

LayTracks3D: Mesh Generator for General Assembly Models

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Overview

Input

LayTracks3D can handle general solids and assembly models.

MAT

Medial Axis Transform (MAT) is a skeleton representation of solid with reduced dimension.

Corridors

Internal MA junctions and outer imprints define critical planes of corridors for decomposition.

Mesh on MA

MA reduces hex meshing to quad meshing on MA. Mesh on the MA defines topology of tracks.

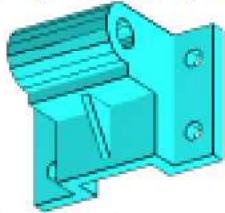
Tracks

Tracks in 3D are tunnels bounded by Rails, which connect center of MA ball to tangent points.

Mesh

Boundary sensitive mesh is generated as tracks are orthogonal to boundary. Tracks are meshed by placing nodes on Rails. Columns of hexes are formed advancing from boundary towards MA.

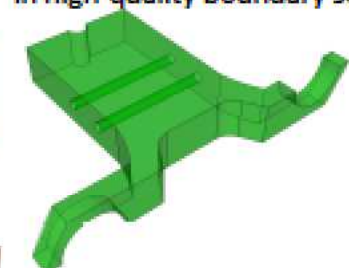
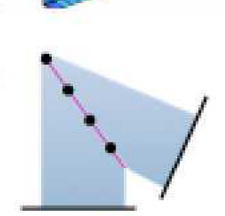
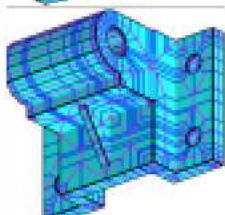
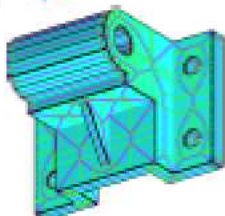
LayTracks
(9-IMR, 2000)



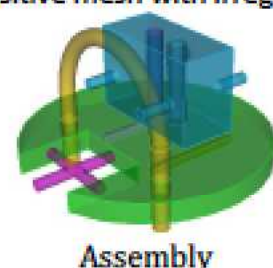
LayTracks3D
(22-IMR, 2013)



Abstract: This poster is an extension of all-quad meshing algorithm *LayTracks* [1], to generate high quality hex/hex-dominant meshes of general 3D assembly models. *LayTracks3D* uses the mapping between the *Medial Axis* (MA) and the boundary of the 3D domain to decompose complex 3D domains into simpler domains called *Tracks*. Tracks in 3D are tunnels with no branches, symmetric, non-intersecting, orthogonal to the boundary, and shortest path from MA to the boundary. These properties of the tracks result in high-quality boundary sensitive mesh with irregular nodes restricted to MA.



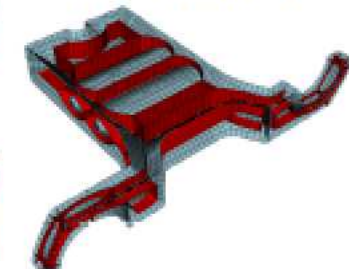
Solid with Holes



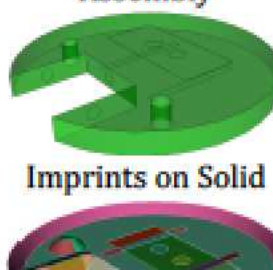
Assembly



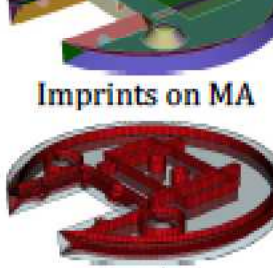
Thin-Wall Solid



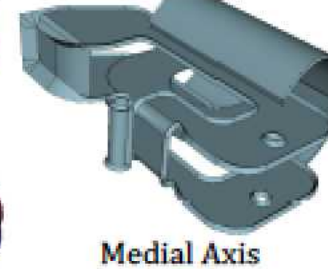
Mesh on MA in Corridor



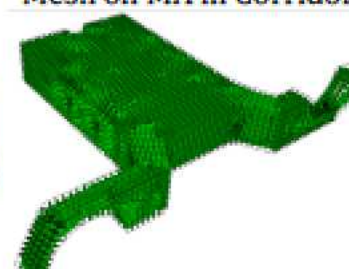
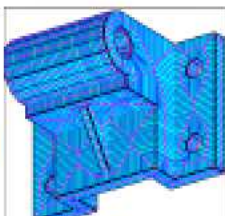
Imprints on Solid



