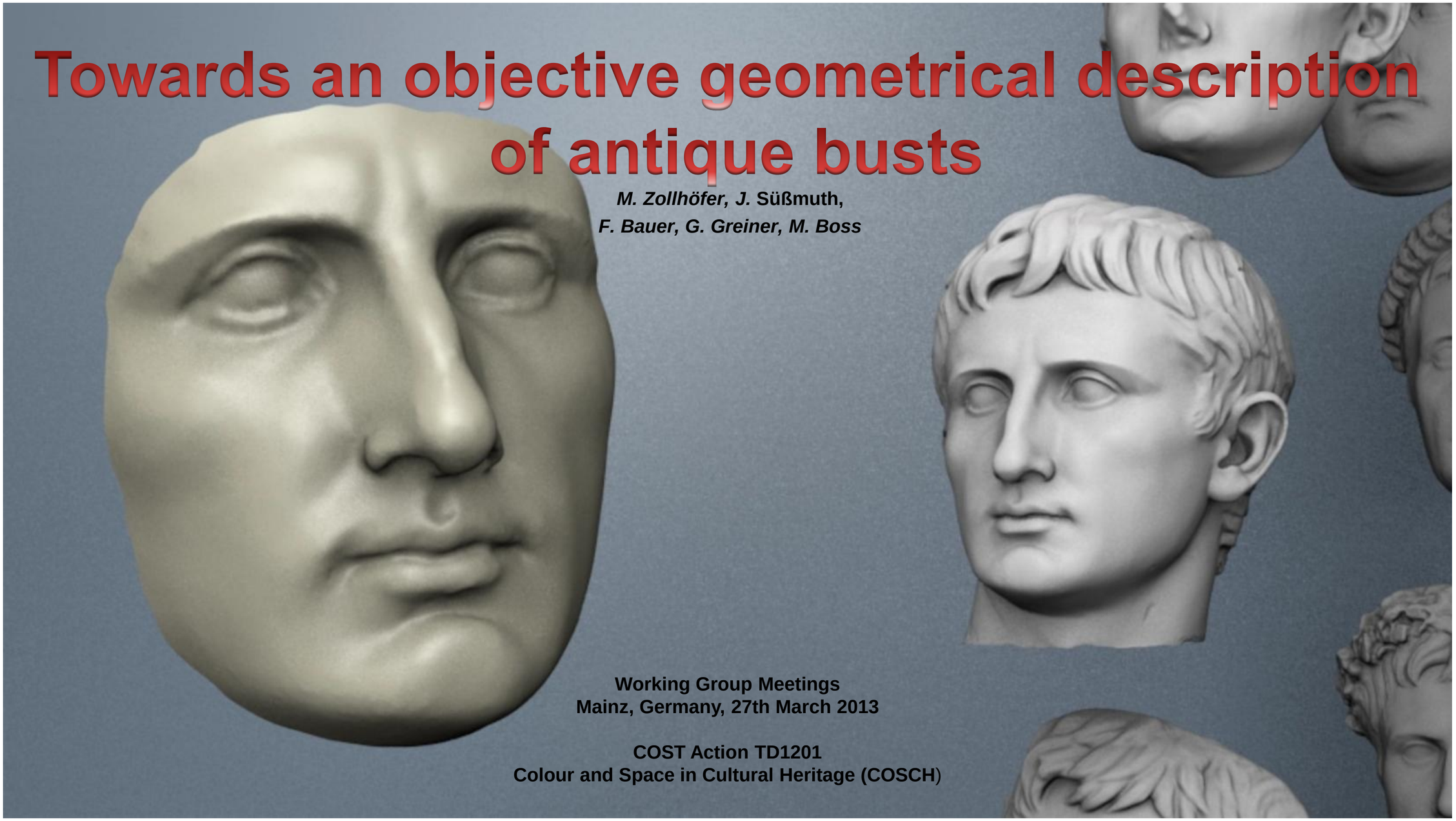
Towards an objective geometrical description of antique busts

