Visualization of the difference between two triangle meshes

FACULTY OF MATHEMATICS AND PHYSICS
Charles University

Author: **Jan Horešovský**

Supervisor: **RNDr. Josef Pelikán**

Department of Software and Computer Science Education

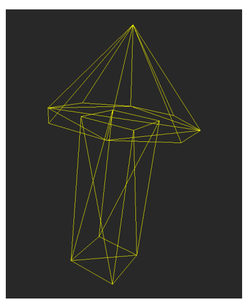
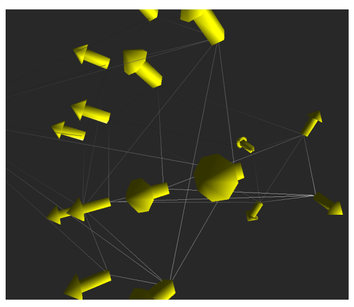
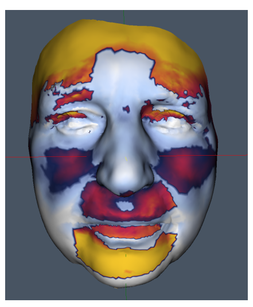
Contact: horesovskyh@gmail.com
Application: github.com/honzukka/MeshDiff
Thesis: github.com/honzukka/Bachelor-Thesis

Introduction

What is the main difference between these two faces?*

Currently, similar questions are usually tackled as follows:

1) 3D models (**triangle meshes**) of the objects are obtained
2) A difference **metric** is computed
3) The metric is visualized using **color** [1]

Issues

- Color **fails** to encode both magnitude and direction of a metric
- No metric clustering -> may result in **cluttering**

Metric Clustering

We performed clustering on the vertex distance metric to make it suitable for visualization using **arrows** instead of colors and also to **suppress redundant information**.

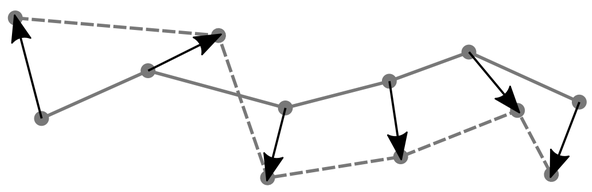


Fig. 1
A simplified schema of the two triangle meshes with arrows representing the **vertex distance metric**

Fig. 2 [2]
Hierarchical clustering - an arbitrary number of clusters covering the whole space can be extracted from the **dendrogram**

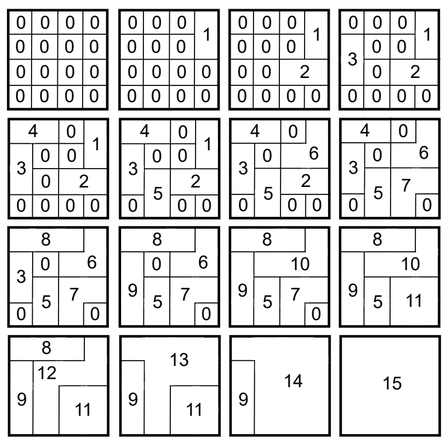


Fig. 3
Clustering error - user-driven weighted ratio of **distance**, **magnitude difference** and **angle** of the associated arrows. Underlying **mesh density** can also be considered

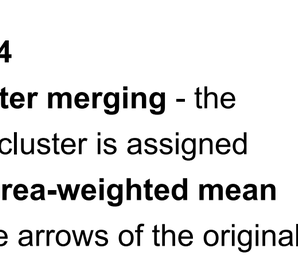
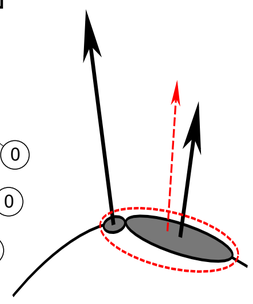


Fig. 4
Cluster merging - the new cluster is assigned the **area-weighted mean** of the arrows of the original clusters which have to be **neighbors** and have the **smallest error**



