Adventures with Topological Mesh Modeling

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Topological Mesh Modeling is an umbrella term I use to cover all my work based on extensions the theory of graph rotation systems.
It includes (1) Orientable 2-manifol mesh modeling using graph rotation systems and its computer graphics applications, (2) Knot modeling with immersions of non-orientable manifold meshes and (3) Topological constructions that is based on geometric and physical constraints with graph rotation systems. We recently started to work on immersions of 3-manifolds as a representation to develop shape modeling systems. For details please check http://www.viz.tamu.edu/faculty/ergun/research/topology/index.html

I recently realized that there is many results that comes out of by-products of our work that are not necessarily known by many researchers. Therefore, in this talk, I will demonstrate some interesting issues that are not covered in papers. With interactive examples, I will demonstrate how inserting and deleting a single edge can change the topology of a 2-manifold mesh by opening and closing holes; and combining surfaces. As a consequence of this property, I will show that subdivision schemes such as Catmull-Clark or Doo-Sabin can be C1 discontinuous by demonstrating some overlooked cases. Using topological graph theory, I will also show that how many ways a genus-n manifold mesh can be unfolded into a single 4n-sided polygon.
I will also show the importance of discrete versions of Gaussian-Bonnet theorem and Gaussian curvature and their use for physical construction of shapes. I will also provide a brief overview of extended versions graph rotation systems that can be used to model knots, links and cyclic woven objects and 3-space immersions of 3-manifolds.