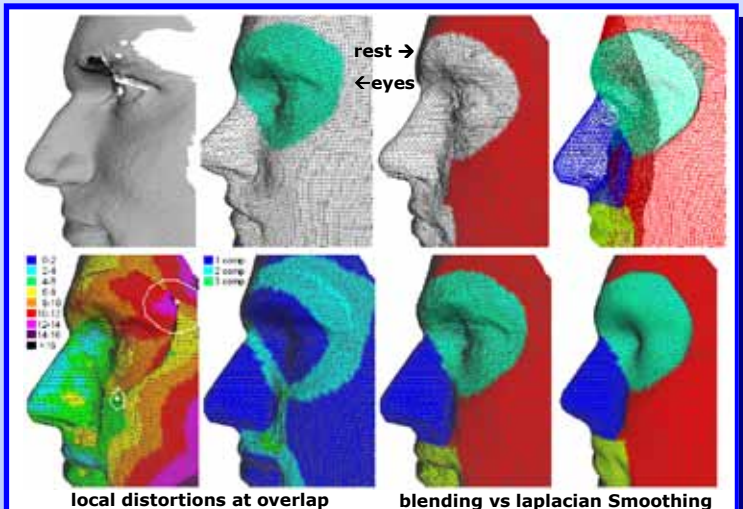
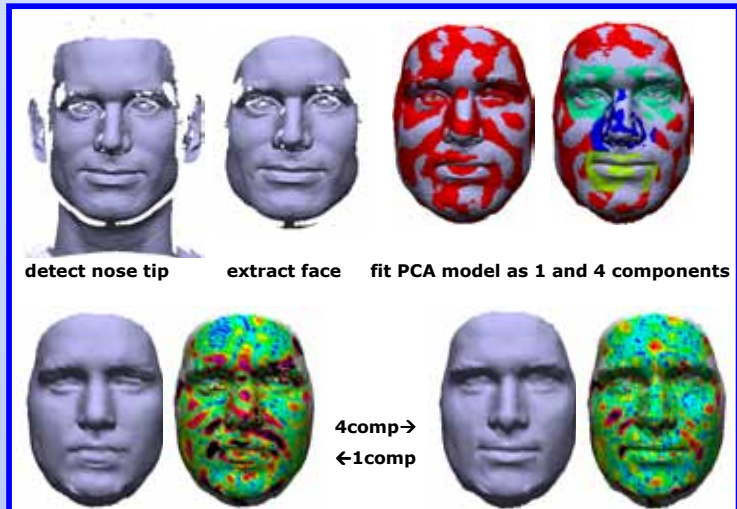


Automatic Bootstrapping of a Morphable Face Model using Multiple Components

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Contributions

- A **fully automatic method to bootstrap** a statistical deformation model of the human face
- Applicable to **general 3D face scans** with noise and holes
- Automatically **checks for redundancy**

Bootstrapping challenge

- If the model fits a new example well, there is no use of adding the new example to the model. This must be automatically verified
- If the model doesn't fit the new example, the correspondences are incorrect and the example cannot be added to the model
- It should be fully automatic

Approach

- Automatically detect the nose tip and segment the face
- "F. B. ter Haar and R. C. Veltkamp. A 3D Face Matching Framework for Facial Curves. *Graphical Models*, 71(2):77-91, 2009."
- Fit the morphable face (PCA) model as 1 and 4 components
- "F. B. ter Haar and R. C. Veltkamp. 3D Face Model Fitting for Recognition. In *European Conference on Computer Vision (ECCV)*, pages 652-664, 2008."
- Repair discontinuities at the borders of 4 components
- Check redundancy: accuracy 4comp fit equals accuracy 1comp fit
- Add new faces to the example set of the morphable face model and rebuild

Blending borders

- Detect local distortions
- Find for each vertex nearby components
- Determine for each vertex a weights for each nearby component
- Morph each vertex towards its virtual position in another component

Dataset

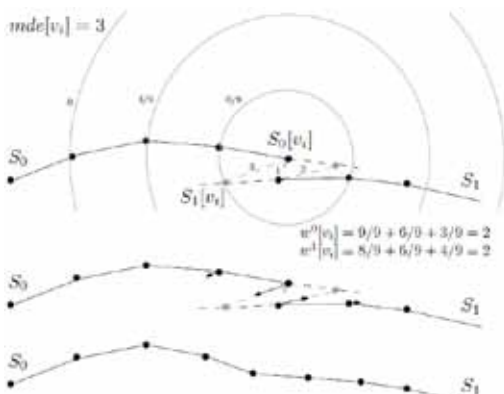
- Training set of 16 face scans from the UND, GAVAB, BU-3DFE, Dutch CAESAR and our local dataset. Different poses, expressions, resolution, coverage
- Test set of 277 UND scans
- Distance measure: Root Mean Squares Error (RMS) of closest point pairs between fitted model and the scan data

Experiment

- Select a redundancy threshold based on the training set
- A new face has a RMS(4 comp) minus RMS(1comp) larger than threshold
- Add new face(s) to morphable face model and build the new PCA model
- 35 scans of the UND set selected as being new

Conclusion

- New bootstrapping algorithm to successfully update an initial face model
- Useful to produce more accurate fits to new scan data, which is important for the identification of faces
- Fully automatic, reuses initial face statistics, checks for redundancy, and retains the full correspondence even in case of noisy scan data with holes



maximum displacement error $mde[v_i] = \max_{c \in comp} (e(S_{fine}[v_i], S_c[v_i]))$
 where $e(p, q)$ is the Euclidean distance between two 3D coordinates p and q .

