

## Overview

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

- Create polycube structure.
- Create corresponding corner points between physical and parametric domain

Based on polycube structure, user needs to manually create a coarse hex mesh of polycube using ABAQUS or Pointwise. The coarse mesh will be the input for GenHex.exe.

### I/O

Input:

- manifold triangle mesh in the **raw format**.
  - No restriction
- Segmentation file from Segmentation.exe (.k).

Output:

- Polycube structure in triangle mesh in .vtk format:
- Corner points in .txt format:

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

Manual modification if needed in LS-Prepost: If needed, update segmentation file with special normal direction in LS-Prepost and output a new .k file.

No matter whether manual modification is needed, you must use LS-Prepost to open and save the file to the "XXX\_initial\_read.k", which will be used as the input.

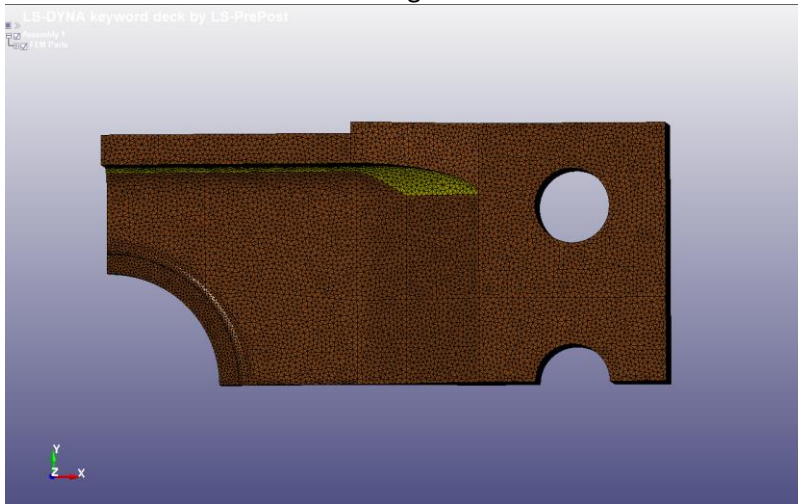
### Usage of LS-Prepost to update segmentation file with special normal direction:

User may update segmentation file with special normal direction in LS-Prepost and output a new .k file.

Here, we will use the helicopter model to explain the usage of the free program

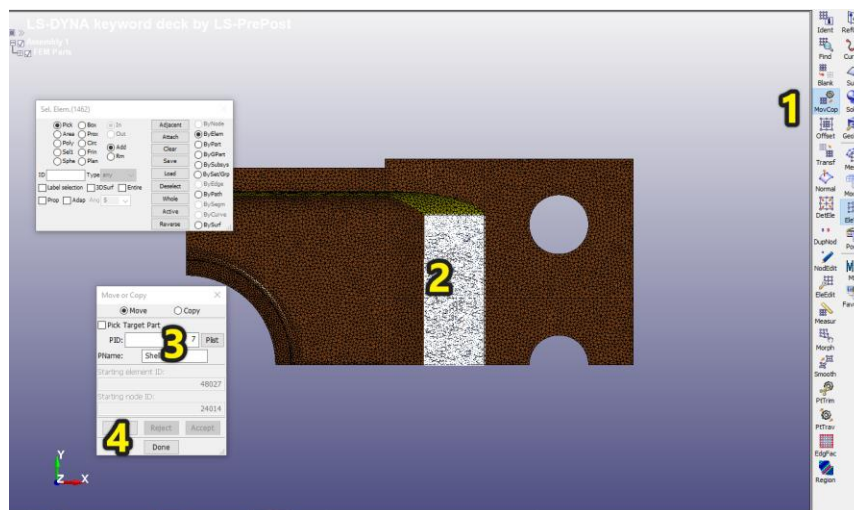
([https://ftp.lstc.com/anonymous/outgoing/lsprepost/4.6/win64/LS-PrePost-4.6.18-x64-20Sep2019\\_setup.exe](https://ftp.lstc.com/anonymous/outgoing/lsprepost/4.6/win64/LS-PrePost-4.6.18-x64-20Sep2019_setup.exe)):

The initial visualization of the segmentation mesh is shown below:

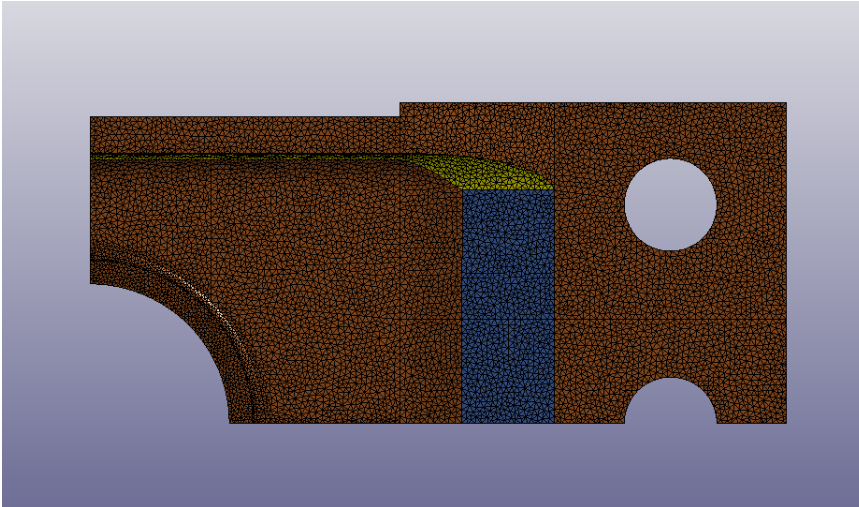


We will update segmentation file with special normal direction. The following four steps will solve the problem:

1. Click move/copy tab
2. Click the elements which you want to update segmentation file with special normal direction
3. Enter the target patch ID. The target ID is 7
  - a. When ID=7, it represents the normal direction is  $(-1,0,1)$
  - b. When ID=8, it represents the normal direction is  $(-1,0, -1)$
4. Click Apply button.