M. Zollhöfer, J. Süßmuth,
F. Bauer, G. Greiner, M. Boss



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COST Action TD1201
Colour and Space in Cultural Heritage (COSCH)

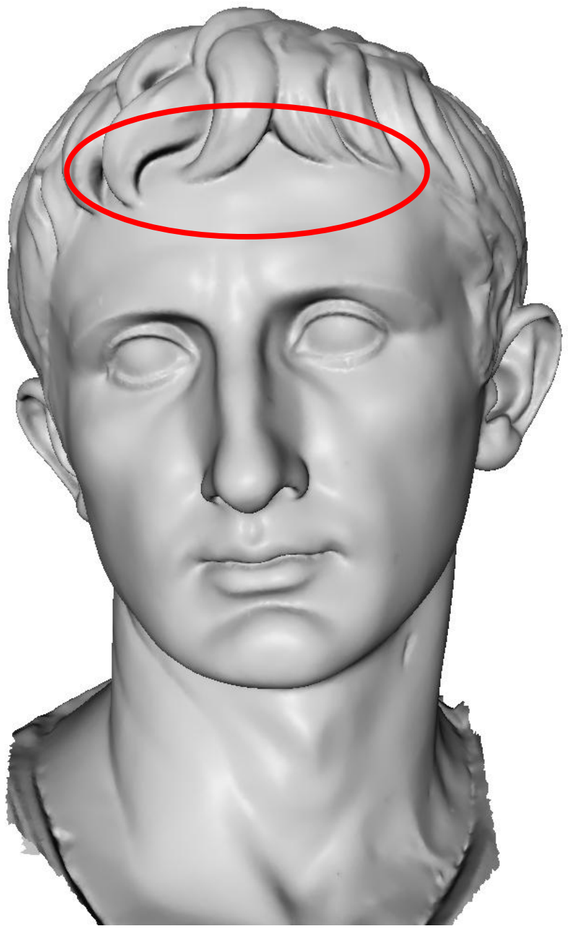
Overview

- Motivation
- Data Acquisition
- Data Reconstruction
- Rigid Registration
- Non-Rigid Registration
- Statistical Face Model
- Results
- Conclusion/Future Work

- References

Motivation

- Different portraits of Augustus:
  - What makes us recognize his portrait?
  - Which features are inspired by the classical concept of beauty and god-like appearance?
  - Which features can be attributed to the real person?



Breuckmann GmbH

- Archaeologists count the strands of hair:
  - Little effort was made to capture his identity using the characteristic geometry of his face

Data Acquisition - „Antikensammlung“ Erlangen

- We started to scan busts of the famous emperor
  - **Up to now:** 15 busts of the **„Antikensammlung“ Erlangen**
    - Third largest collection of antiques in Bavaria
    - Main focus on Greek and Roman historical artefacts
    - 450 plaster casts and 900 artefacts
  - **Goal:** Build a database of the emperors facial geometry



