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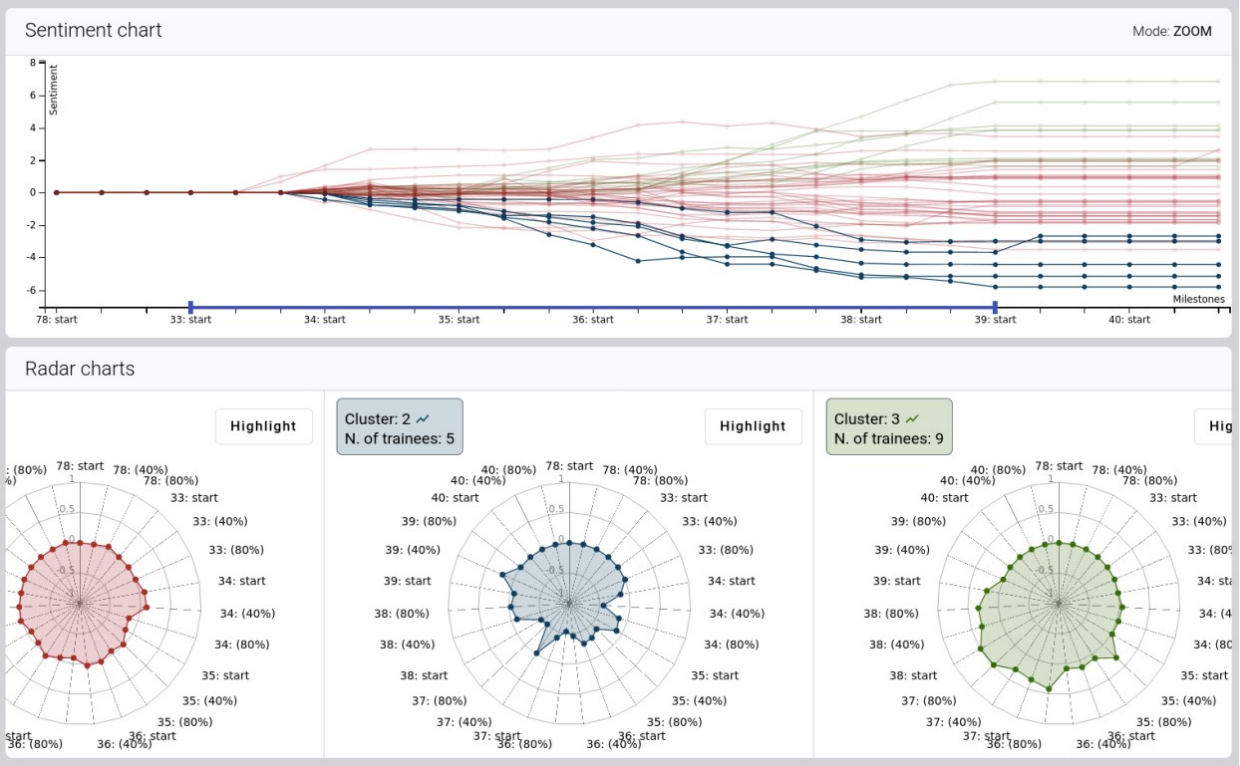
Visual Data Analysis

in cybersecurity education and forensic anthropology

Radek Ošlejšek – Faculty of Informatics, MU

Cybersecurity education

- **Cybersecurity (training)**
  - Software: KYPO Cyber Range Platform, **KYPO Analyst**
  - In cooperation with CERIT (Pavel Čeleda, Jan Vykopal, Jakub Čegan, …)



