

# **Computational Geometry in Design and Manufacturing of Free-form Surfaces**

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Computational geometry for design and manufacturing plays a vital role in the process of bringing new products from design to the market place. A great variety of modern products, from cellular phones, computer consoles, die and mold to automotive body panels and aerospace parts, all rely on this technology for the design and manufacturing in the product development. Computational geometry for design and manufacturing of complex surfaces is a mathematically challenging area, full of tough design/manufacturing problems and hard geometrical puzzles that are yet to be solved. The problems are certainly interdisciplinary, and good solutions will require the efforts of engineers, mathematicians and computer scientists.

Sculptured surfaces, or so-called free-form surfaces, are commonly used in the aerospace, automotive, die/mold manufacturing and consumer products industry. These surfaces usually have free-formed geometry of complex shapes and are difficult to be machined. Sculptured surface objects are usually produced with 2.5D roughing, and 3-axis or 5-axis finishing by using CAD/CAM and numerical controlled (NC) machine tools or rapid prototyping (RP). One of the main obstacles, which prevents the implementation of entirely automatic manufacturing of free-form objects, is the lack of robustness of the geometric computation techniques and the interrogation tools to support the planning and programming for the manufacturing processes. In this talk, important issues of geometric computation and robust geometric interrogation analysis for sculptured surface manufacturing will be addressed.

This talk will focus on the analytical and geometric processing technologies for design and manufacturing of complex surfaces. The talk will discuss the research on topics involving interesting geometry and dealing with real industrial problems with a close connection to the following topics:

- CAD/CAM and multi-axis NC machining
- Sculptured Surface Machining (SSM) and shape interrogation
- High speed machining (HSM) and NC tool path optimization
- Rapid prototyping of complex surfaces
- Virtual sculpting and Haptic rendering of complex surfaces