MMAE SEMINAR

Wednesday, October 17, 2007
E-1 BUILDING – CRAWFORD AUDITORIUM
3:30 – 4:30 PM

Skeletal Modeling for Conceptual Geometric Design

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Abstract

Conceptual design is that stage of the design process in which multiple possible design solutions are conceptualized and the best of these is (are) chosen for embodiment. Concept generation is considered by many to be the most critical stage in the process, as the development of innovative concepts is a necessary precursor for successful innovative products. Computer-aided design (CAD) tools and systems are pervasive in industry as the standard means for documenting product geometry. Increases in productivity due to these tools (and their role in globalizing the economy) are well-documented. However, the approaches to generating and representing geometry that are used in modern CAD systems do not lend support to idea generation in the conceptual design stage.

This presentation discusses the issues that lead to the need for a different approach to geometry creation for conceptual design. I will describe a different approach to creating three-dimensional solids using lower dimensional geometric primitives (points, lines, triangles, etc.) to create a "skeleton" of the geometry. This skeleton is then "skinned over" to create a solid representation of the geometry. The talk will focus on the use of convolution surfaces to generate the geometry from the skeleton. A particular focus of this research is ensuring that the convolution surface has the same topology as the skeleton. We use Morse theory to analyze the topology of the surface and compare to the skeleton. We describe an efficient algorithm that we have developed to find the critical points by analyzing the skeleton. This approach is then coupled with appropriate heuristics for determining parameter values of the convolution surface that force its topology to match that of the skeleton.