Subdivision Surfaces for Multiresolution Modeling, Simulation, and Design

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Abstract

Much of today's engineering design practice is hampered by many, largely incompatible, tools for geometric modeling, physical simulation and design. Finding unifying principles, representations, and computational algorithms provides one avenue to better this situation.

In this presentation I will discuss results of a recent project by a group of Caltech faculty, postdocs, and students (mRSED: Multiresolution Simulation for Engineering Design) and cover the use of subdivision surface representations as a basis for such an integrated treatment. Subdivision surfaces offer many computational advantages in free-form surface modeling ranging from adaptive level of detail to deep connections with wavelet representations. The underlying basis functions are also ideally suited as a foundation for finite element treatments of the mechanical response of thin-shells.

These techniques are part of a broader program aimed at developing efficient representations and algorithms for the manipulation of digital geometry. They will be essential in hierarchical (multiscale) modeling, design, and simulation efforts that are required to track and deal with uncertainty, especially those that involve many scales. I will conclude with a discussion of the exciting opportunities that present themselves.