Overview

This is a documentation for executable file GenHex.exe, which has the following function:

- Create all-hex mesh.

I/O

Input:

- manifold triangle mesh in the **raw format.**
  - No restriction
- Updated segmentation file from Segmentation.exe (.k)
- Patch file based on the above updated segmentation file (.k)
  - Only needed if the updated segmentation file didn't satisfy topology constraints [2]
- Polycube structure from Polycube.exe (.vtk) and its coarse hex mesh in parametric domain (.raw, manually created in Abaqus or Pointwise)
- Corresponding corner points between physical and parametric domain from Polycube.exe (.txt)

Output:

- All-hex mesh (.vtk) with specified octree subdivision level.

All .k file can be visualized using LS-Prepost.

Usage of executable file:

User can run the executable file "GenHex.exe" through command line.

Each file that ends with ".bat" contains a series of line commands for the specific model. User can run the file to get the ideal results for each model. User can also open the file with text editor to check the detailed commands.

Here, we will use the following file structure to explain the usage of the program:

Generator for Volumetric Mesh/

GenHex.exe

example/

cube_with_hole/

helicopter/

rod_demo/

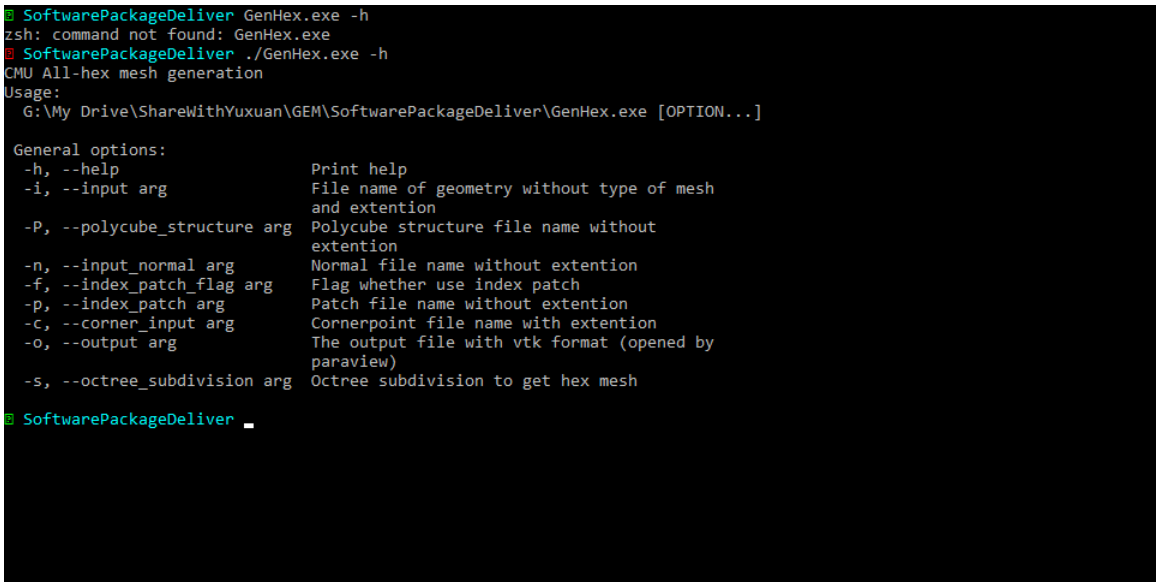
The GenHex is explained using the model in rod folder ("rod_tri.raw" as input file).

The options to run the code are explained as follow:

Help Interface (“-h” or “--help”)

User can use this option to check the help information

Example: GenHex.exe -h



Input mesh setting (“-i” or “--input”)

User need to set the input mesh file using this option.

Input polycube structure setting (“-P” or “--polycube_structure”)

User need to set the polycube structure (hex mesh in parametric domain) information using this option.

Note: This file (polycube structure) is used as a parametric domain. This means that the change in length does not affect the final hex mesh result. Based on the update version of the program, the polycube may have different dimension (length, width and depth).

Input segmentation setting (“-n” or “--input_normal”)

User need to set the segmentation information using this option.

Patch file for topology constraints (“-f” or “—index_patch_flag”)

User can use this option to control if patch file is needed.

