesh requirements

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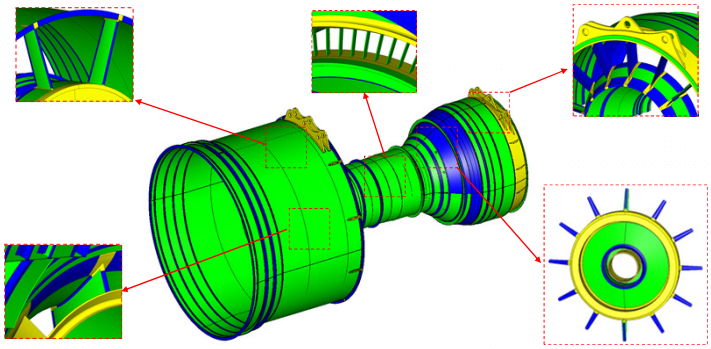
INTRODUCTION:

- Simulation Intent captures from the outset of the design process how the component is to be idealised and represented in the simulation model
- In this work simulation intent is used to construct meshes for an aero engine component
- Thin-sheet and long-slender regions are identified and subdivided out of an aerospace component[1,2].
- By defining different simulation intent, different meshing strategies can be used to create efficient meshes for the same subdivided model

MODEL PARTITIONING USING GEOMETRIC REASONING

- The CADfix Thin-Thick tool is used to identify and extract thin-sheet regions from the model.
- QUB algorithms then use tools based on the CADfix API to extract long-slender regions[2].
- The remaining regions are classed as 'Complex'.



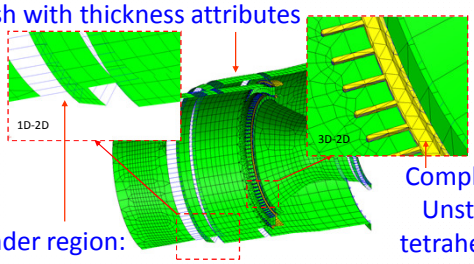
Complex

Thin-sheet
(Region has two long dimensions compared to thickness)

Long-slender
(Region has one long dimension compared to cross sectional dimensions)

SIMULATION INTENT: USE A REDUCED DIMENSIONAL MESH, WITH ELEMENT TYPE MATCHED TO GEOMETRIC SHAPE

Thin-sheet region:
Shell mesh with thickness attributes



Complex region:
Unstructured tetrahedral mesh

Long-slender region:
Beam elements with cross sectional attributes

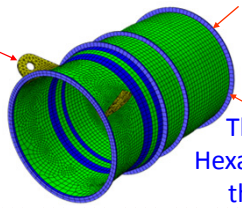
267,993 DoF

- Idealisation process automated in Siemens NX
- Interface data automatically calculated from the partitioned model is used to tie different regions together

SIMULATION INTENT: USE A REDUCED DIMENSIONAL MESH, WITH ELEMENT TYPE MATCHED TO GEOMETRIC SHAPE

Complex region:
Unstructured tetrahedral mesh

Long-slender region:
Swept pentahedral mesh



Thin-sheet region:
Hexahedral mesh swept through thickness

707,553 DoF

- Mesh automatically created in ABAQUS CAE
- Meshes at the interfaces of different regions conform

CONCLUSIONS

- Geometric reasoning has been used to subdivide aerospace components based on shape profiles
- Simulation intent has been used to define different mesh styles for subdivided regions

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[1] Robinson, T.T., Armstrong, C.G., Fairey, R., Automated mixed dimensional modelling from 2d and 3d cad models. Finite Elements in Analysis and Design, 47(2):151-165, 2011.
[2] Makem, J.E., Armstrong, C.G., Robinson, T.T., Automatic decomposition and efficient semi-structured meshing of complex solids. Proceedings of the 20th International Meshing Roundtable (Paris), 20:199{215, 2011.