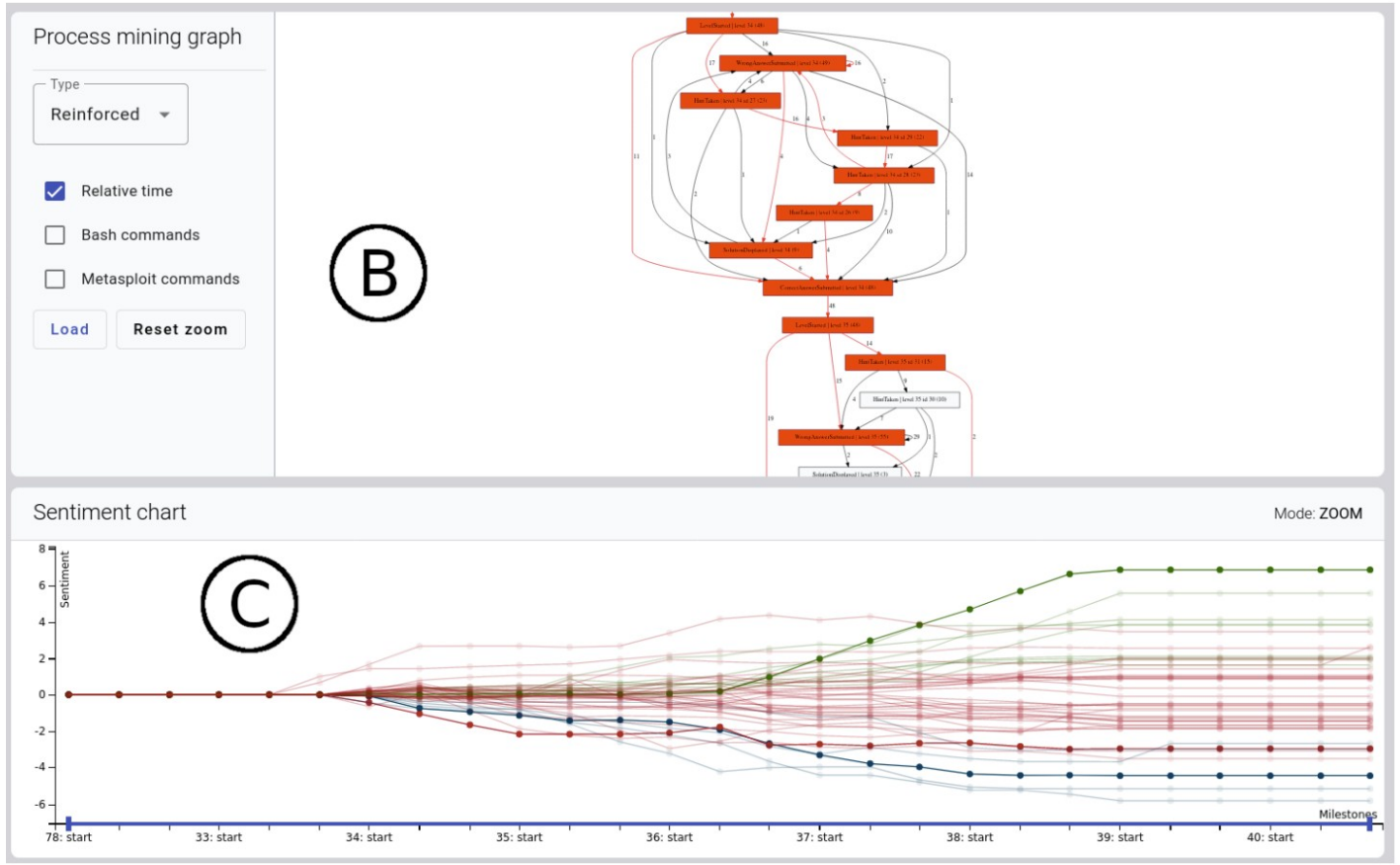
Cybersecurity: KYPO Analyst

- **Goal:** Support post-training analysis (revealing flaws in training design, difficulty, gameplay strategies, etc.)
- **Techniques:** process mining, metric-based data analysis, clustering and other ML methods.

Input: Process-oriented data

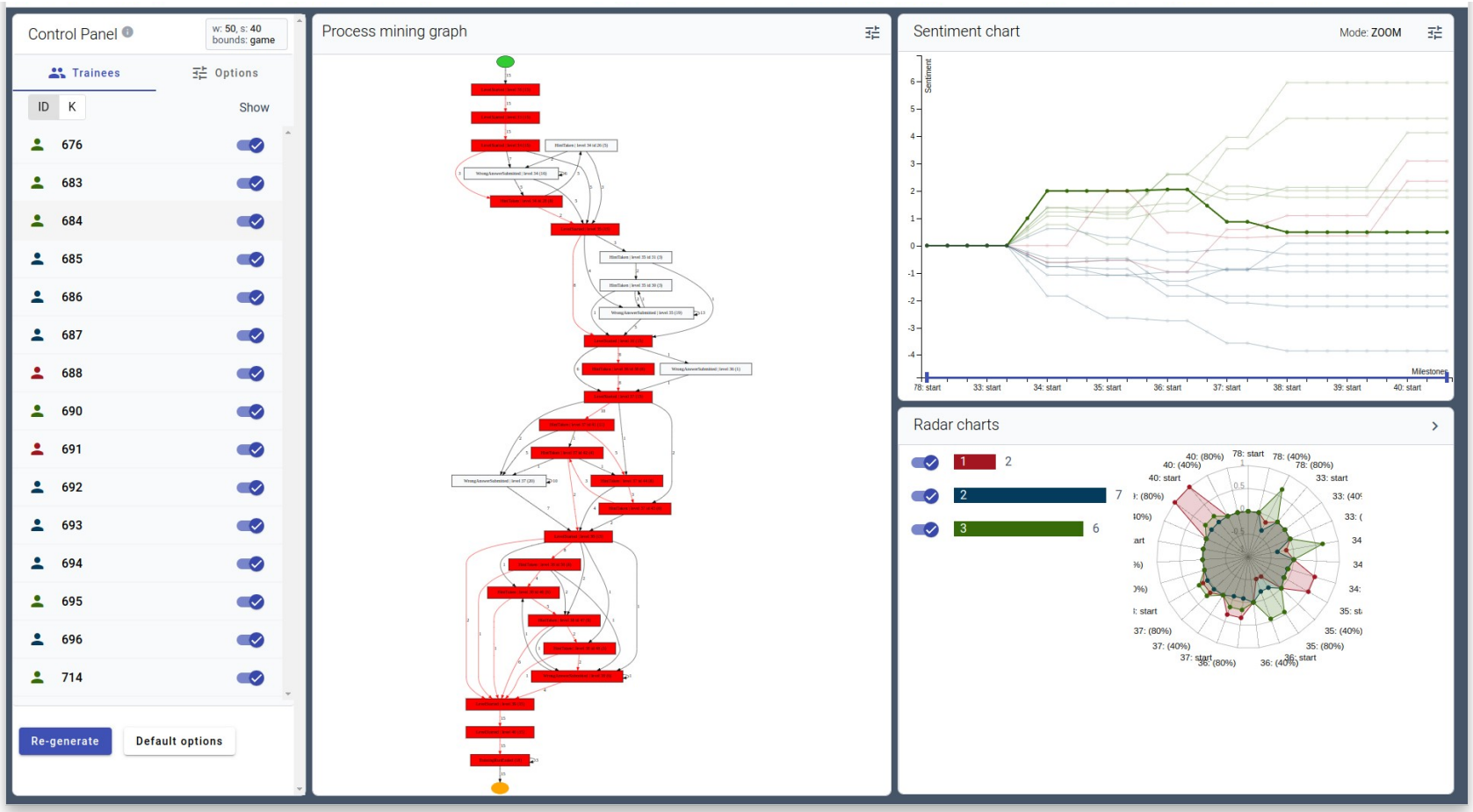
Events log

User1;2.08.2020 10:31:43;use webmin_backdoor
User1;2.08.2020 10:32:44;set RHOST
User1;2.08.2020 10:33:19;set LHOST
User1;2.08.2020 10:34:27;set SSL
User1;2.08.2020 10:34:35;set TARGET
User2;2.08.2020 10:32:17;use webmin_backdoor
User2;2.08.2020 10:32:43;exploit
User2;2.08.2020 10:44:33;set RPORT
User2;2.08.2020 10:45:21;exploit
User2;2.08.2020 10:56:02;set LHOST
User2;2.08.2020 10:56:20;set SSL
User2;2.08.2020 10:58:35;set TARGET



