Second Order Surface Analysis
Using Hybrid Symbolic and Numeric Operators

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Abstract

Results from analyzing the curvature of a surface can be used to improve the implementation, efficiency, and effectiveness of manufacturing and visualization of sculptured surfaces.

In this paper, we develop a robust method using hybrid symbolic and numeric operators to create trimmed surfaces each of which is solely convex, concave, or saddle and partitions the original surface. The same method is also used to identify regions whose curvature lies within prespecified bounds.

1 Introduction

A critical characteristic for many applications in computer graphics and in CAD is the shape of the model’s surface. Second order surface analysis can be used to understand curvature characteristics, and thus shape, and to improve the implementation, efficiency and effectiveness of manufacturing and analysis processes. Fundamental operations, such as adaptive subdivision and refinement, use shape information to decide where and how many knots to add. Algorithms for the creation of tool paths for NC (Numerically Controlled) code generation for freeform surfaces are usually based on ball end cutters with their spherical centers following an (approximate) offset surface of the original surface. Flat end cutters can remove material faster and have a better finish; however, flat end cutters can be used only with 5 axis milling in convex regions (see Figure 1).

Definition 1.1 A surface trichotomy is a partition of a surface into three types of regions: convex, concave and saddle shapes (Figure 1).