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Robust mesh editing using Laplacian coordinates.

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Summary: Shape deformation and editing are important for animation and game design. Laplacian surface based methods have been widely investigated and used in many works. In this paper we propose a robust mesh editing framework which improves traditional Laplacian surface editing. It consists of two procedures: skeleton based as-rigid-as-possible (ARAP) shape modeling and detail-preserving mesh optimization. Traditional ARAP shape modeling relies on the mesh quality. Degenerated mesh may adversely affect the deformation performance. A preprocessing step of mesh optimization can alleviate this problem. However, skinny triangles can still be generated during deformation, which adversely affect the editing performance. Thus our method performs Laplacian mesh deformation and optimization alternately in each iteration, which ensures mesh quality without noticeably increasing computational complexity or changing the shape details. This approach is more robust than those solely using Laplacian mesh deformation. An additional benefit is that the skeleton-based ARAP modeling can approximately preserve the volume of an object with large-scale deformations. The volume is roughly kept by leveraging the skeleton information and employing a carefully designed energy function to preserve the edge length. This method does not break the manifoldness of traditional ARAP methods or sacrifice speed. In our experiments, we show that (1) our method is robust even for degenerated meshes, (2) the deformation is natural in terms of recovering rotations, and (3) volumes are roughly kept even under large-scale deformations. The system achieves real time performance for surface meshes with 7k vertices.

Keywords: mesh editing; Laplacian coordinate; skeleton; volume preservation; mesh optimization
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