Development of a Size Function for Surface Mesh Data

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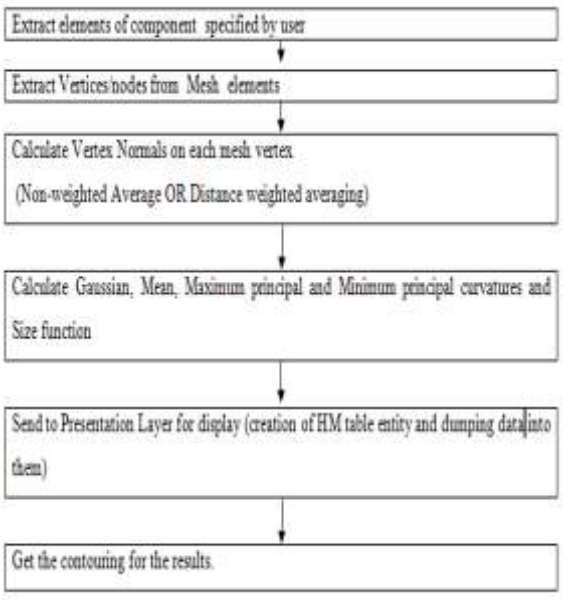
Abstract:

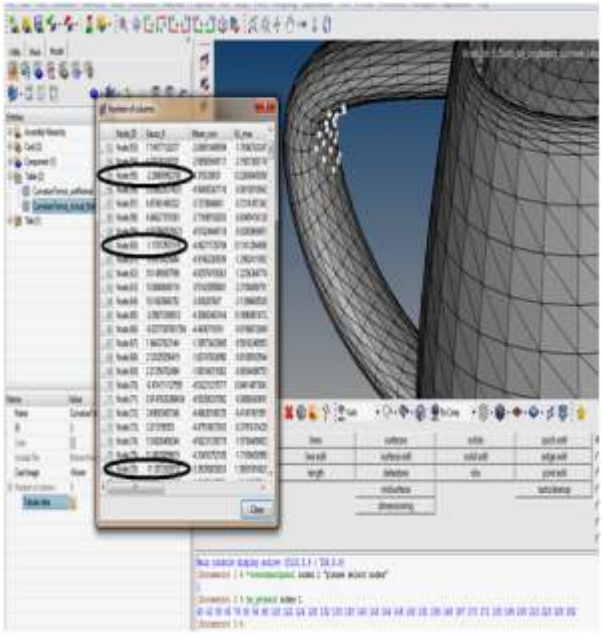
Mesh generation is an essential function required in various fields like finite element analysis or computational fluid dynamics, mathematics, computer science, and engineering. Features of the geometry are enhanced by varying mesh element size of the geometry. Size function is used to vary the mesh elements across the geometry. It helps in reducing the mesh elements at unimportant surfaces and more accurate results can be brought about in critical areas of the geometry.

In this project an attempt is made to develop a size function for given surface mesh data based on curvature function to control the mesh size using the distance weighted averaging of vertex normals and curvatures. The size function functionality was developed and integrated into Hypermesh software. The requirements of the functionality of the system were captured and usecase analysis was done mapping against requirements. The chosen design for implementing size function does not require parameterization of mesh vertices that avoids over head. The curvatures like Gaussian curvature, Mean curvature, Maximum principal curvature and Minimum principal curvatures are obtained based on the normals of the mesh vertices. Using these obtained values of curvatures, the size function is then calculated using average normal, distance weighted normal and non-weighted normal. The principal curvature values are also calculated using different methods like simple average curvature values and distance weighted average values.

The size function obtained was validated against standard meshed primitives such as meshed cylinder and meshed sphere and the values were found matching with the theoretical values. The developed size function is analysed using dummy face model. The values of size function, Gauss curvature and mean curvature calculated can be utilized to extract features of the geometry.



Flow chart for overall process



Sign of Gaussian curvature for concave region of teapot