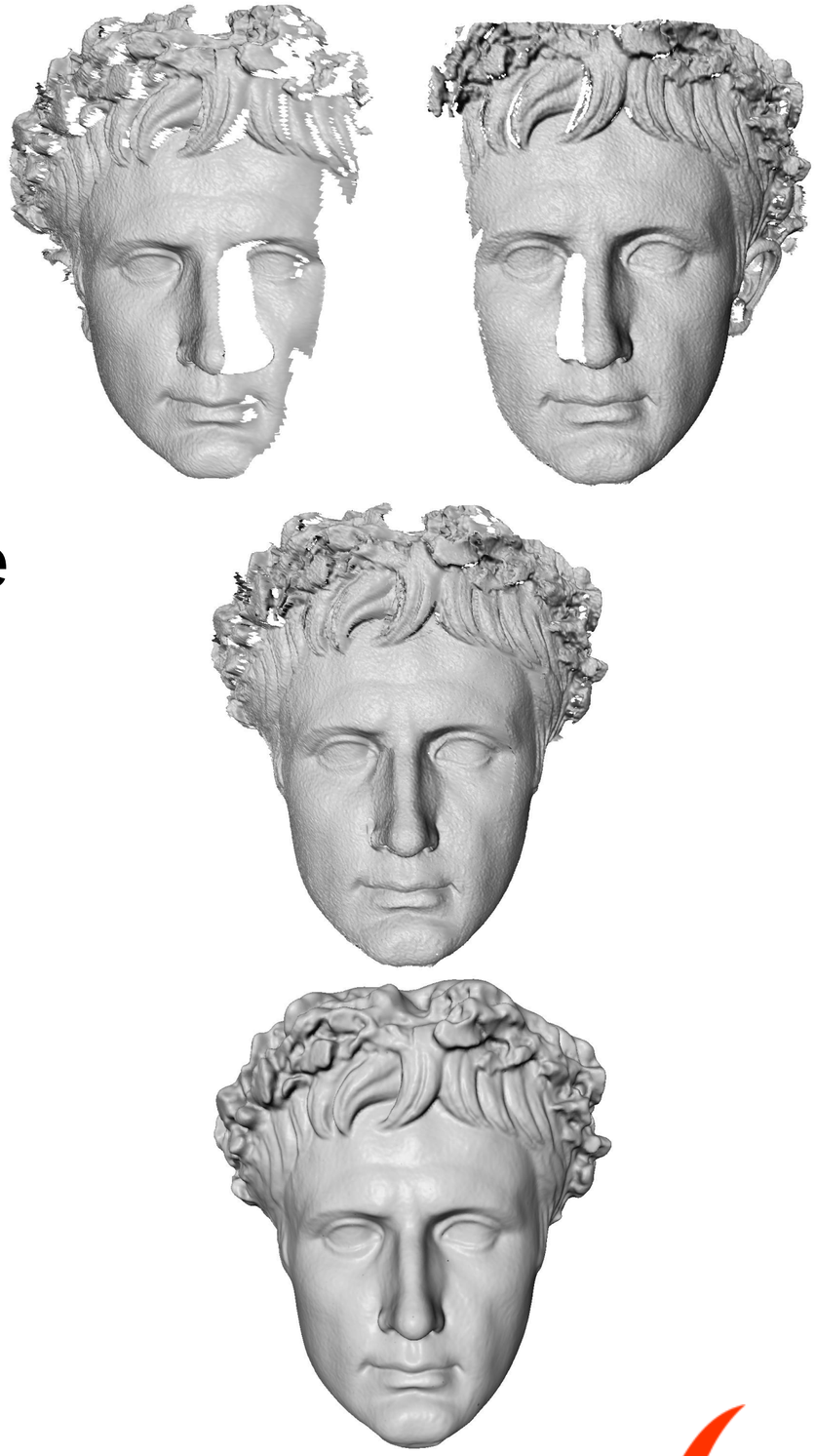

Data Acquisition - Setup

- We use a portable structured light scanner
  - DAVID SLS-1
  - We fuse multiple scans to obtain a good reconstruction