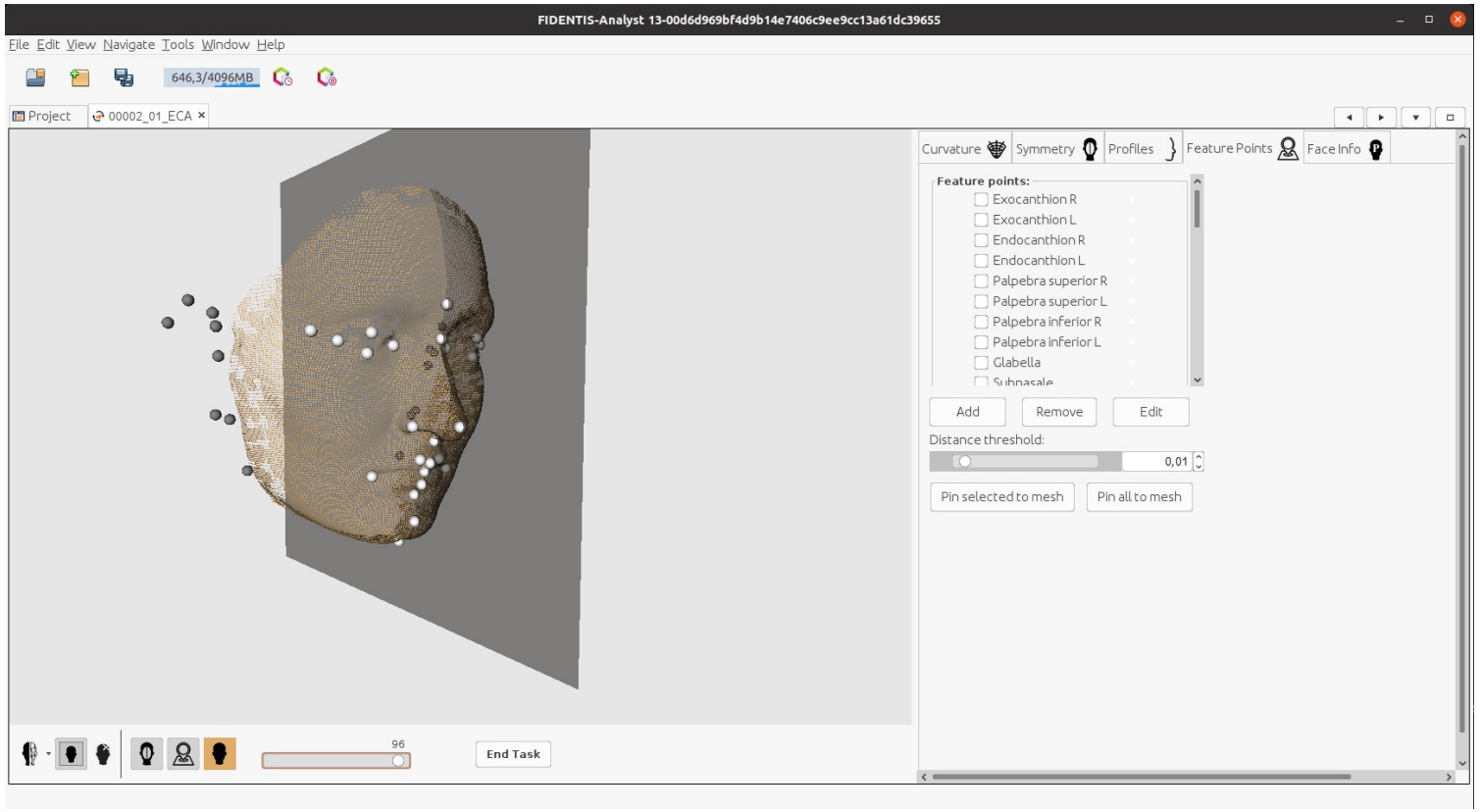
Examples of Bachelor and Master Thesis

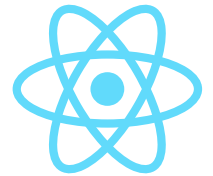
- **Integration and optimization of process graphs**
  - Currently only Heuristic net is available that suffers from inefficiency

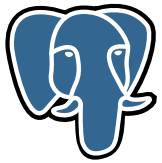


Forensic Anthropology

- **3D Face Identification and Forensic Analysis**
  - Software: **FIDENTIS Analyst II**
  - In the cooperation with Department of Anthropology, Faculty of Science (Petra Urbanová)







