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Efficient mesh denoising via robust normal filtering and alternate vertex updating

Key words: Mesh denoising; Guided normal filtering; Alternate vertex updating; Corner-aware neighborhoods

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Motivation

- In spite of the rapid development 3D acquisition techniques, noise from different sources is inevitable, and noise has great impact on the downstream applications.
- It is a challenging job to denoise mesh with sharp feature.
- The state-of-the-art feature-preserving mesh denoising methods cannot robustly recover piecewise feature lines and avoid flipping triangles.
- Current methods cannot capture local structures around features, especially near corners.

Main idea

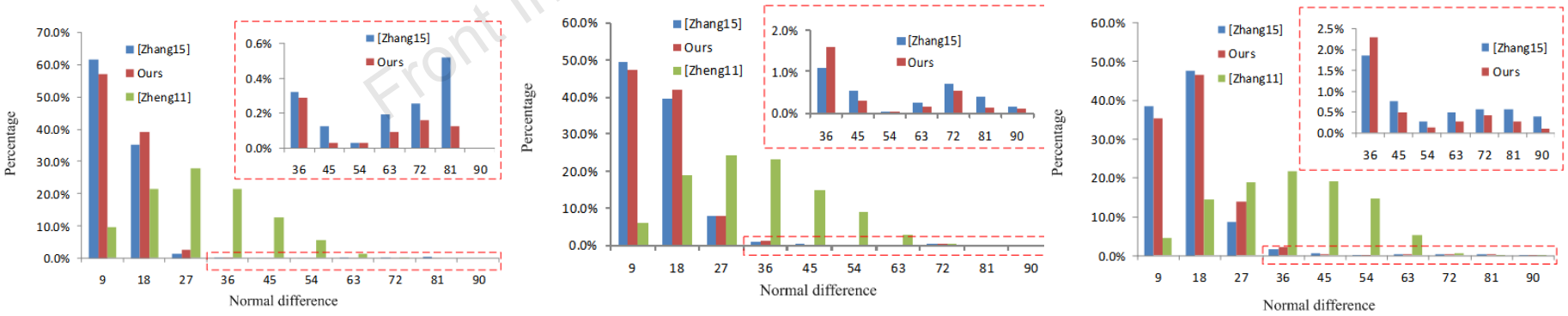
- A robust guided normal estimation method is proposed based on CANs, which is of better adaptivity to local structures around corners.
- Individual regularization terms are integrated into vertex updating models according to vertex classification, which makes our method suitable for multifarious noise but immune to flipping.
- Introduce a new feature consistency measure for guided normals estimation.

Method

1. To adapt to corner, define unbalanced Corner-aware neighborhood (CAN) and leverage CANs to construct substructures near feature.
2. Tangential Laplacian is added in the conventional vertices updating formulae, and thus noise both in normal direction and tangential direction can be annihilated effectively.
3. The new confidence measure covers both the (intrinsic) overall consistency of all face normals in the substructure and the (extrinsic) individual obedience to the whole.

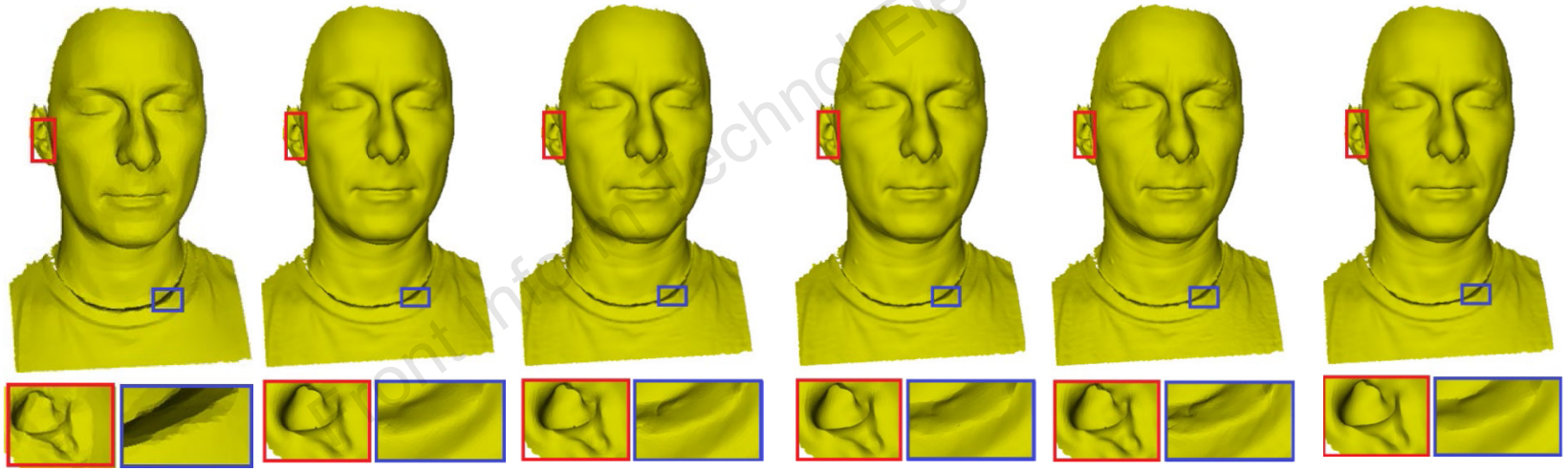
Major results

- Comparison of differences between guided normals and ground-truth ones before the first normal iteration. The histograms of normal differences of the Fandisk model are with levels 0.25, 0.30 and 0.35 of Gaussian noise distributed in the normal direction. The subplots are the close-up view of the dashed differences of Zhang WY et al. (2015) and our method



Major results

- Comparison with state-of-the-art denoising methods on real scanned data.



Conclusions

- We employ a novel corner-aware neighborhood and consistency measuring method to estimate guided normals, which improves robustness greatly.
- To improve the quality of denoised meshes, we impose individual regularization constraints on distinct types of vertices.
- We take an alternate vertex updating strategy according to the reliability of filtered normals, which is more efficient than the batch method.