Data Reconstruction

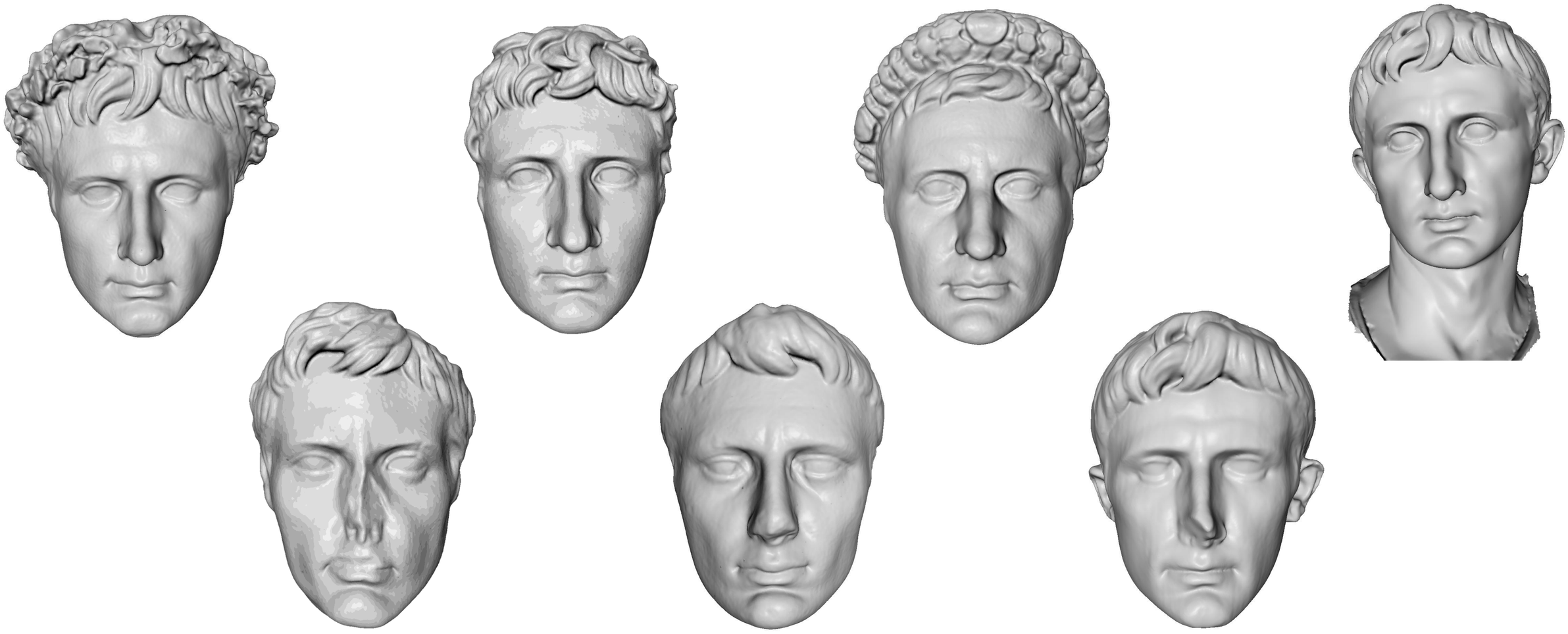
- We acquire multiple 3D-Scans
  - 3D-Scans not aligned
    - Compute optimal rigid alignment
      - [Besl92, Chen92]
  - Merge scans to compute a single surface
    - Poisson Surface Reconstruction
      - [Kazhdan06]

