EGADS Tessellation Analysis Interface Module (AIM)

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1 Introduction

1.1 EGADS Tessellation AIM Overview

A module in the Computational Aircraft Prototype Syntheses (CAPS) has been developed to interact .....

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

Details of the AIM's shareable data structures are outlined in AIM Shareable Data if connecting this AIM to other AIMs in a parent-child like manner.

2 AIM Inputs

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

- **Proj_Name = NULL**
  This corresponds to the output name of the mesh. If left NULL, the mesh is not written to a file.
- **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
- **Mesh_Format = "AFLR3"**
  Mesh output format. Available format names include: "AFLR3", "VTK", "TECPLOT", "STL" (quadrilaterals will be split into triangles), "Airfoil", "FAST", "Nastran".

  - "Airfoil" corresponds to the following file format in which the nodal coordinates of the body's edges are written. Bodies should be face bodies, planar, and have no holes. A $*$.af suffix is used for the file:
    "Character Name"
    x[0] y[0] x y coordinates
    x[1] y[1]
    ... ...

- **Mesh_ASCII_Flag = True**
  Output mesh in ASCII format, otherwise write a binary file if applicable.

- **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 (deprecated)

- **Multiple_Mesh = True**
  If set to True (default) a surface mesh will be generated and output (given "Proj_Name" is set) for each body. When set to False only a single surface mesh will be created. Note, this only affects the mesh when writing to a file (no effect on sharable data AIM Shareable Data) .

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

3 AIM Shareable Data

The egadsTess AIM has the following shareable data types/values with its children AIMs if they are so inclined.

- **Surface_Mesh**
  The returned surface mesh after egadsTess execution is complete in meshStruct (see meshTypes.h) format.

- **Attribute_Map**
  An index mapping between capsGroups found on the geometry in mapAttrToIndexStruct (see miscTypes.h) format.

4 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

5 Mesh Sizing

NOTE: Available mesh sizing parameters differ between mesh generators.

Structure for the mesh sizing tuple = ("CAPS Group Name", "Value"). "CAPS Group Name" defines the capsGroup 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)

5.1 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.

5.2 Single Value String

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

- (NONE Currently)