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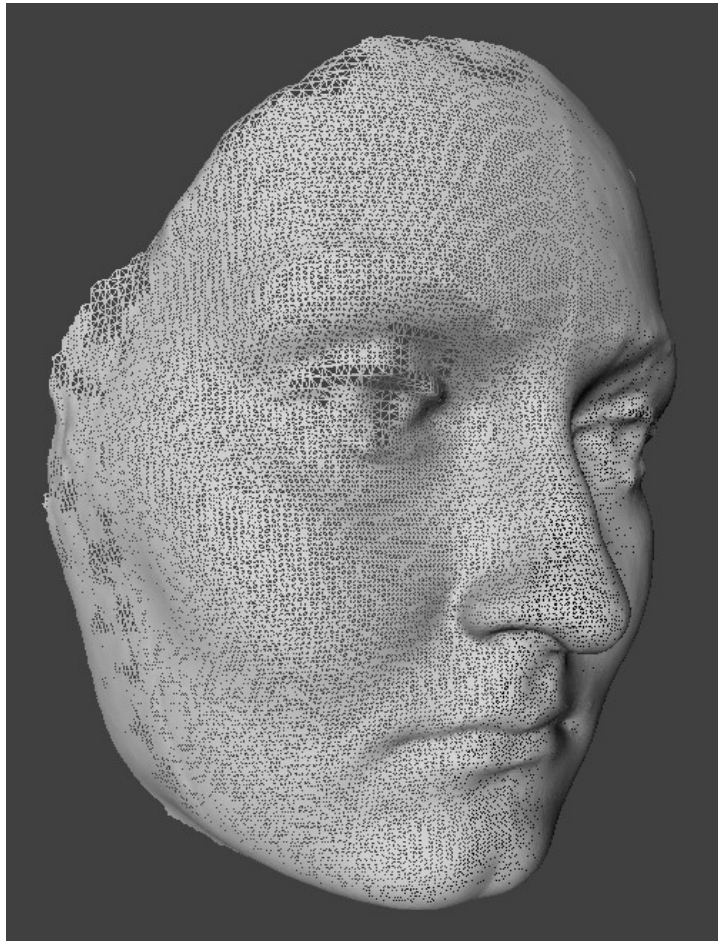
Forensic Anthropology

Input: Photogrametry data
(3D geometry + photo texture)



Goals:

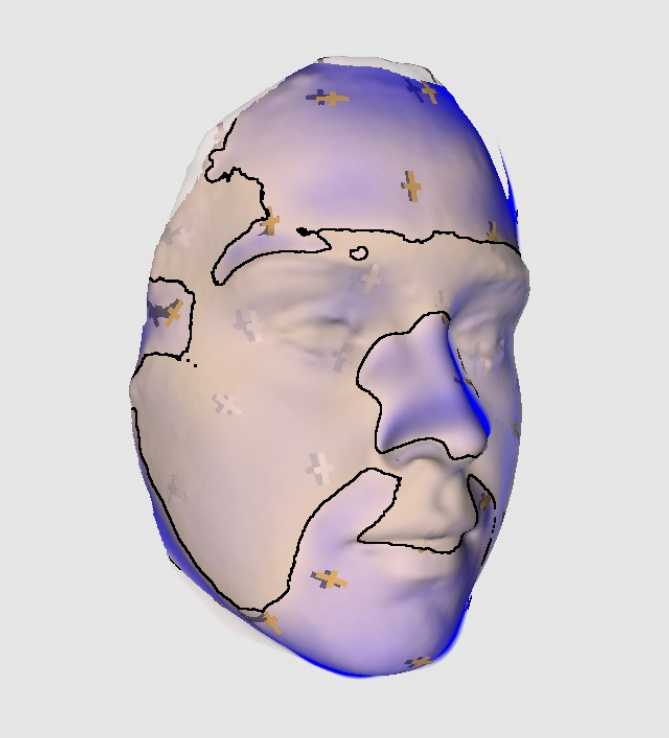
- Automated face identification in big data sets (100.000+ faces).
- Pre-selection of (a few) thousands of candidates.
- Fully automated process.

- Forensic-aware (anatomically correct) identification on smaller data sets.
- Automated pre-processing with exploratory analysis and expert-driven decision-making.

- Visual-analysis methods of detail forensic investigation.

