Volumetric T-spline Construction from Boundary Representations

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In this talk, comprehensive schemes are described to construct rational trivariate solid T-splines from boundary triangulations. For arbitrary topology objects, we first compute a smooth harmonic scalar field defined over the mesh and saddle points are extracted to determine the topology. By dealing with the saddle points, a polycube whose topology is equivalent to the input geometry is built and it serves as the parametric domain for the trivariate T-spline. A polycube mapping is then used to build a one-to-one correspondence between the input triangulation and the polycube boundary. After that, we choose the deformed octree subdivision of the polycube as the initial T-mesh, and make it valid through pillowing, quality improvement and applying templates to handle extraordinary nodes and partial extraordinary nodes. The obtained T-spline is C^2-continuous everywhere over the boundary surface except for the local region surrounding polycube corner nodes.

The parametric mapping method has been extended to conformal solid T-spline construction with the input boundary spline representation preserved. For genus-zero topology, one cube is adopted as the parametric domain for the solid T-spline. Starting from the cube with all the nodes on the input surface as T-junctions, we adaptively subdivide the domain based on the octree structure. After that we insert two boundary layers between the input T-spline surface and the boundary of the subdivision result. Finally, knot intervals are calculated from the T-mesh, the solid T-spline are then constructed. The obtained T-spline is conformal to the input T-spline surface with exactly the same boundary representation and continuity.

Keywords: Volumetric T-spline, polycube, extraordinary node, parameterization