➢ High-Quality 3D-Models



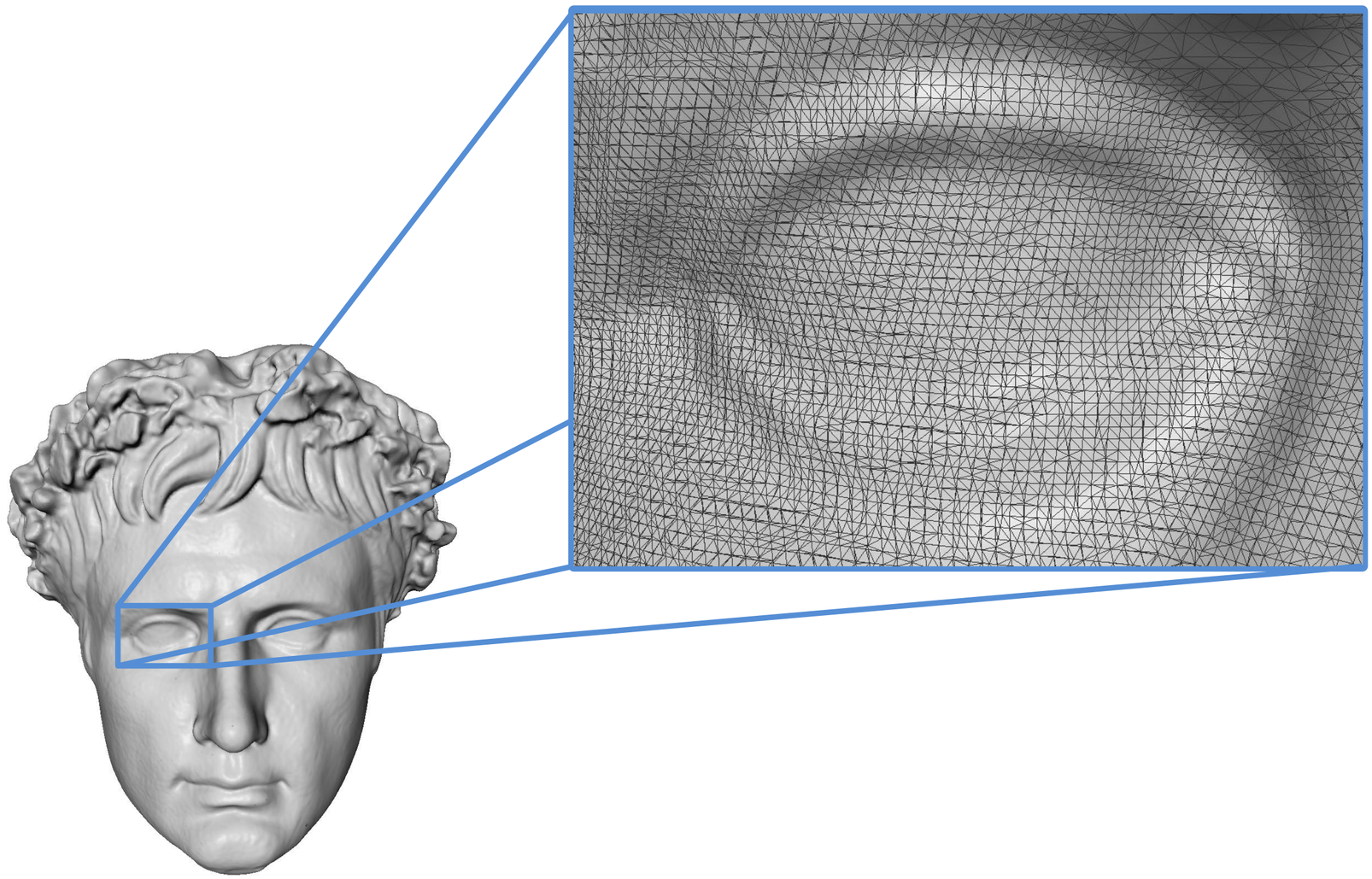
Data Reconstruction - Results

- 15 busts of the „**Antikensammlung“ Erlangen** digitized
  - We want to scan more bust in the future



