On topological properties of polygonal meshes

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In this paper we investigate the topological properties of polygonal meshes. The most simple way to define a mesh is to give a vertex stream and an index stream, then the streams define a so-called polygon soup, an unorganized set of polygons. The first stream contains 3D points, the second stream is an index array of the vertices of polygons that spans the surface elements of the mesh. Most of the topological properties of an arbitrary polygon soup can be derived easily from the index stream, for example: connectedness, orientability, manifoldity, solidity, Euler-characteristic, etc. If the mesh defines an object, that has a physical realization, we can compute its area and volume. Moreover there are several efficient data structures and computing methods, which require physical input meshes. Our goal is to clear the definition of physical meshes, give some conditions for a mesh to be physical. Some algorithms are discussed to detect and repair topological properties of a given polygonal soup. Besides our theoretical results we present our MATLAB software package for analyzing and manipulating meshes.

References