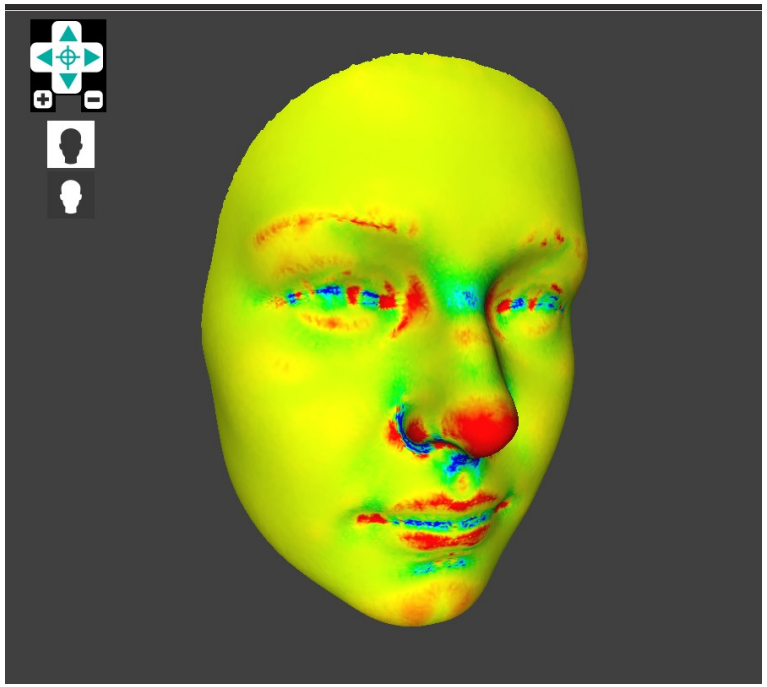
3D Face Similarity Measurement

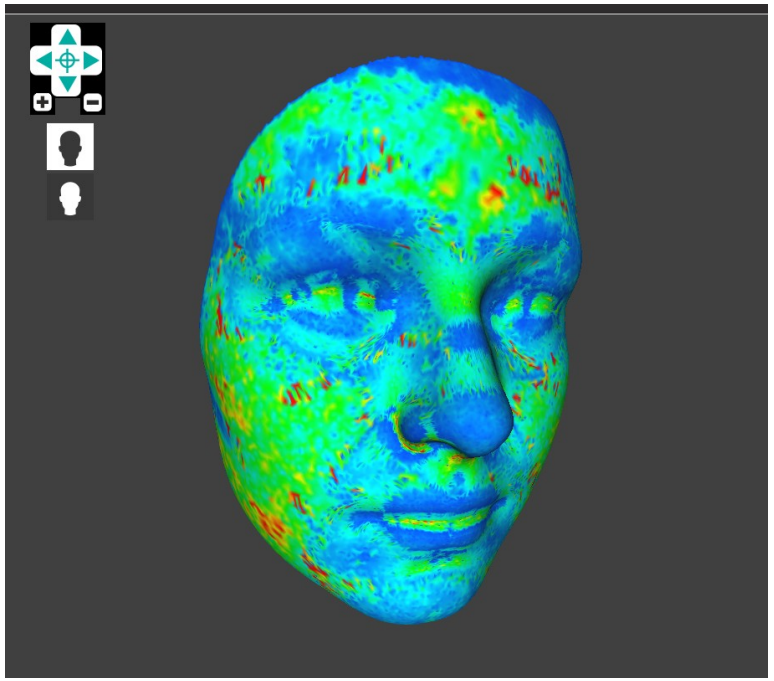
- **Goals:** To decide, whether the two faces belong to the same person **and why**.
  - Computation/enumeration of (dis)similarity of 3D scans
  - Providing a visual representation for decision-making of forensic analysts.



Descriptor-based Similarity Techniques

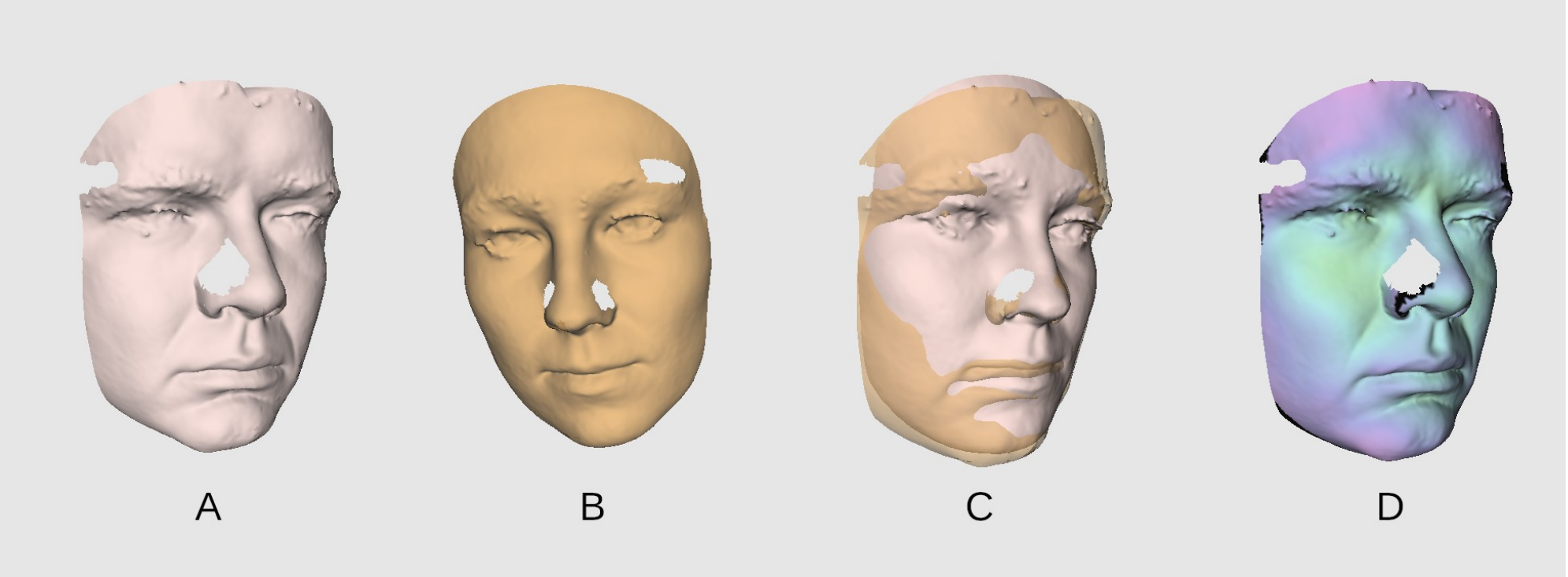
- Descriptors: Color of eyes, distance between eyes, curvature of some are (e.g., nose), etc.
- Descriptors must be detected automatically.
- These techniques are independent on the position of 3D scans in space.





