CART3D Analysis Interface Module (AIM) User Guide

May 28, 2020

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This documentation contains four sections to document the use of the CART3D AIM. CART3D Examples contains example ∗.csm input files and pyCAPS scripts designed to make use of the CART3D AIM. These example scripts make extensive use of the CART3D attributes and CART3D AIM Inputs and CART3D AIM Outputs.

1.3 Dependencies

ESP client of libxddm. For XDDM documentation, see $CART3D/doc/xddm/xddm.html. The library uses XML Path Language (XPath) to navigate the elements of XDDM documents. For XPath tutorials, see the web, e.g. www.↩ developer.com/net/net/article.php/3383961/NET-and-XML-XPath-Queries.htm

Dependency: libxml2, www.xmlsoft.org. This library is usually present on most systems, check existence of 'xml2-config' script

2 CART3D Examples

This example contains a set of ∗.csm and pyCAPS (∗.py) inputs that uses the CART3D AIM. A user should have knowledge on the generation of parametric geometry in Engineering Sketch Pad (ESP) before attempting to integrate with any AIM. Specifically, this example makes use of Design Parameters, Set Parameters, User Defined Primitive (UDP) and attributes in ESP.

3 CART3D attributes

The following list of attributes drives the CART3D geometric definition.

- **capsAIM** This attribute is a CAPS requirement to indicate the analysis the geometry representation supports.

- **capsReferenceArea** [Optional: Default 1.0] This attribute may exist on any *Body*. Its value will be used as the Reference_Area entry in the CART3D input.
- **capsReferenceChord** [Optional: Default 1.0] This attribute may exist on any *Body*. Its value will be used as the Reference_Length entry in the CART3D input.
- **capsReferenceX** [Optional: Default 0.0] This attribute may exist on any *Body*. Its value will be used in the Moment_Point entry in the CART3D input.
- **capsReferenceY** [Optional: Default 0.0] This attribute may exist on any *Body*. Its value will be used in the Moment_Point entry in the CART3D input.
- **capsReferenceZ** [Optional: Default 0.0] This attribute may exist on any *Body*. Its value will be used in the Moment_Point entry in the CART3D input.

4 AIM Inputs

The following list outlines the CART3D inputs along with their default value available through the AIM interface.

- **Tess_Params = [double, double, double]**. <Default [0.025, 0.001, 15.00]>
  These parameters are used to create the surface mesh for CART3D. Their order definition is as follows.
  1. Max Edge Length (0 is any length)
  2. Max Sag or distance from mesh segment and actual curved geometry
  3. Max angle in degrees between triangle facets
- **outer_box = double**. <Default 30>
  Factor of outer boundary box based on geometry length scale defined by the diagonal of the 3D tightly fitting bounding box around body being modeled.
- **nDiv = int**. <Default 5>
  nominal # of divisions in backgrnd mesh
- **maxR = int**. <Default 11>
  Max Num of cell refinements to perform
- **Mach = double**. <Default 0.76>
- **alpha = double**. <Default 0.0>
  Angle of Attach in Degrees
- **beta = double**. <Default 0.0>
  Side Slip Angle in Degrees
- **gamma = double**. <Default 1.4>
  Ratio of specific heats (default is air)
- **maxCycles = int**. <Default 1000>
  Number of iterations
- **SharpFeatureDivisions = int**. <Default 2>
  nominal # of ADDITIONAL divisions in backgrnd mesh around sharp features
- **nMultiGridLevels = int**. <Default 1>
  number of multigrid levels in the mesh (1 is a single mesh)
- **MultiGridCycleType = int**. <Default 2>
  MultiGrid cycletype: 1 = "V-cycle", 2 = "W-cycle" 'sawtooth' cycle is: V-cycle with MultiGridPreSmoothing = 1, MultiGridPostSmoothing = 0
- **MultiGridPreSmoothing = int**. <Default 1>
  number of pre-smoothing passes in multigrid

- **MultiGridPostSmoothing = int**. <Default 1>
  number of post-smoothing passes in multigrid
- **CFL = double**. <Default 1.2>
  CFL number typically between 0.9 and 1.4
- **Limiter = int**. <Default 2>
  organized in order of increasing dissipation.
  0 = no Limiter, 1 = Barth-Jespersen, 2 = van Leer, 3 = sin limiter, 4 = van Albada, 5 = MinMod
- **FluxFun = int**. <Default 0>
  0 = van Leer, 1 = van Leer-Hanel, 2 = Colella 1998, 3 = HLLC (alpha test)
- **iForce = int**. <Default 10>
  Report force & mom. information every iForce cycles
- **iHist = int**. <Default 1>
  Update 'history.dat' every iHist cycles
- **nOrders = int**. <Default 8>
  Num of orders of Magnitude reduction in residual
- **Xslices = double**
  OR
- **Xslices = [double, ... , double]**
  X slice locations created in output.
- **Yslices = double**
  OR
- **Yslices = [double, ... , double]**
  Y slice locations created in output.
- **Zslices = double**
  OR
- **Zslices = [double, ... , double]**
  Z slice locations created in output.
- **Model_X_axis = string**
  Model_X_axis defines x-axis orientation.
- **Model_Y_axis = string**
  Model_Y_axis defines y-axis orientation.
- **Model_Z_axis = string**
  Model_Z_axis defines z-axis orientation.

5 AIM Outputs

Integrated force outputs on the entire body are available as outputs from the loadsCC.dat output file.

- **C_A**. entire Axial Force
- **C_Y**. entire Lateral Force
- **C_N**. entire Normal Force
- **C_D**. entire Drag Force
- **C_S**. entire Side Force
- **C_L**. entire Lift Force

- **C_l**. entire Rolling Moment
- **C_m**. Pitching Moment
- **C_n**. Yawing Moment
- **C_M_x**. X Aero Moment
- **C_M_y**. Y Aero Moment
- **C_M_z**. Z Aero Moment