Pointwise, a mesh generation tool for OpenFOAM

HPC enabling of OpenFOAM for CFD application
CINECA, 26th-28th November 2012
Your Presenter: Porto Ricerca

Our principal activity is in the CFD sector, mainly for external fluid-dynamics.

We provide:

– Consulting
– Softwares
CFD consulting: Aeronautics

Complete set of softwares
- panel code
- Euler code
- RANS
- 2D (Mses) and 3D
CFD consulting: Aeronautics

Additional Modules:
- flight dynamics integration
- ice collection efficiency
- rotor
CFD consulting: Aeronautics

Collaborations with Universities
CFD consulting: Marine sector

• Free Surface
• Un-steady analysis (sea-keeping)
CFD consulting: Marine sector

Optimization
CFD consulting: Marine sector

Optimization
CFD consulting: Automotive

External fluid-dynamics

Heat exchanger
Softwares

Analytical Methods

Pointwise

Your Presenter
Pointwise Introduction

Mesh generation for computational fluid dynamics (CFD)
- Gridgen
- Pointwise

Quality and Flexibility
High levels of automation

Intimate levels of control (mesh metrics)
Quality

**Hexahedral meshing**
- elliptic PDE methods for smoothness, clustering and orthogonality control
- hyperbolic PDE and algebraic extrusion methods

**Unstructured and hybrid meshing**
- T-Rex (anisotropic tetrahedral extrusion) for extruding regular layers of high-quality tetrahedra
- classic hybrid meshing via extrusion
- mixed hex-tet meshes
<table>
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<th>Quality</th>
<th>Available Metrics</th>
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<tr>
<td>Jacobian</td>
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**Available Metrics**

1. **Quality**
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   - Volume
   - Component Volume
   - Area
   - Length
   - Length I
   - Length J
   - Length K
   - Volume Ratio
   - Area Ratio

2. **Available Metrics**
   - Equiarea Skewness
   - Equivolume Skewness
   - Centroid Skewness
   - Wall Spacing
   - Wall Orthogonality
   - Database associativity
   - Boundary Proximity
   - Surface Proximity
   - Maximum Included Angle
   - Equiangle Skewness
Flexibility

Import CAD data from native and standard formats

Export grid and boundary conditions to open-source, commercial and standard CFD formats
## CFD and CAE formats supported

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Glyph

Tcl-based scripting language

Journaling and playback
T-REX
Open File and Select Solver: OpenFOAM
Select domains: Create Block
Populate Block: Grid, T-Rex
3D T-Rex

- Primary settings are available on T-Rex tab of Grid, Solve.
- Max. Layers provides an upper limit for the desired number of anisotropic layers.
- Full Layers specifies how many complete layers of anisotropic cells are generated.
- Growth Rate controls the growth of successive layer heights.
Push Attributes

- *Push Attributes* is a new feature unique to Pointwise.
- When enabled, T-Rex settings are automatically propagated to the parent entities.
- T-Rex attributes set on a block will update the bounding domains and connectors.
- T-Rex attributes set on a domain will update the bounding connectors.
Set Boundary Conditions for T-Rex grid
Solve: Initialize
Match and Push Attributes for 'In and Out'
Examine: Max Included Angle on Y=0 cut

T-Rex grid
Refine grid: introduce new domain
Add face to block: Save Baffle face
T-Rex Boundary Condition for Baffle face
Solve, Initialize

T-Rex
Examine: Max Included Angle and Histogram

High Max Incl. Angle
Examine: Max Included Angle and Histogram

High Skewness
Refine grid: Advanced and Skew Criteria

T-Rex

Fluid Dynamics Specialist
3D T-Rex

- Advanced attributes provide additional control over the T-Rex volume.
- *Isotropic Seed Layers* inserts additional layers of points into the isotropic region if aniso layers stop short.
- *Collision Buffer* specifies how much space should be retained between collision fronts for isotropic cell insertion.
- *Aniso-Iso Blend* controls the rate at which tets grown off anisotropic domains transition to an isotropic state.
3D T-Rex

- Skew Criteria options for skew quality checks can occur during T-Rex extrusions to prevent poor quality cell formation.
- Delay Skew Criteria prevents skew criteria from being evaluated for a specified number of layers.
- Max Angle checks the maximum included angle of the tet cell as well as the maximum included angle in the tet’s faces.
Solve, Initialize
Examine: Max Included Angle and Histogram

- Lower Max Incl. Angle
- Better solution
Export CAE: Combine anisotropic tets
Combine anisotropic tets: cells reduction
Glyph
Pointwise's Tcl-based scripting language, Glyph, provides customization capabilities. Rather than type scripts entirely by hand, you can use journaling.

Glyph gives the possibility to:
- automate complex grids
- reproduce the same grid for similar geometries (results not mesh depending)
- link Pointwise to a Process Integration and Design Optimization software.
Script file example: text file

Variables declaration

Glyph text file example
Database creation
Database intersection
Surface mesh
Volume mesh

Script executed
# Directory from which script is run
set cwd [file dirname [info script]]

# Fuselage conica and line data

set point1 "-4.00 0.00 0.00"
set point2 "-1.00 0.00 0.75"
set CornerP1 "-4.00 0.00 0.75"
set curvatural "0.40"
set point3 "3.00 0.00 0.75"
set point4 "6.50 0.00 0.00"

# Wing data

set RootScale "1.70 1.20 1.20"
set RootPich "1.00"
set RootPosition "2.00 0.00 0.00"
set TipScale "0.50 0.50 0.50"
set TipPich "-2.00"
set TipPosition "1.70 5.00 0.50"

# Shape Creation

pw::Display resetView +Y
set _TMP(mode _1) [pw::Application begin Create]
set _TMP(_PW _1) [pw::SegmentConic create]
Database creation
Database intersection
Surface mesh
Volume mesh

Script re-executed
Thank you for attending.

more examples at
http://www.pointwise.com/webinar/

for more info

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