Registration-based Similarity Techniques

- Automated registration (mutual alignment in space) followed by space-dependent measurement techniques



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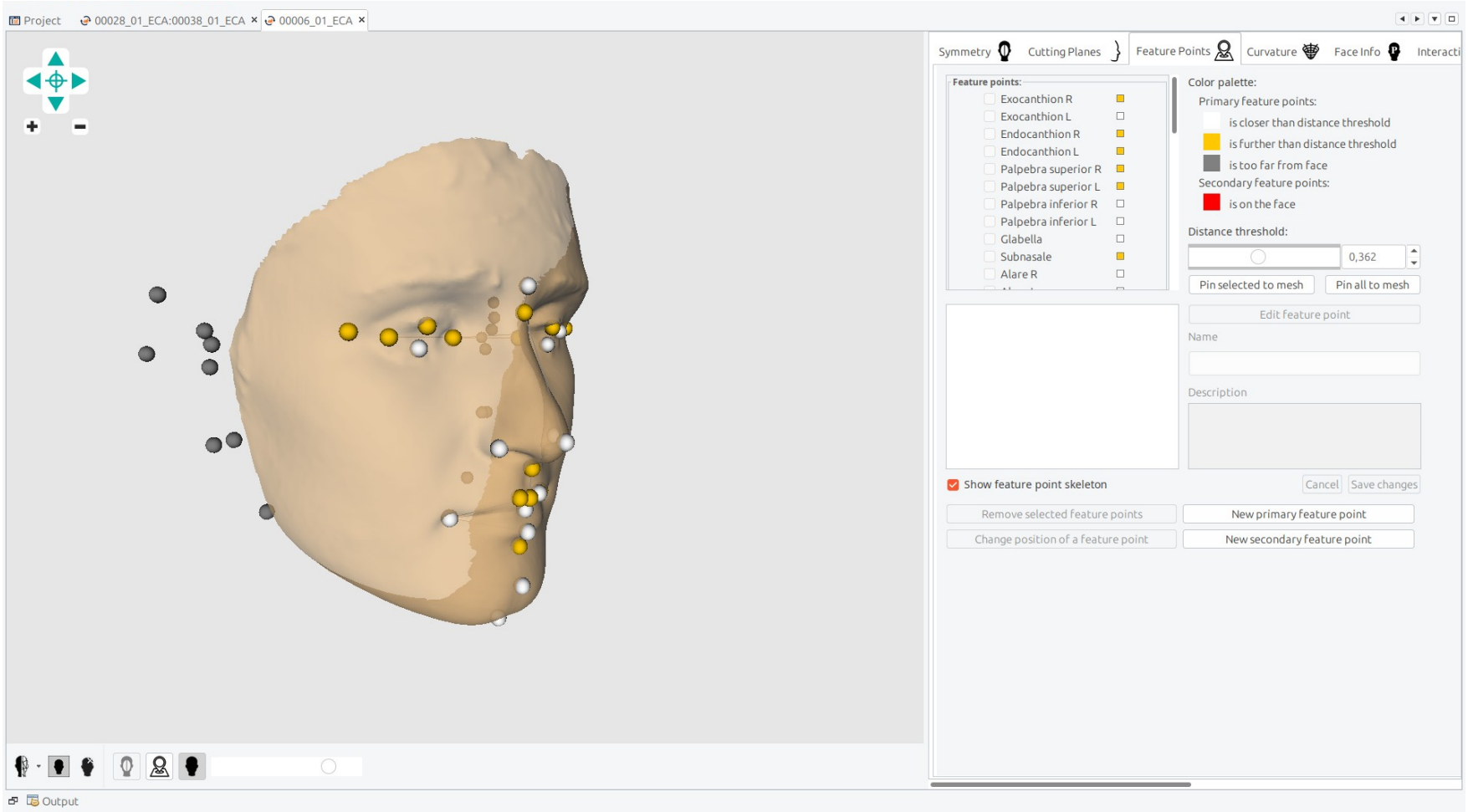
Examples of Bachelor and Master Thesis

- **Automated Anthropological Landmark Detection** (using machine-learning techniques)



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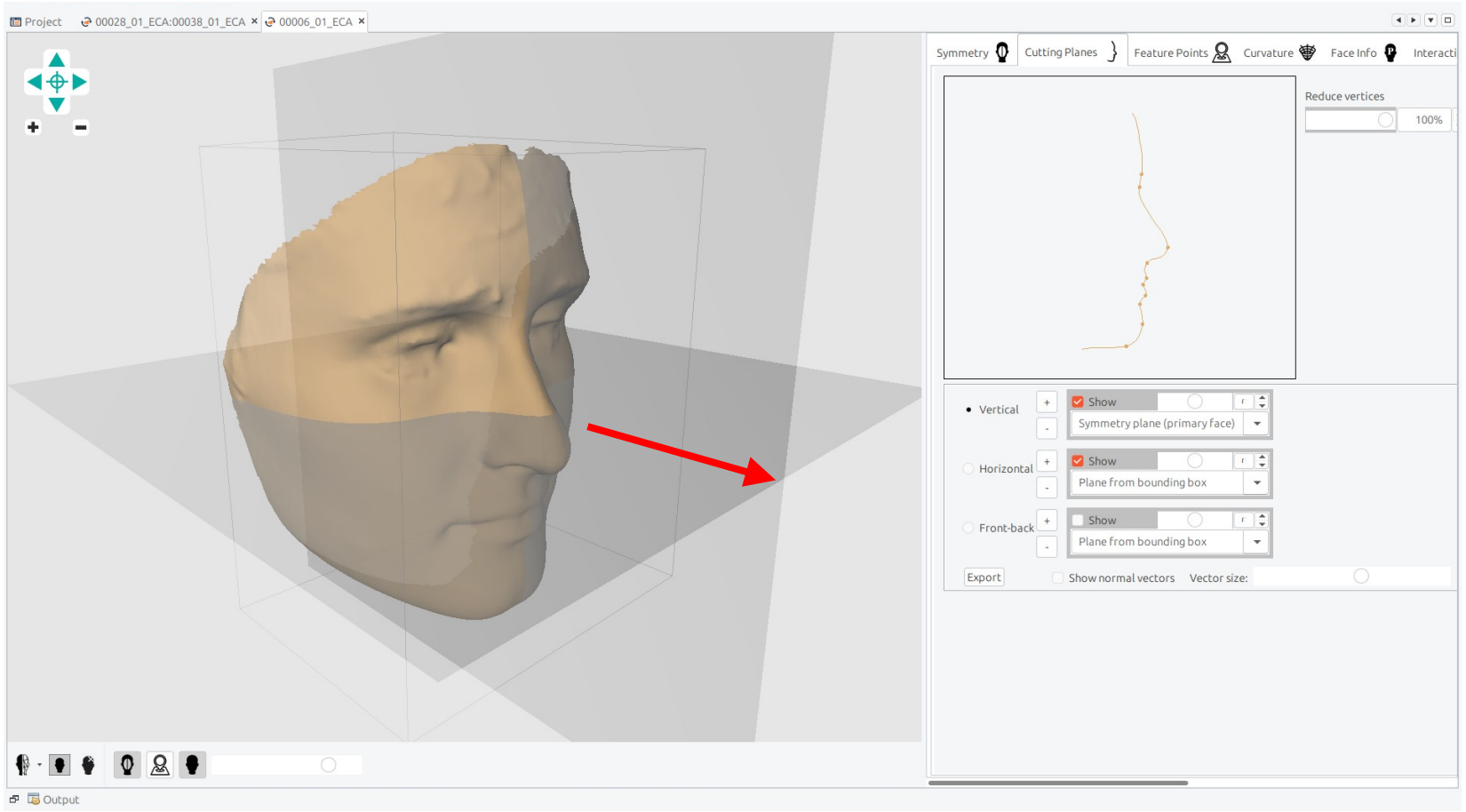
Examples of Bachelor and Master Thesis

