SuperD: SubD Modeling without Subdivision

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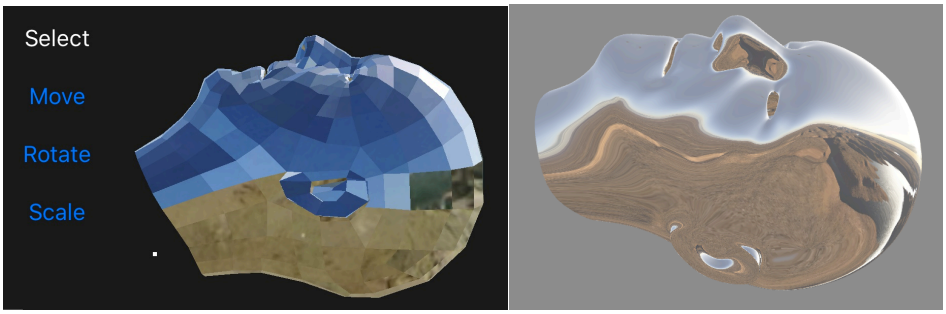

Figure 1. *Test configuration showing(left) SubD cage, (right) N-sided smoothing*

Abstract

The *SuperD* modeler employs a recursive subdivision, modeling interface for design, but without the troublesome extraordinary points or patch clusters at those points. The key to SuperD is use of new N-sided surface patches, which correspond to the mesh topology. The N-sided patches also enable G^2 continuity, good triangulation and efficient mobile device implementation.

1 Background

Recent advances in N-sided surfaces allow more flexible and fairer surfaces than previously seen in this arena [VARADY 2011]. Recursive subdivision (*SubD*) is widely used in design and animation due to its popular mesh interface [PETERS 2008]. We let the SubD interface drive a natural arrangement of N-sided surface patches for G^2 continuity that feels like the SubD modeling experience, but without extraordinary points. Fig. 1 (left) shows a SubD input cage for surfacing (right). The environment map is a good test for G^2.

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2 Method in Brief

Quintic Bezier end control points are computed from every two adjacent SubD face centers. All control points lie on the plane with face centers and the midpoint of the common edge. Loops of these curves are collected that cycle the common vertex of each face. This creates a dual relationship between the edge valency of the vertex and the number of curves in the loop. The N-sided surface patches derive solely from the boundary curves and their derivatives. If the curves meet with G^2, then so will the surfaces. Variations in this design scheme are achieved by varying the location of end points in the face, or the fullness of the Bezier curves.

3 Implementation

Fig. 1, which shows an existing SubD input surfaced with our scheme, was implemented in iOS for an iPhone/iPad. Computing is straight-line, (no branch, no recursion) which streams display triangles to the GPU; thus saving on time and energy consuming memory fetches.

References

VARADY, T., SALVI, P. and ROCKWOOD 2011, A Transfinite surface interpolation over irregular N-sided domains, *CAD*, vol. 43, 11, 1330-1340.

PETERS, J. AND REIF, U. 2008, *"Subdivision Surfaces", Geometry and Computing,* Springer Verlag.