USC | IMSC

A NATIONAL SCIENCE FOUNDATION ENGINEERING RESEARCH CENTER

sensory interfaces

Digital Geometry Processing

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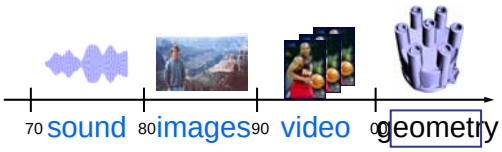
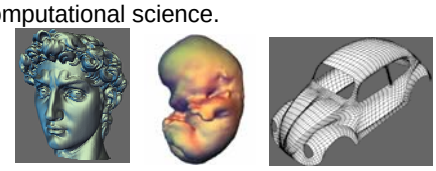
Research Goal

Three-dimensional geometry is the **next wave of multimedia data**, after sound, images, and video. Our research goal is to develop **theoretical and algorithmic foundations** for efficient, reliable and scalable tools for arbitrary 3D geometric models. This will foster the use of 3D geometry, on the internet or even in computational science.

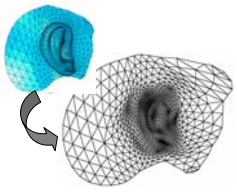




Geometry is used for art, science, and technology

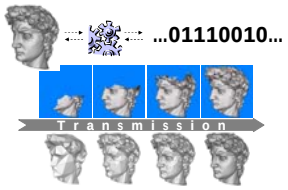
Research Approach & Accomplishments

In contrast to the transition between sound (1D) and images (2D), we are facing more challenges when dealing with geometry. Geometry is not a signal in the usual sense: characteristics such as *curved domain, irregular sampling,* or *topology* are fundamentally different. Our unique approach is to build a theory of discrete surfaces, not through arbitrary discretization of differential properties, but by preserving natural invariants and understanding the parallels between discrete and differential structures. To prove the relevance of our approach, we have provided numerous accomplishments in **surface compression, parameterization, smoothing, remeshing,** and even **simulation**.



Surface Parameterization

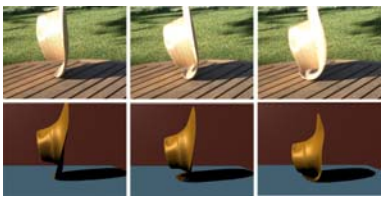
Geometry Remeshing



Surface Compression

Uniqueness & 5-Year Plan

In the current trend of cross-disciplinary research efforts, **digital geometry** (be it simple 3D shapes or higher dimensional discrete manifolds) is a central and challenging issue from the modeling and computational perspective spanning *several* sciences—biology, molecular dynamics, geophysics, as well as engineering. We are therefore developing a *discrete exterior calculus*, to lay out the foundations for a *geometric sampling theory.*



Thin shell simulation, compared to real experiments (hat, paper…)

Compression of medical datasets