- -f 1: Require patch file

Input Patch file setting (“-p” or “--index_patch”)

User need to set the patch information using this option.

When -f=1, the program will read this option to give more segmentation to satisfy topology constraints.

Input corner point setting ("-c," or "--corner_input")

- User need to set the corresponding corner points between physical and parametric domain from (.txt) using this option. This file is automatically generated from Polycube.exe. Here, the extension cannot by omitted.

Octree subdivision ("-s" or "--octree_subdivision")

- User can use this option to perform Octree subdivision

  Example of spline construction with one level, two level will be shown in the end of this document:

The example is shown in the following options.

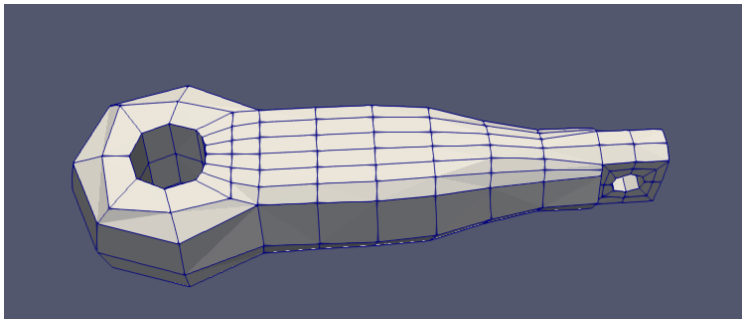
Example: GenHex.exe -i rod -P rod_paraHex_hex -n rod_initial_read -c rod_Output_CornerPoints.txt -s 2 -o rod

```
G:\My Drive\ShareWithYuxuan\GEM\SoftwarePackageDeliver>GenHex.exe -i .\example\rod_demo\rod -P .\example\rod_
demo\rod_paraHex_hex -n .\example\rod_demo\rod_initial_read -c .\example\rod_demo\rod_Output_CornerPoints.txt
  -s 2 -o .\example\rod_demo\rod
[==============>                                                  ] 20 %
[============================>                                    ] 40 %
************************************************************
Initializing the polycube structure!
[========================================>                        ] 60 %
[============================================================================] 100 %
Done!
------------------------------------------------------------------
```

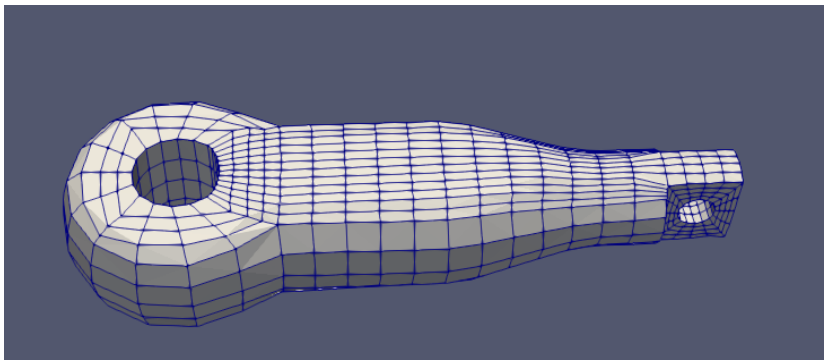
The polycube based all-hex mesh are output as below:

The visualization of the polycube based all-hex mesh are shown below:

Octree level 1: GenHex.exe -i rod -P rod_paraHex_hex -n rod_initial_read -c rod_Output_CornerPoints.txt -s 1 -o rod



Octree level 2: : GenHex.exe -i rod -P rod_paraHex_hex -n rod_initial_read -c rod_Output_CornerPoints.txt -s 2 -o rod



References

[1] K. Hu, Y. J. Zhang, T. Liao. **Surface Segmentation for Polycube Construction Based on Generalized Centroidal Voronoi Tessellation**. *Computer Methods in Applied Mechanics and Engineering Special Issue on Isogeometric Analysis*, 316:280-296, 2017.

[2] K. Hu, Y. Zhang. **Centroidal Voronoi Tessellation Based Polycube Construction for Adaptive All-Hexahedral Mesh Generation**. *Computer Methods in Applied Mechanics and Engineering*, 305:405-421, 2016.