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Visual salience guided feature-aware shape simplification

Key words: Visual salience, Shape simplification, Content-aware, Weighted quadric error metric, Feature-aware

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Introduction

- Large scale sampled data of complex highly detailed shapes always exhibits a large proportion of redundant information due to the uniform sampling of common 3D automatic scanning devices.

- Such complex 3D models often incur some difficulties due to their requirement of large memory and high time complexity in both shape modeling and real-time rendering.

- To overcome these difficulties, shape simplification and re-sampling schemes provide some efficient solutions for shape modeling and rendering tasks.

- By incorporating the visual salience measure into the shape re-sampling operation, a novel salience guided mesh simplification technique is presented in this paper.

Content-aware salience measure

Given a complex relief shape, the content-aware salience measure can be estimated using a center-surround operator on Gaussian-weighted relief heights in a scale-dependent manner.

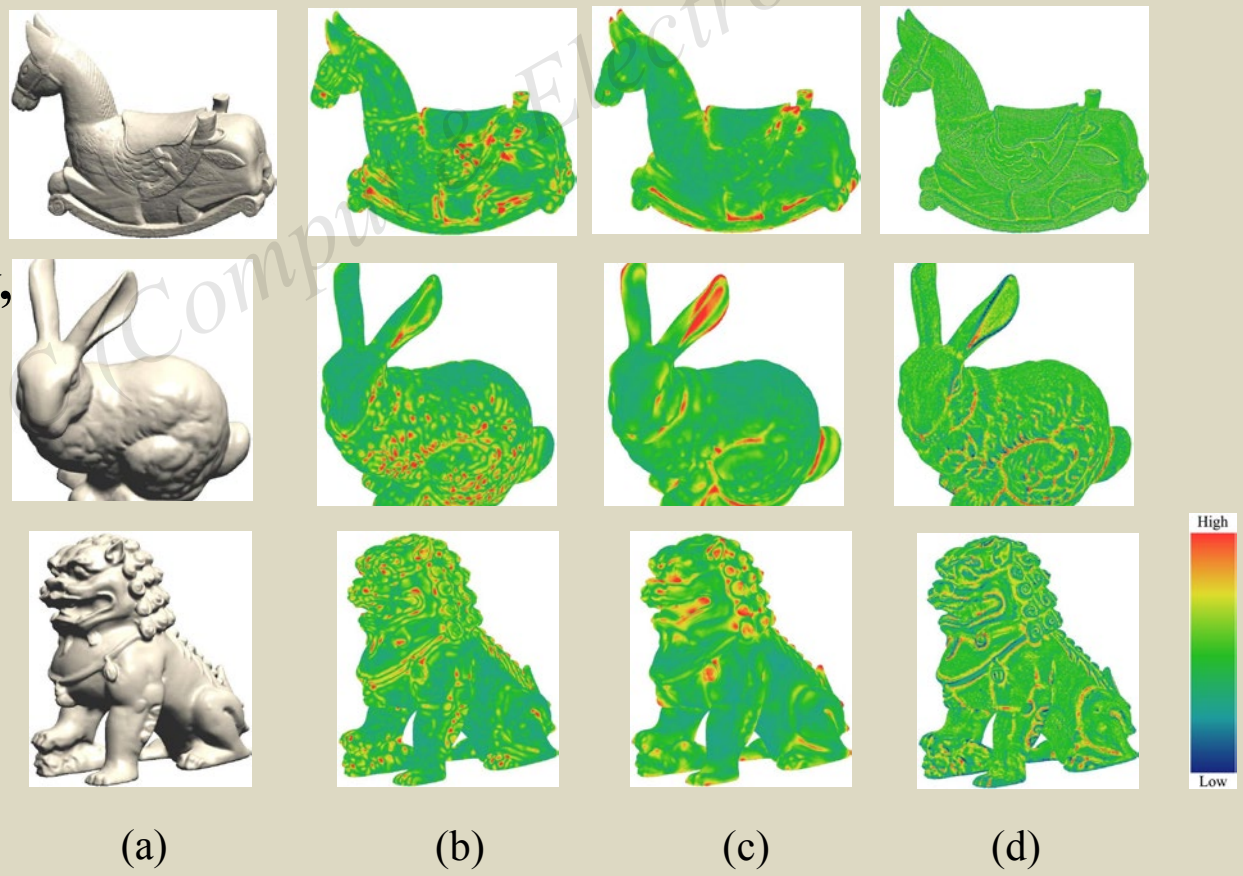

Fig. 2 Visual salience map for Horse, Stanford Bunny, and Lion models
(a) Original model; (b) Our salience map; (c) Lee *et al.* (2005)'s salience map; (d) Liu *et al.* (2007)'s salience map

Our algorithm for shape simplification

1. Guided by our content-aware visual salience map, our feature-aware shape simplification algorithm can be performed by weighting the high-dimensional feature space quadric error metric of vertex pair contractions with the weight map derived from our visual salience map.

2. The weighted quadric error metric is calculated in a six-dimensional feature space by combining the position and normal information of mesh vertices.

