Geodesic and prismatic mesh generation

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ABSTRACT

In ALE simulations with moving meshes, mesh topology has a direct influence on feature representation and code robustness. In three-dimensional simulations, modeling spherical volumes and features is particularly challenging for a hydrodynamics code. Calculations on traditional spherical meshes (such as spin meshes) often lead to errors and symmetry breaking. Although the underlying differencing scheme may be modified to rectify this, the differencing scheme may not be accessible. This work documents the use of spherical geodesic meshes to mitigate solution-mesh coupling. These meshes are generated notionally by connecting geodesic surface meshes to produce triangular-prismatic volume meshes. This mesh topology is fundamentally different from traditional mesh topologies and displays superior qualities such as topological symmetry. This work describes the geodesic mesh topology, including motivating demonstrations with the FLAG hydrocode, and extensions of related prismatic meshes into cylindrical and other meshes.

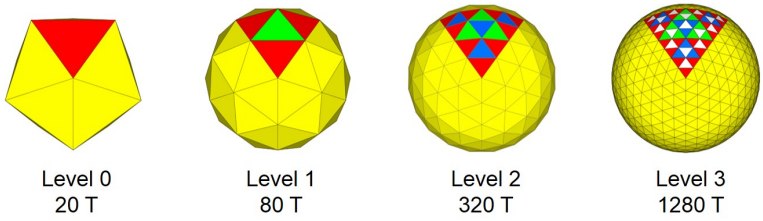

Figure 1: Triangular discretizations of the sphere admit to straightforward refinement techniques.

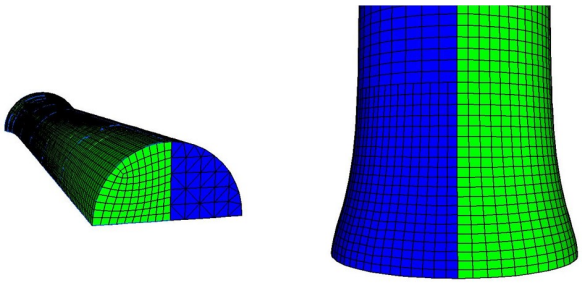

Figure 2: Taylor impact comparison between simulations on a hexahedral mesh (green) and a triangular prismatic mesh (blue).