Gang XU, Li-shan DENG, Wen-bing GE, Kin-chuen HUI, Guo-zhao WANG, Yi-gang WANG, 2014. Quasi-angle-preserving mesh deformation using the least-squares approach. *Journal of Zhejiang University-SCIENCE C (Computers & Electronics)*, **15**(9):754-763. [doi:10.1631/jzus.C1400103]

Quasi-angle-preserving mesh deformation using the least-squares approach

Key words: Mesh deformation, Angle-based representation, Detail-preserving, Least-squares approach

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Motivation

- Find a new approach to keep the geometric details of triangular mesh during shape deformation and editing.
- Angle quantity on discrete mesh is an important information for curvature metrics.
- Integrate angle information with mesh deformation framework.

Main contributions

- We propose an angle-based mesh representation, which is invariant under translation, rotation, and uniform scaling, to encode the geometric details of a triangular mesh.

- From the angle-based mesh representation, we propose a quasi-angle-preserving mesh deformation system with the least-squares approach via handle translation, rotation, and uniform scaling.

Angle-based mesh representation

Theorem 1 Given the angle quantities of vertex $\boldsymbol{v}_i$ and the normal at $\boldsymbol{v}_i$, the 1-ring neighborhood of vertex $\boldsymbol{v}_i$ can be computed by translation, rotation, and uniform scaling.

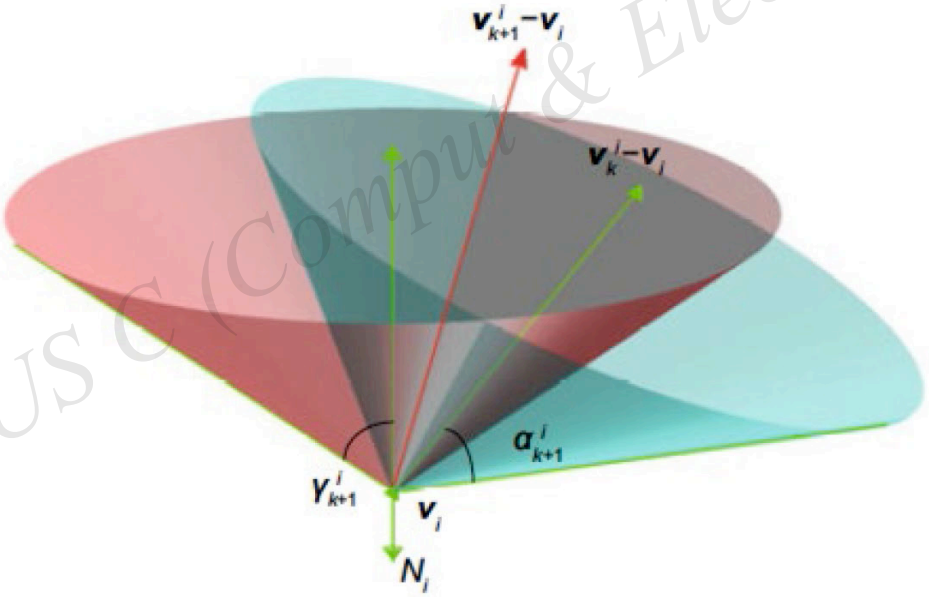


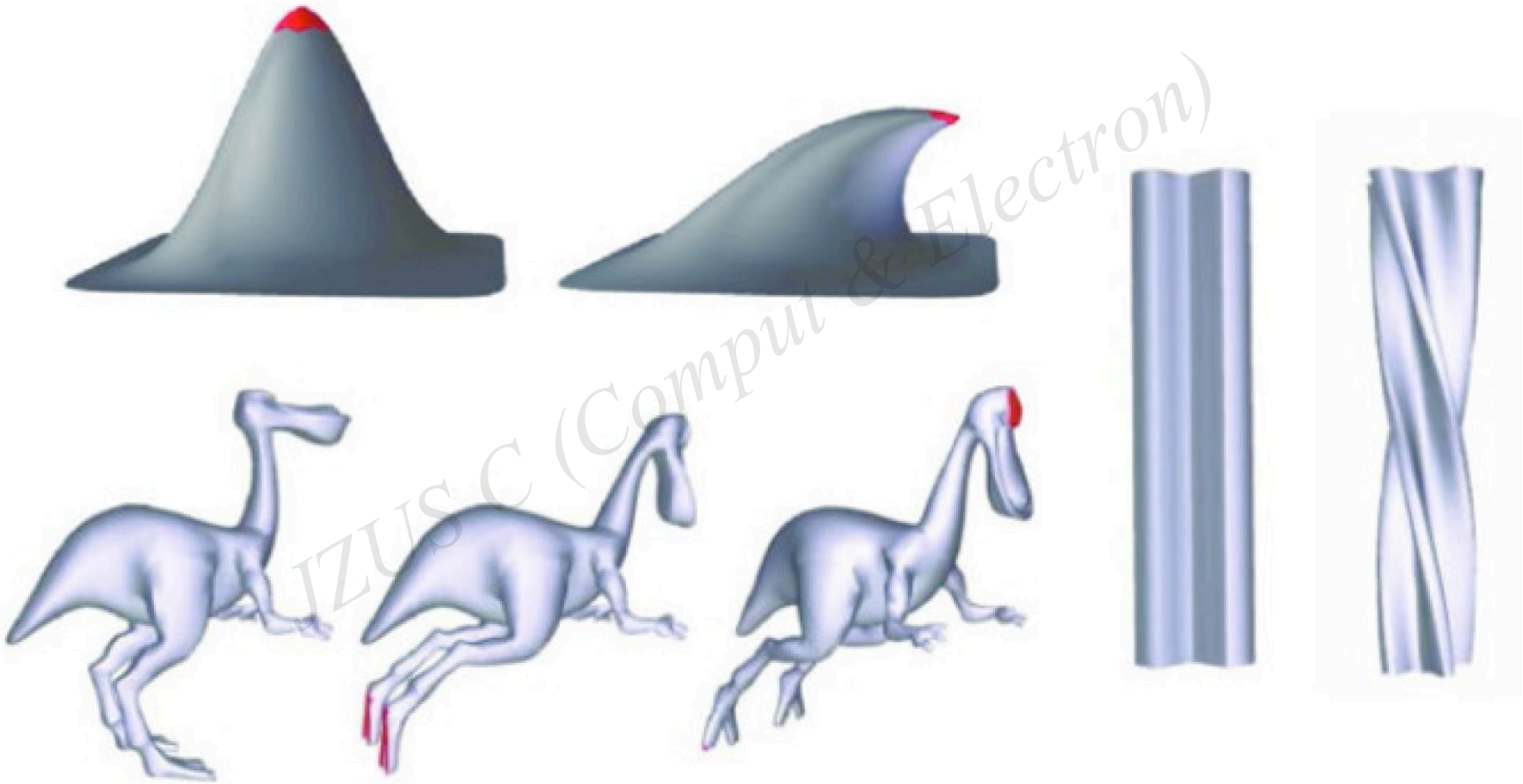
Fig. 2 Proof of Theorem 1 by cone construction

Quasi-angle-preserving mesh deformation framework

The mesh editing process consists of the following steps:

1. The user defines a region of interest (ROI) for editing.
2. The user selects some triangles of the ROI as a handle, which acts as a control point to obtain desired deformation results.
3. The user moves the handle to a new position.
4. The surface is reconstructed according to the relocation of the handle and the angle-based representation.

Main results (I)



Main results (II)