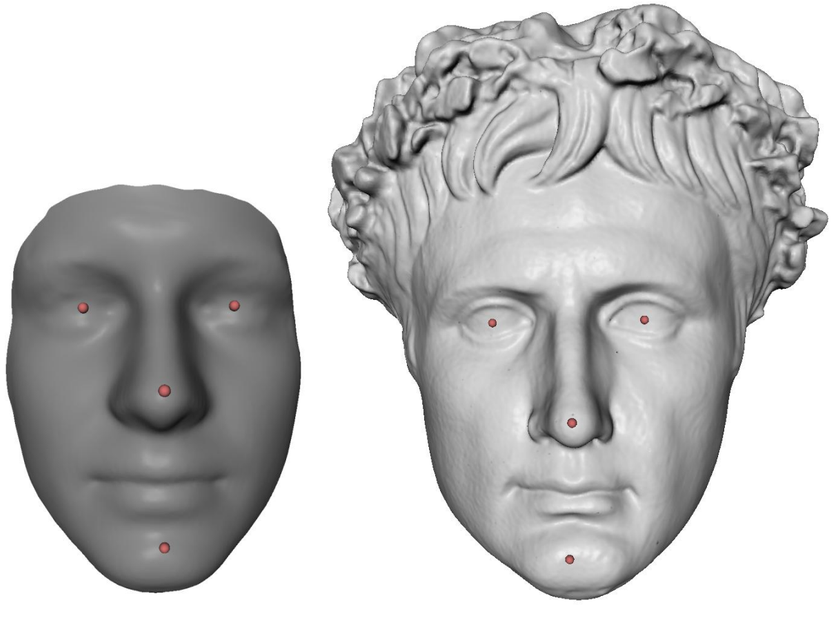
Data Reconstruction - Problem

- All the 3D-Scans have different topology
  - We do **not** know any corresponding regions
    - Which part of the model correspond to the nose, eyes, etc…

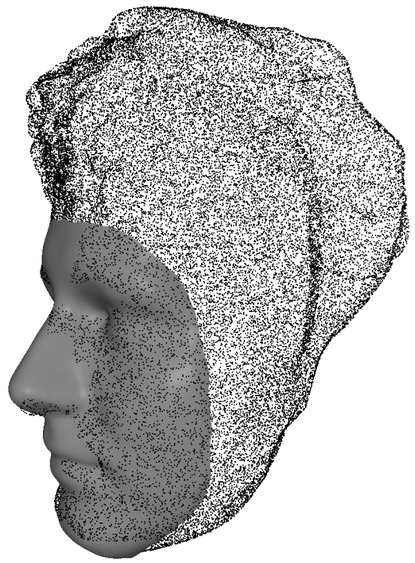


Rigid Registration

- We start with a sparse set of manually placed correspondences
  - Template mask and 3D-Scan

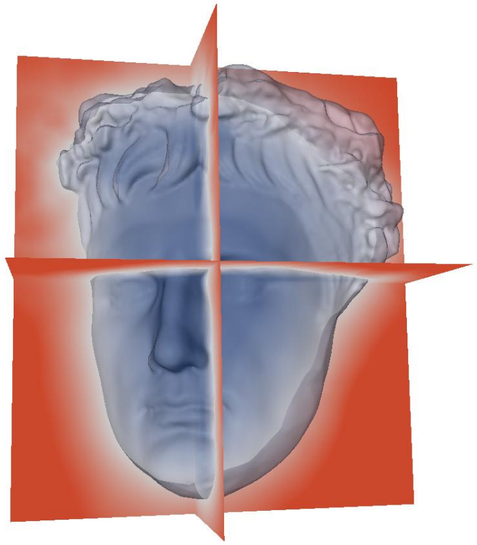


- Compute best rigid transformation [Schönemann66] and scaling
  - Transform mask in the coordinate system of the 3D-Scan:
    - Same orientation, position and scale



Non-Rigid Registration

- We fit the template mask using non-rigid registration
  - Warp template such that it matches the input [Süßmuth10]
    - Two steps:
      - Coarse Alignment
        - » Deformation Graph [Sumner 07]
        - » Minimize distance to target using distance field
      - Fine Alignment
        - » Optimize vertex positions
        - » ARAP Regularization [Sorkine07]
        - » Point-point distance measure



Non-Rigid Registration - 2

- Result is a set of masks with the same topology
  - Dense set of correspondences
    - Basis for further processing