The result shows as follow



### Usage of executable file:

User can run the executable file “Polycube.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/

Polycube.exe

example/

cube\_with\_hole/

helicopter/

rod\_demo/

The Polycube 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: Polycube.exe -h

```
SoftwarePackageDeliver ./PolyCube.exe -h
CMU Polycube construction
Usage:
  G:\My Drive\ShareWithYuxuan\GEM\SoftwarePackageDeliver\PolyCube.exe [OPTION...]

General options:
-h, --help          Print help
-i, --input arg     File name of geometry without type of mesh and
                    extention
-I, --iteration arg Iteration number, default is 100
-s, --step arg      Step, default is 0.2
-n, --input_seg arg Segmentation file name without extention
-o, --output arg    The output file with vtk format (opened by
                    paraview)
-c, --corner_output arg The output file of cornerpoint
```

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

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

### *Iteration setting (“-l” or “--iteration”)*

User can use this option to control the number of iteration. It will move the nodes into its own projection normal plane.

### *Step setting (“-s” or “--step”)*

User can use this option to control the value of steps. It will decide how quick the nodes will be moved into its own projection normal plane. Too large steps may damage the polycube structure. Too small steps may need more iterations which is set in iteration setting.

### *Input segmentation setting (“-n” or “--input\_seg”)*

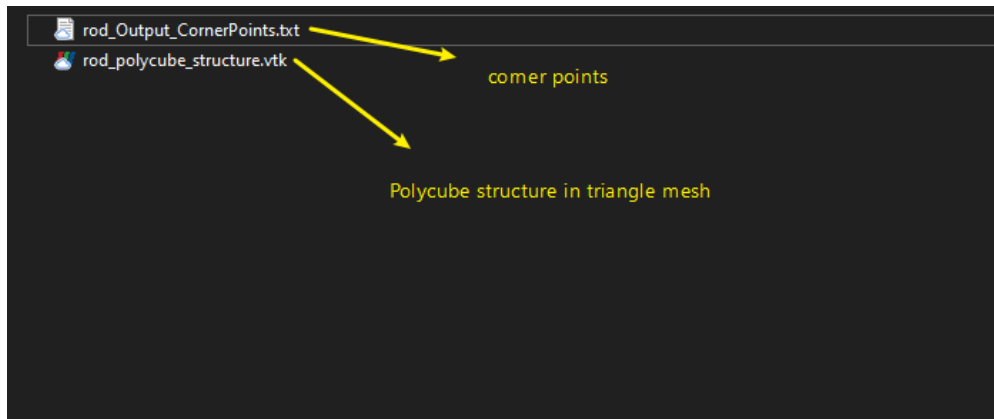
User need to set the segmentation information using this option.

The example is shown in the following options.

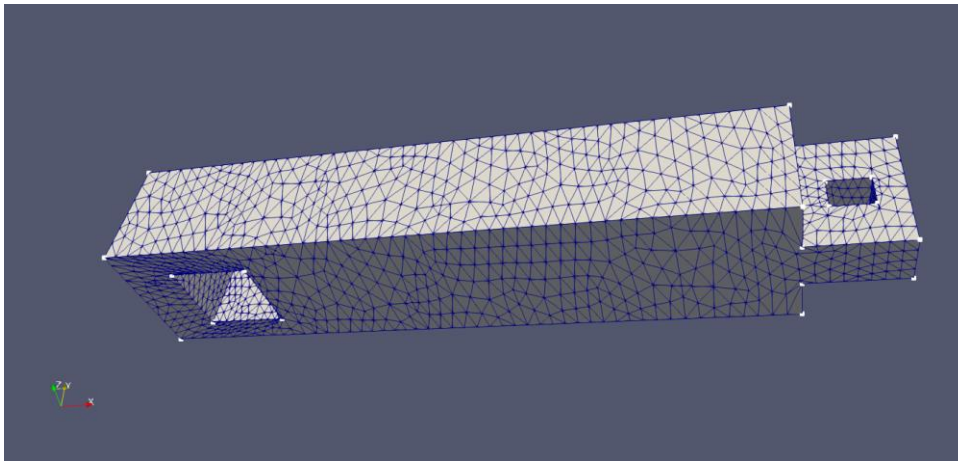
Example: `PolyCube.exe -i rod -l 10000 -s 0.01 -n rod_initial_read -o rod_polycube_structure -c rod_Output_CornerPoints.txt`

```
Create polycube structure
G:\My Drive\ShareWithYuxuan\GEM\SoftwarePackageDeliver>PolyCube.exe -i .\example\rod_demo\rod -l 10000 -s 0.01 -n .\example\rod_demo\rod_initial_read -o .\example\rod_demo\rod_polycube_structure -c .\example\rod_demo\rod_Output_CornerPoints.txt
[====>] 4 %
[=====>] 9 %
[=====>] 14 %
[=====>] 19 %
[=====>] 24 %
[=====>] 29 %
[=====>] 34 %
[=====>] 39 %
[=====>] 44 %
[=====>] 49 %
[=====>] 54 %
[=====>] 59 %
[=====>] 64 %
[=====>] 69 %
[=====>] 74 %
[=====>] 79 %
[=====>] 84 %
[=====>] 89 %
[=====>] 94 %
[=====>] 99 %
Done!
-----
Press any key to continue . . .
```

The Polycube structure in triangle mesh and corner points in .txt format are output as below:



The visualization of the Polycube structure in triangle mesh and corner points in .txt format are shown below:



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).