Abstract

This thesis deals with a problem of constructing the continuous/smooth representation of a solid from its discrete representation. Representation in the form of point and mesh of triangles are referred to as discrete representation of the solid. Three steps are involved in constructing the continuous representation. The first step involves the grouping of points (given point representation) or triangle (given tessellated representation) in such a way that an appropriate single surface can be fitted to the points/triangles grouped. In second step a surface (usually parametric surface) is fitted through the grouped points or the vertices of the grouped triangles. In the last step the connectivity between the different surfaces obtained are identified and the faces, edges and vertices are generated. The problem of grouping the triangles for an optimized polyhedral representation has been addressed first. A mesh that contains only as many triangles as are necessary to represent the underlying geometry within a specified tolerance is referred to as optimized mesh. The second problem involves the parameterization of the unordered points for interpolating B-spline surface.

Optimized polyhedral representation is becoming very common in today's industry. In application areas like rapid prototyping, visualization, manufacturing, etc only optimized mesh is used for saving computational effort. In this thesis an algorithm has been proposed for automatically grouping an optimized mesh into its underlying surfaces. Optimized mesh is associated with a distinct characteristic that the error value based on which it has been optimized is known. The approach presented here utilizes this information to segment the optimized mesh.

This thesis also addresses the problem of initial parameterization of the unordered points for fitting B-spline parametric surface. The surface calculation procedure is an it-
erative one. Parameterization of points is necessary to provide an initial guess for the subsequent iterations. A good initial guess is highly desirable for obtaining a good result in the subsequent steps. Two distinct approaches have been proposed in this thesis for assigning parameter values to points. In the first approach, parameterization is done by projecting the points on a suitable planar base surface, that is selected automatically. This approach has been implemented for the class of non-wraparound surfaces. The second approach works on a mesh of points. This approach is distinct from the earlier approach and can parameterize points on any surface that is homeomorphic to a circular disc. Algorithms have been implemented and tested on typical data.