- **Automated pose detection** (orientation of facial scans in the space)
  - Geometrically and/or using machine-learning methods



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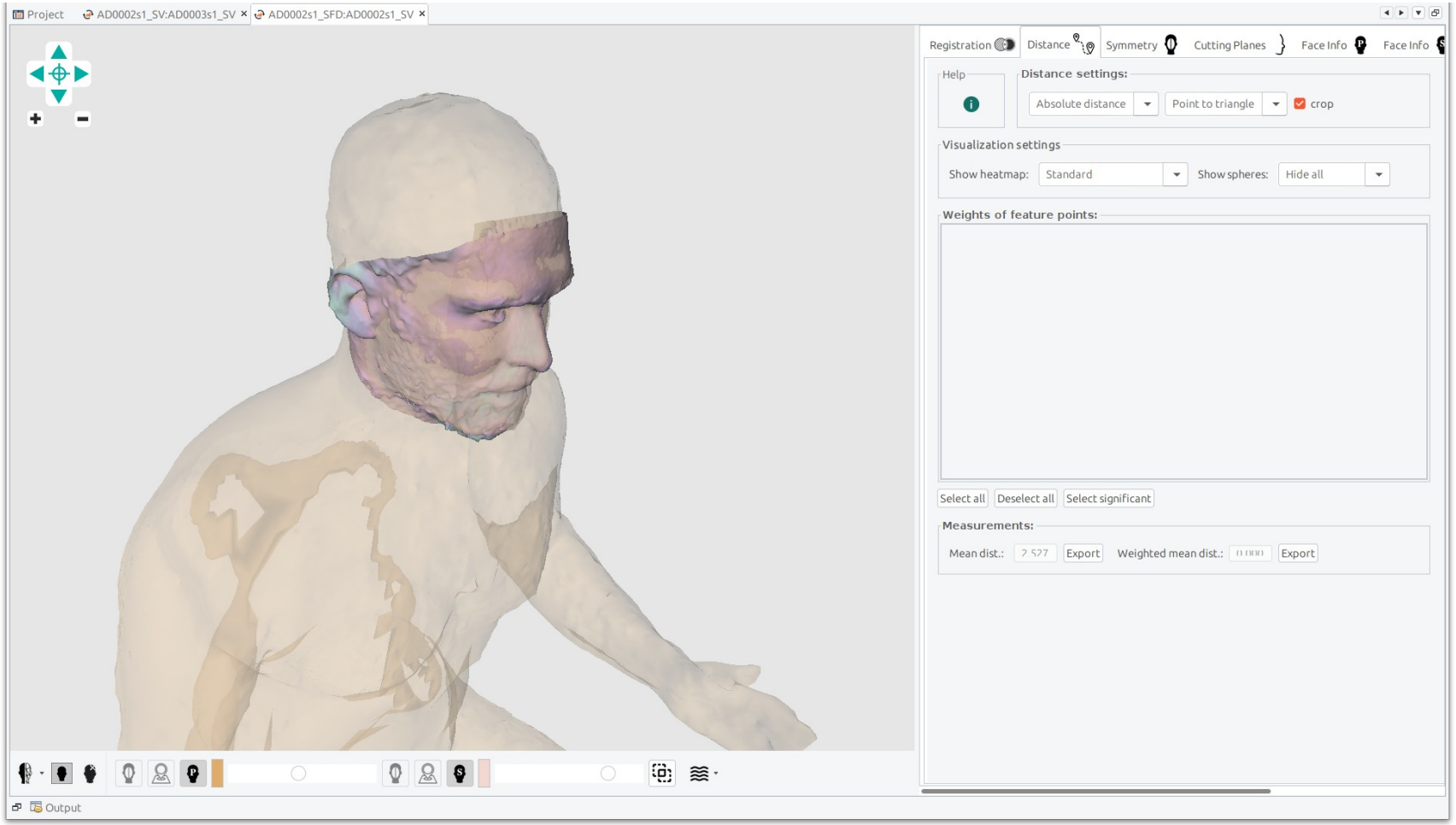
Examples of Bachelor and Master Thesis

- **Superimposition of 3D face scan to body scan**



PhD Topics

Even the scans of the same person are not the same. We need identification techniques that can adapt to changes introduced by