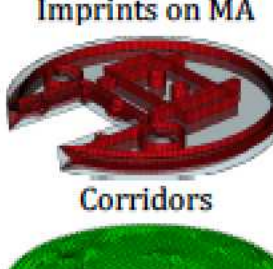
Imprints on MA



Medial Axis



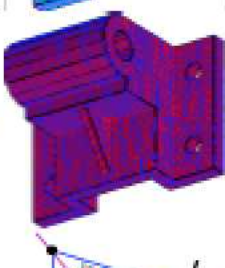
Tracks



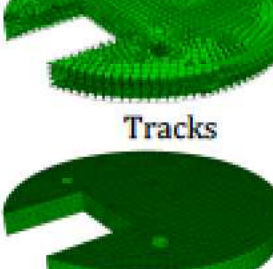
Corridors



Tracks



Mesh Cross Section



Tracks

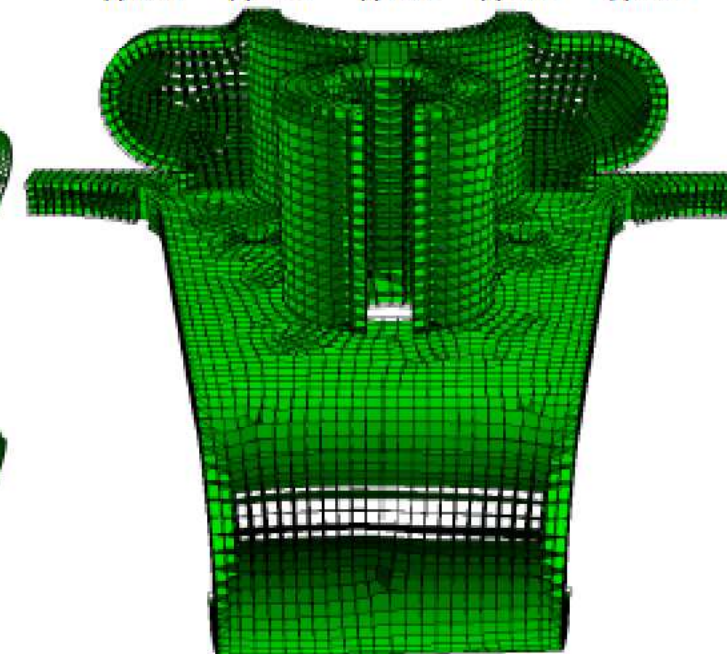
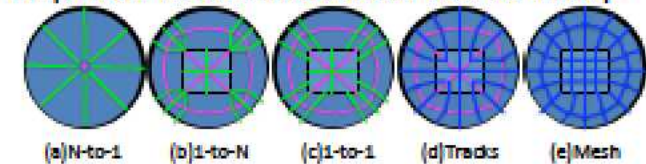


Mesh Cross Section



LayTracks3D Characteristics:

- Handles general solids & assemblies
- Boundary sensitive: Corridors and Tracks intersect boundary orthogonally
- Dimension reduction: MA reduces 3D hex meshing to quad meshing on MA
- Geometry adaptive: MA radius function provides sizing and anisotropy control
- Preserves imprints and sharp features
- Fast remeshing: MA & Corridors remain unchanged during interactive remeshing
- Mesh is morphable if MA remains unchanged
- Orientation insensitive
- Parallelizable as decomposition based method
- Potential All-Hex?: Medial N-to-1 and N-to-1 map need to be transformed to 1-to-1 map



[1] Quadros W. R., et al., "LayTracks: A New Approach to Automated Quadrilateral Mesh Generation using MAT", Proc. 9th International Meshing Roundtable, 239-250, Oct 2000.

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