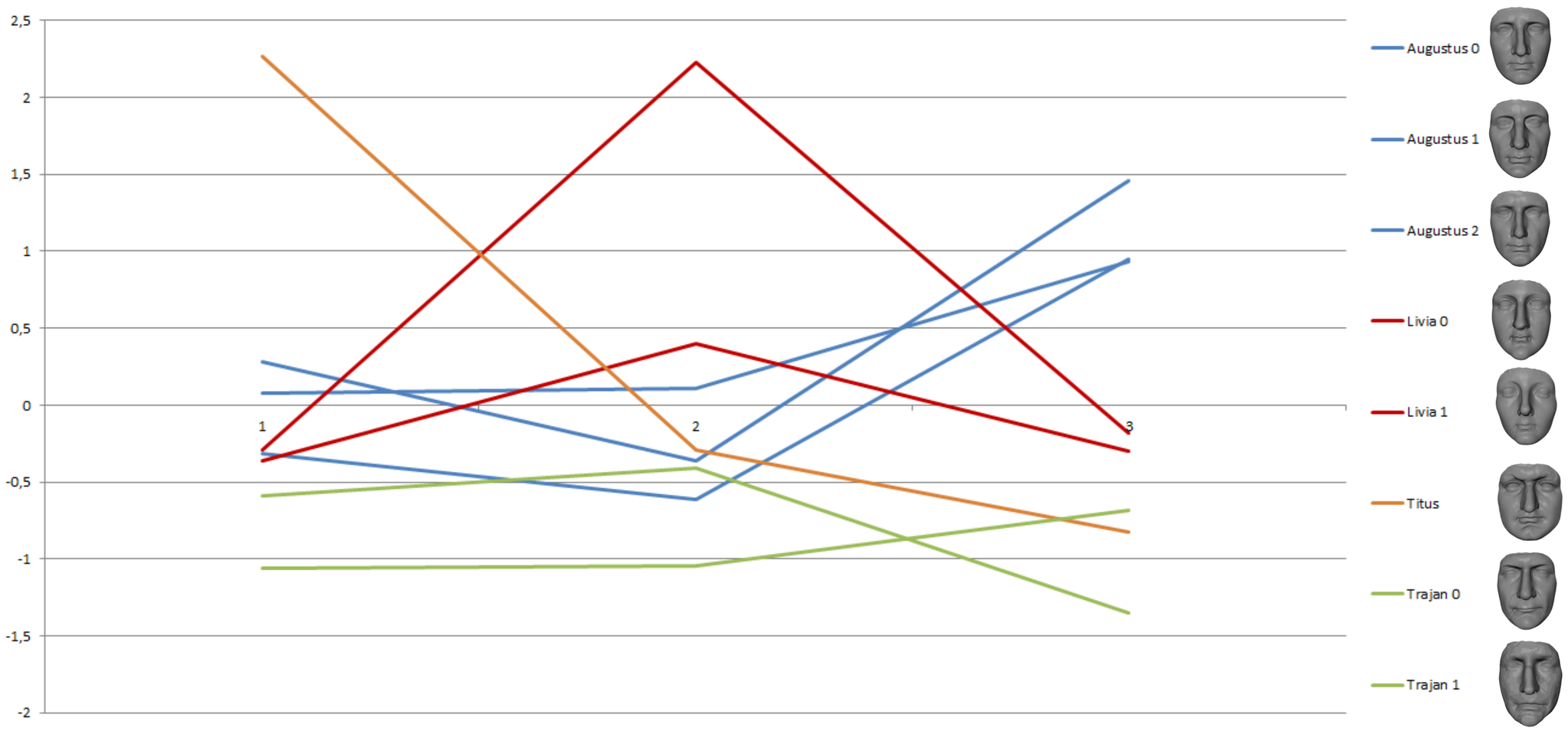
Statistical Face Model

- Database:
  - 8 undamaged busts:
    - 3x Augustus
    - 2x Livia
    - 2x Trajan
    - 1x Titus

- Statistical Analysis
  - Mathematical space spanned by the faces [Blanz99, Blanz07]
    - Principal Component Analysis (PCA)
  - Visually explore the variations in the datasets