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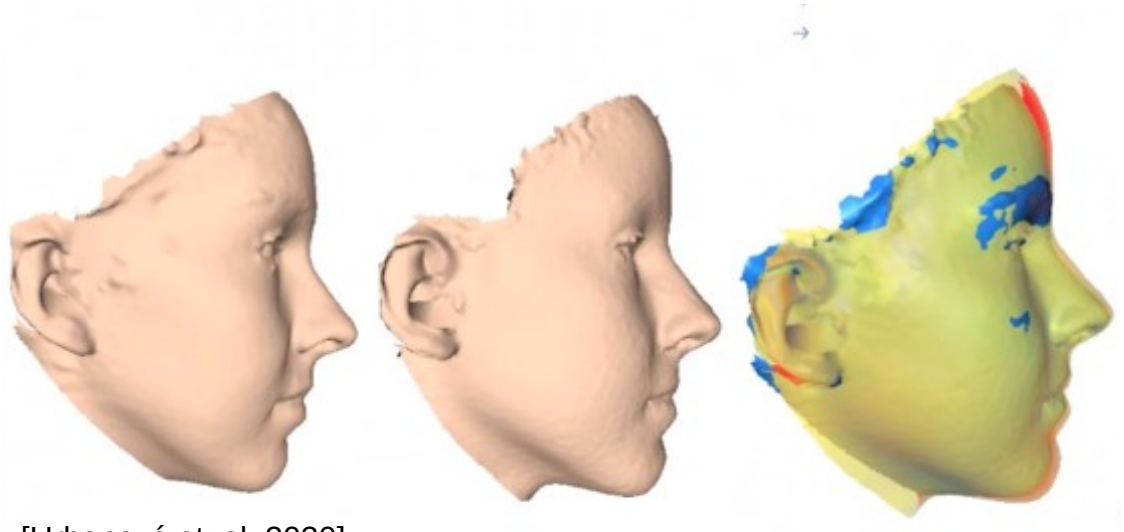
- **Ageing:** identification and simulation/prediction



[Urbanová et. al, 2020]

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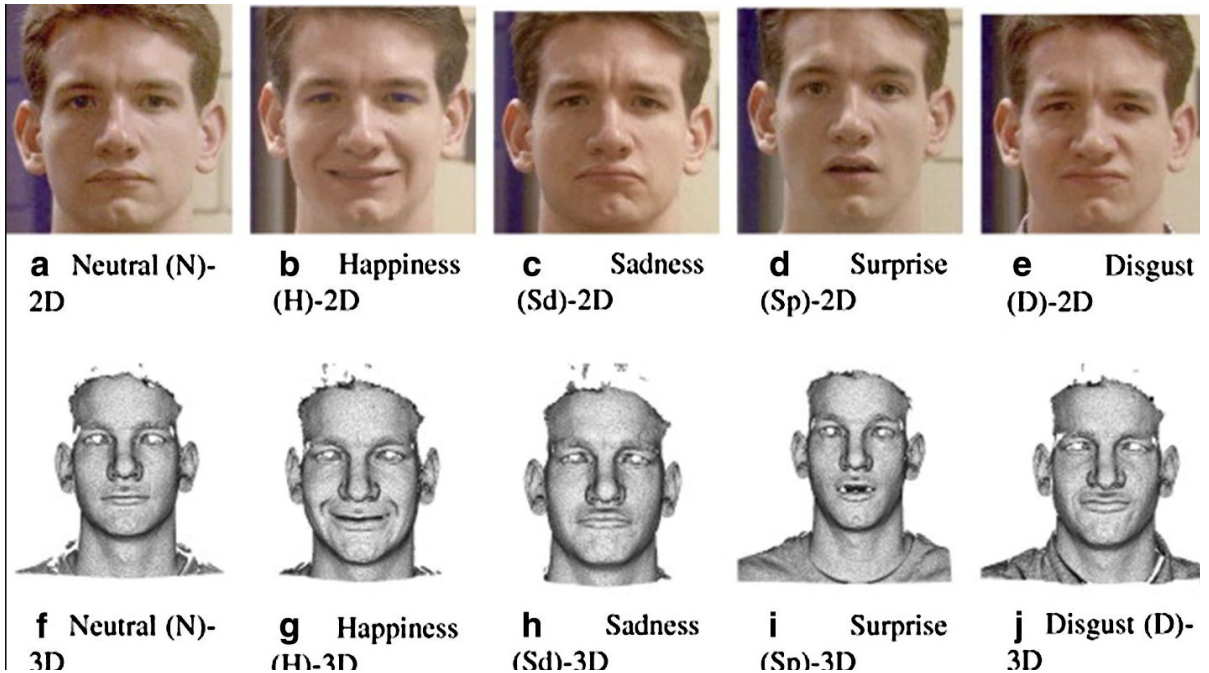
- Ageing: identification and simulation/prediction
- **Poses**



[Zhou, S., Xiao, S.: 3D face recognition: a survey. 2018]

PhD Topics

Even the scans of the same person are not the same. We need identification techniques that can adapt to changes introduced by

- Ageing: identification and simulation/prediction
- Poses
- **Occlusion**
- ...

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PhD Topics

Even the scans of the same person are not the same. We need identification techniques that can adapt to changes introduced by

- Ageing: identification and simulation/prediction
- Poses
- Occlusion
- **Variability in a given population** (i.e., computationally demanding statistical exploration and evaluation)
- ...

Thank you for your attention!

- **KYPO Analyst**: www.radek-oslejsek.cz/it/cybersecurity-education-and-training
- **FIDENTIS Analyst II**: www.radek-oslejsek.cz/it/fidentis-analyst-2
- oslejsek@fi.muni.cz