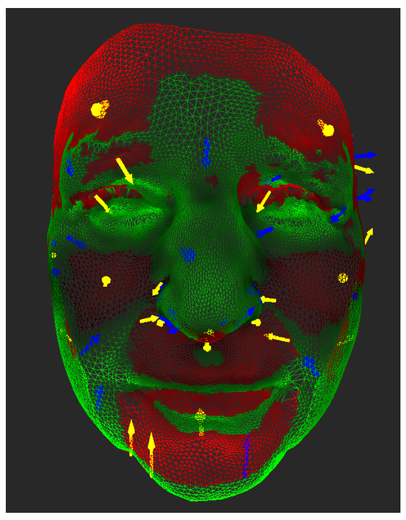


Fig. 5
Arrow visualization combined with colors

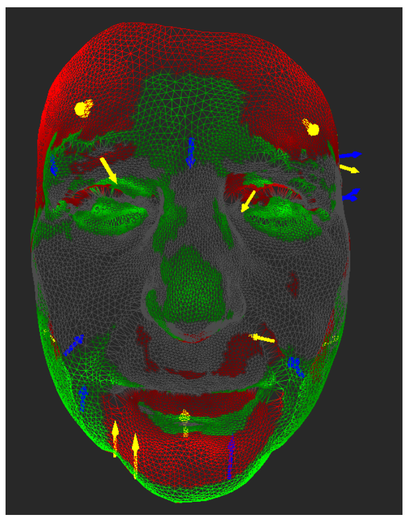
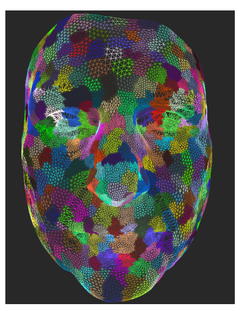
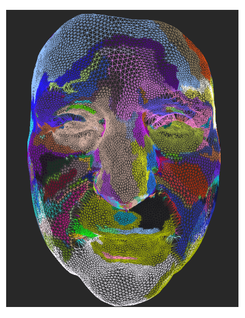


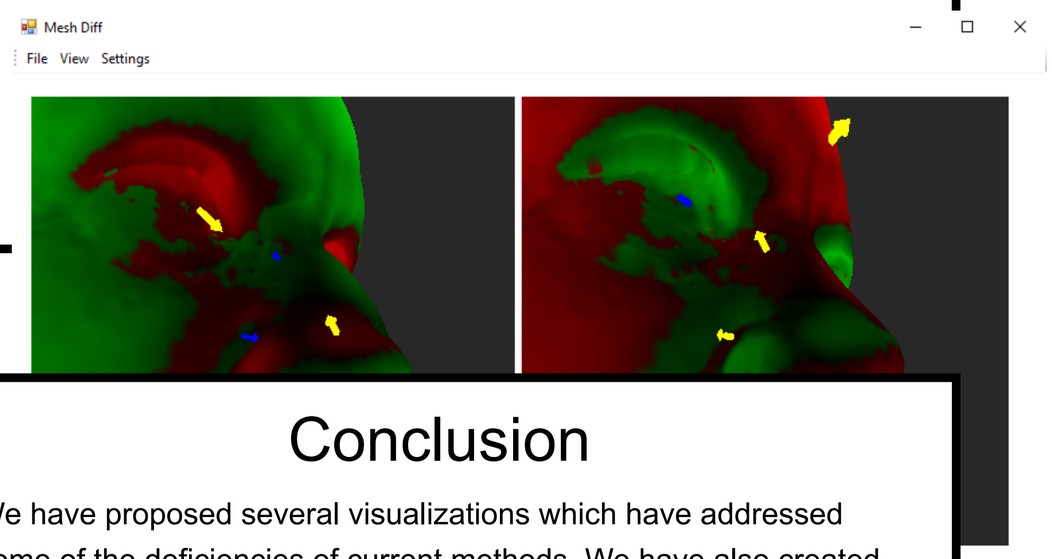
Fig. 6
Thresholding applied on areas with low metric value

Fig. 7
Cluster color visualization with emphasized **distance** (left) and **angle** (right) weights

Experimental Application

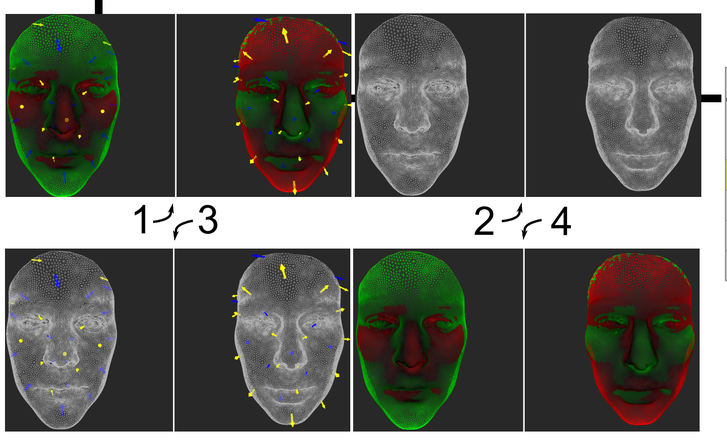
- built on top of a **mesh viewer** written by Josef Pelikán
- supports visualization **generation**, **export** and **import**
- a specific mesh **view matrix** can also be saved and loaded



User Study

- **37 volunteers** answered questions about various pairs of triangle meshes based on a randomly chosen visualization (one out of four for each question)
- qualities of certain visualizations have emerged but some questions were **ambiguous** and the scale of the study was **too small**

Example question: *Which face has larger cheekbones?*



*one of them is upside down

Visualization	1	2	3	4
Time to Answer (normalized)	16.11	24.59	18.47	15.01
Right	11	4	6	5
Left	2	4	0	1
Not Sure	0	3	1	0
Total	**13**	**11**	**7**	**6**

Conclusion

We have proposed several visualizations which have addressed some of the deficiencies of current methods. We have also created an application which can be used for generating visualizations on custom data sets. Our user study has failed to fully assess both new and old visualizations but we believe that it can be built upon and that such an assessment would be a vital contribution to the area.

References:
[1] CGG MFF UK. Morphome3cs II. Charles University in Prague, Czech Republic, 2015. URL http://www.morphome3cs.com.
[2] Telea and van Wijk. Simplified representation of vector fields. In VIS '99 Proceedings of the conference on Visualization '99: celebrating ten years, 1999.