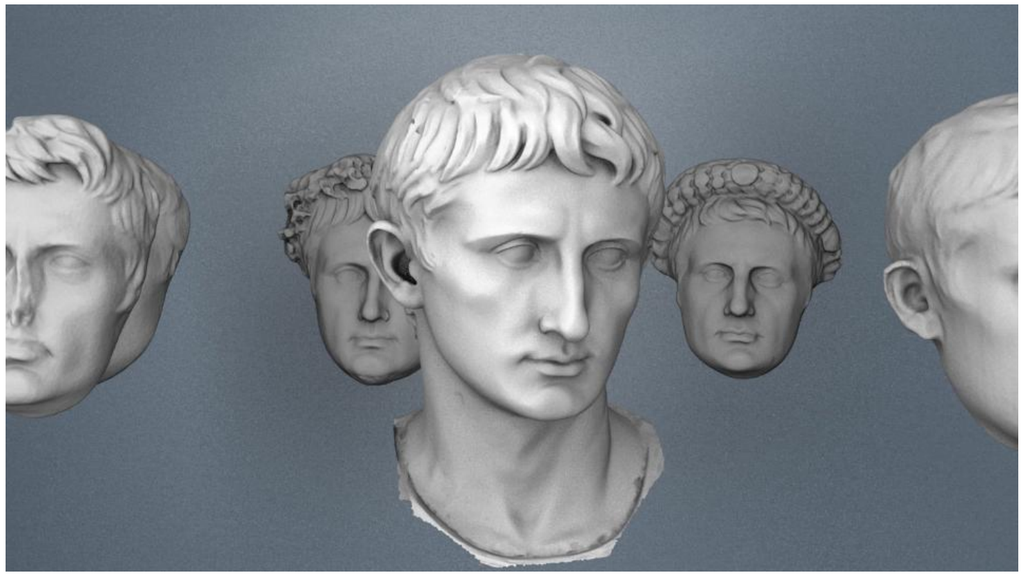
Statistical Face Model - 2

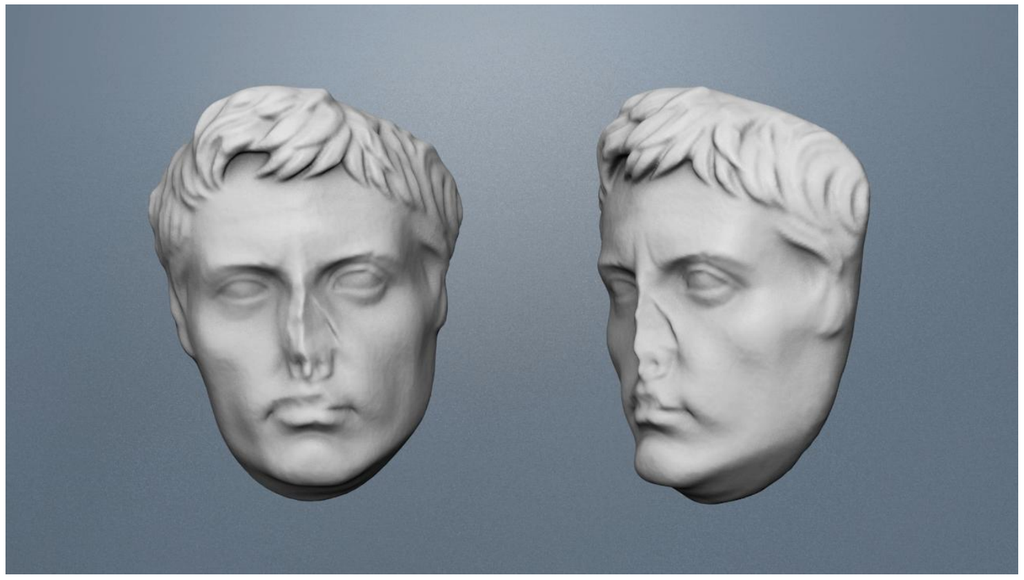
- Small number of degrees of freedom
  - Use coefficients as feature vectors (DNA)?
    - Needs a more detailed analysis:
      - More scans, more tests, etc…



Results

- Videos:





Conclusion/Future Work

- Foundation for Statistical Analysis are dense correspondences
  - Non-Rigid Registration

- In the future we plan to:
  - Enlarge our database
    - More busts of the emperor
    - Other classical rulers
  - Descriptors:
    - Objectively distinguish between rulers

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