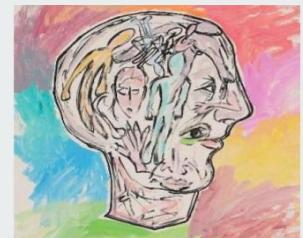

Perception of Mooney Faces: Extreme Generalization through Inverse Rendering?

Shreya Kapoor¹, Maximilian Weiherer¹, Max Siegel¹, Amir Soltani³,
Ilker Yildirim⁴, Josh Tenenbaum², Bernhard Egger¹

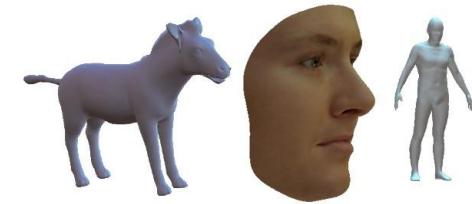
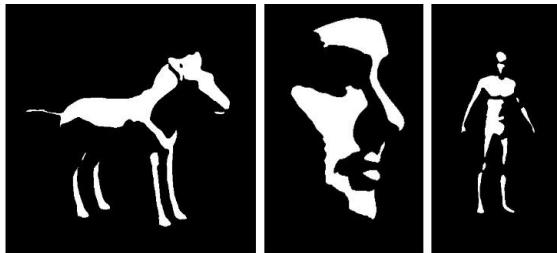
- 1.Friedrich-Alexander-Universität Erlangen-Nürnberg,
- 2.Massachusetts Institute of Technology,
- 3.Boston College,
- 4.Yale University