3. During shape simplification, using a heap keyed on cost with the minimum weighted quadric error cost pair at the top, our visual salience guided shape simplification scheme will iteratively contract vertex pairs of least weighted quadric error cost from the heap until the simplification rate defined by the user is achieved.

Experimental results

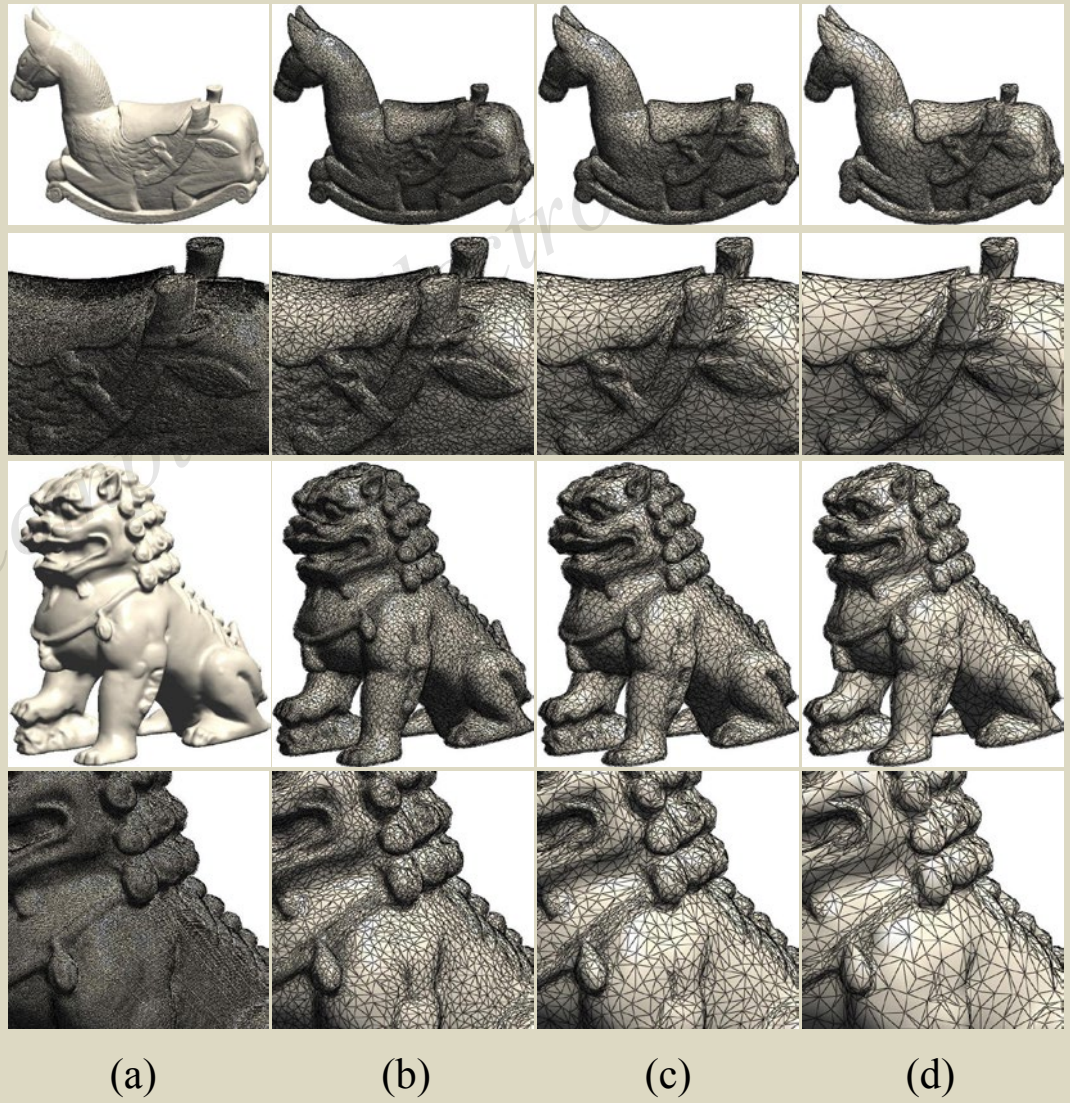

Fig. 4 Feature-aware simplification for the Horse model and Lion model
(a) Original models; (b, c, d) The re-sampling results obtained using our salience guided feature-aware simplification scheme with the simplification rate 80.0%, 90.0%, 95.0%, respectively

Conclusions

- A feature-aware simplification technique is presented for polygonal meshes by incorporating the content-aware visual salience measure of 3D shapes into the re-sampling operation.
- To yield better visual performance for simplified models, our content-aware visual salience measure is calculated using a center-surround operator on Gaussian-weighted relief heights in a multi-scale bottom-up manner.
- Guided by the visual salience map, our shape simplification scheme can be performed by exploiting the visual salience weighted quadric error metric defined in a high-dimensional feature space to measure the vertex pair collapse error.
- Experimental results show that our salience guided simplification scheme adaptively and effectively re-samples the given models and always accounts for the visually salient features of complex shapes.