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Blowing bubbles for multi-scale analysis and decomposition of triangle meshes

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Author(s): Mortara M, Patane G, Spagnuolo M, Falcidieno B, Rossignac J

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Abstract: Tools for the automatic decomposition of a surface into shape features will facilitate the editing, matching, texturing, morphing, compression and simplification of three-dimensional shapes. Different features, such as flats, limbs, tips, pits and various blending shapes that transition between them, may be characterized in terms of local curvature and other differential properties of the surface or in terms of a global skeletal organization of the volume it encloses. Unfortunately, both solutions are extremely sensitive to small perturbations in surface smoothness and to quantization effects when they operate on triangulated surfaces. Thus, we propose a multi-resolution approach, which not only estimates the curvature of a vertex over neighborhoods of variable size, but also takes into account the topology of the surface in that neighborhood. Our approach is based on blowing a spherical bubble at each vertex and studying how the intersection of that bubble with the surface evolves. We describe an efficient approach for computing these characteristics for a sampled set of bubble radii and for using them to identify features, based on easily formulated filters, that may capture the needs of a particular application.

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