EGADS Tess. Analysis Interface Module (AIM)

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0.1 Introduction

0.1.1 EGADS Tessellation AIM Overview

A module in the Computational Aircraft Prototype Syntheses (CAPS) has been developed to interact internal meshing capability for the EGADS library.

An outline of the AIM's inputs and outputs are provided in AIM Inputs and AIM Outputs, respectively.

0.1.2 Clearance Statement

This software has been cleared for public release on 05 Nov 2020, case number 88ABW-2020-3462.

0.2 AIM Inputs

The following list outlines the EGADS Tessellation meshing options along with their default value available through the AIM interface.

- **Proj_Name = "egadsTess_CAPS"**
  Output name prefix for meshes to be written in formats specified by Mesh_Format. These meshes are not linked to any analysis, but may be useful exploring meshing parameters.

- **Mesh_Format = NULL**
  Optional list of string mesh formats to generate meshes not linked to analysis.
  Available format names include: "exodus", "fast", "libMeshb", "stl", "bstl", "su2", "tecplot", "ugrid", "vtk", and "bvtk".
  where the "b" prefix indicates binary version.

- **Mesh_Quiet_Flag = False**
  Complete suppression of mesh generator (not including errors)

- **Mesh_Length_Factor = 1**
  Scaling factor to compute a meshing Reference_Length via:

  Reference_Length = capsMeshLength∗Mesh_Length_Factor

  Reference_Length scales Tess_Params[0] and Tess_Params[1] in both aimInputs and Mesh_Sizing

- **Tess_Params = [0.1, 0.01, 15.0]**
  Body tessellation parameters. Tess_Params[0] and Tess_Params[1] get scaled by Reference_Length if it is set, otherwise by the bounding box of the largest body. (From the EGADS manual) A set of 3 parameters that drive the EDGE discretization and the FACE triangulation. The first is the maximum length of an EDGE segment or triangle side (in physical space). A zero is flag that allows for any length. The second is a curvature-based value that looks locally at the deviation between the centroid of the discrete object and the underlying geometry. Any deviation larger than the input value will cause the tessellation to be enhanced in those regions. The third is the maximum interior dihedral angle (in degrees) between triangle facets (or Edge segment tangents for a WIREBODY tessellation), note that a zero ignores this phase

- **Edge_Point_Min = NULL**
  Minimum number of points on an edge including end points to use when creating a surface mesh (min 2).

- **Edge_Point_Max = NULL**
  Maximum number of points on an edge including end points to use when creating a surface mesh (min 2).

- **Mesh_Sizing = NULL**
  See Mesh Sizing for additional details.

- **Mesh_Elements = "Tri"**
  Element topology in the resulting mesh:

    - "Tri" - All triangle elements

    - "Quad" - All quadrilateral elements

    - "Mixed" - Quad elements for four-sided faces with TFI, triangle elements otherwise

- **Multiple_Mesh = "SingleDomain"**
  If "SingleDomain": Generate a single surface mesh file is assuming multiple bodies define a single computational domain (i.e. CFD)

  If "MultiFile": Generate a surface mesh file for each body.

  If "MultiDomain": Generate a single mesh file containing multiple surface meshes for each body.

- **TFI_Templates = True**
  Use Transfinite Interpolation and Templates to generate structured triangulations on FACEs with 3 or 4 "sides" with similar opposing vertex counts.

0.3 AIM Outputs

The following list outlines the EGADS Tessellation AIM outputs available through the AIM interface.

- **Done**
  True if a surface mesh was created on all surfaces, False if not.

- **NumberOfElement**
  Number of elements in the surface mesh

- **NumberOfNode**
  Number of vertices in the surface mesh

- **Surface_Mesh**
  The surface mesh for a link.

0.4 Mesh Sizing

NOTE: Available mesh sizing parameters differ between mesh generators.

Structure for the mesh sizing tuple = ("CAPS Mesh Name", "Value"). "CAPS Mesh Name" defines the caps←
Mesh on which the sizing information should be applied. The "Value" can either be a JSON String dictionary (see Section JSON String Dictionary) or a single string keyword string (see Section Single Value String)

0.4.1 JSON String Dictionary

If "Value" is a JSON string dictionary (e.g. "Value" = {"edgeDistribution": "Even", "numEdgePoints": 100}) the
following keywords (= default values) may be used:

- **edgeDistribution = "Even"**
  Edge Distribution types. Options: Even (even distribution), Tanh (hyperbolic tangent distribution).

- **numEdgePoints = 2**
  Number of points along an edge including end points. Must be at least 2.

- **initialNodeSpacing = [0.0, 0.0]**
  Initial (scaled) node spacing along an edge. [first node, last node] consistent with the orientation of the edge.

- **tessParams = (no default)**
  Face tessellation parameters, example [0.1, 0.01, 20.0]. (From the EGADS manual) A set of 3 parameters
  that drive the EDGE discretization and the FACE triangulation. The first is the maximum length of an EDGE
  segment or triangle side (in physical space). A zero is flag that allows for any length. The second is a
  curvature-based value that looks locally at the deviation between the centroid of the discrete object and the
  underlying geometry. Any deviation larger than the input value will cause the tessellation to be enhanced in
  those regions. The third is the maximum interior dihedral angle (in degrees) between triangle facets (or Edge
  segment tangents for a WIREBODY tessellation), note that a zero ignores this phase.

0.4.2 Single Value String

If "Value" is a single string, the following options maybe used:

- (NONE Currently)