Friedrich-Alexander-Universität
Faculty of Engineering

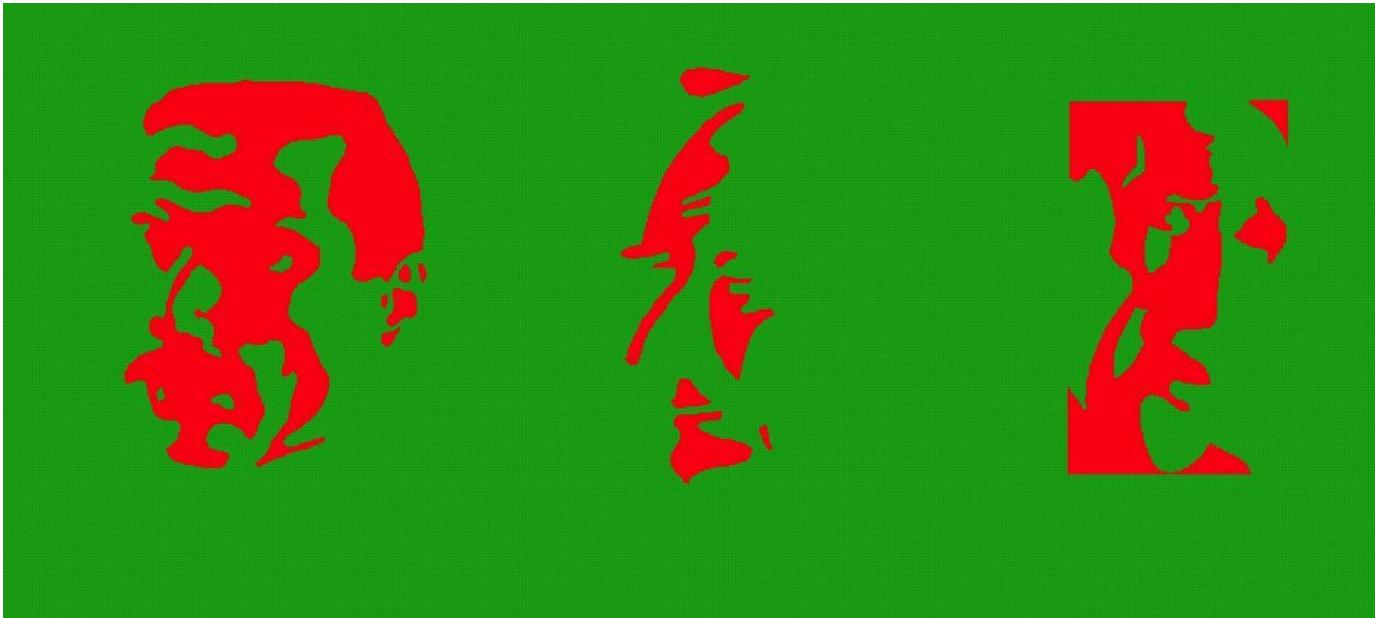


Motivation to study Mooney Images



3D data:Zuffi, Kanazawa, Jacobs, & Black, 2017, BFM :Gerig et al., 2018 and MPI FAUS: Bogo, Romero, Loper, & Black, 2014

Mooney Images: Contrast Inversion



<https://cavlab.net/Demos/Shadows/>

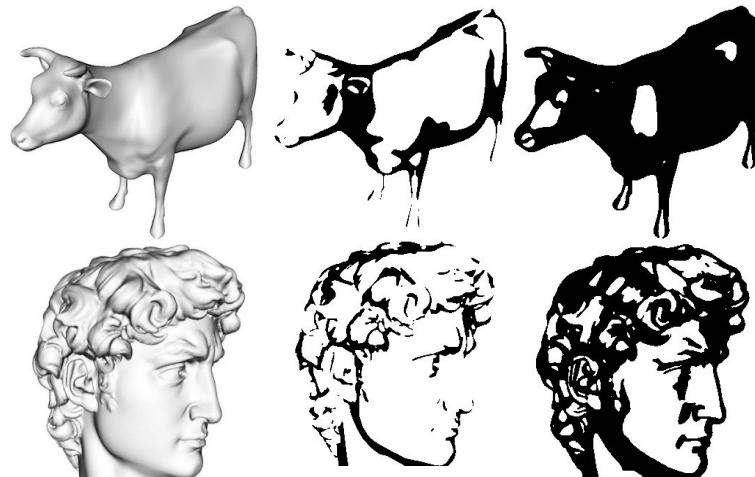
Mooney Images and Line Drawings



RGB
face

Charcoal
drawing

Mooney
face



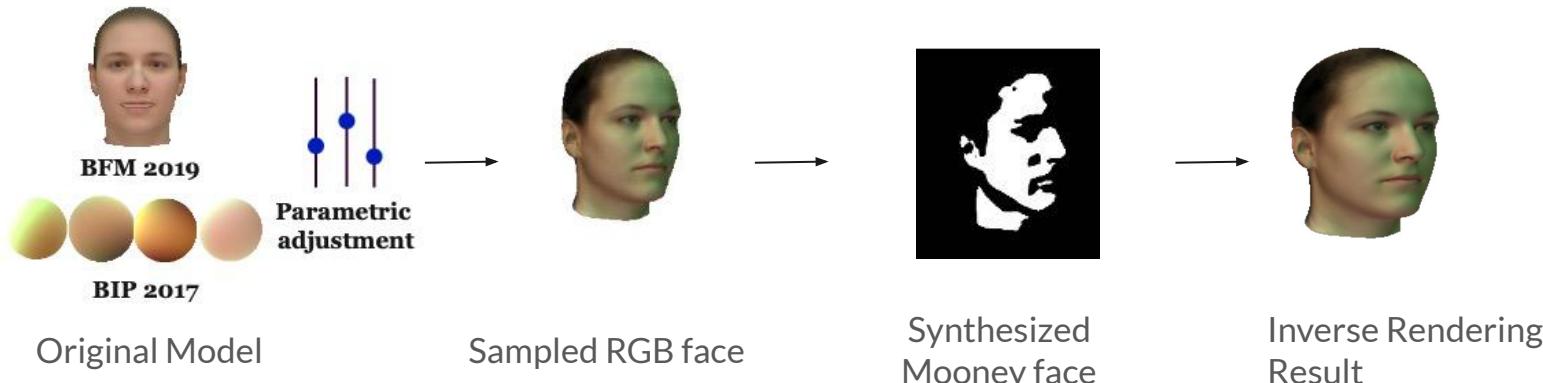
Object
under
lighting

Contours

Thickening
of contours

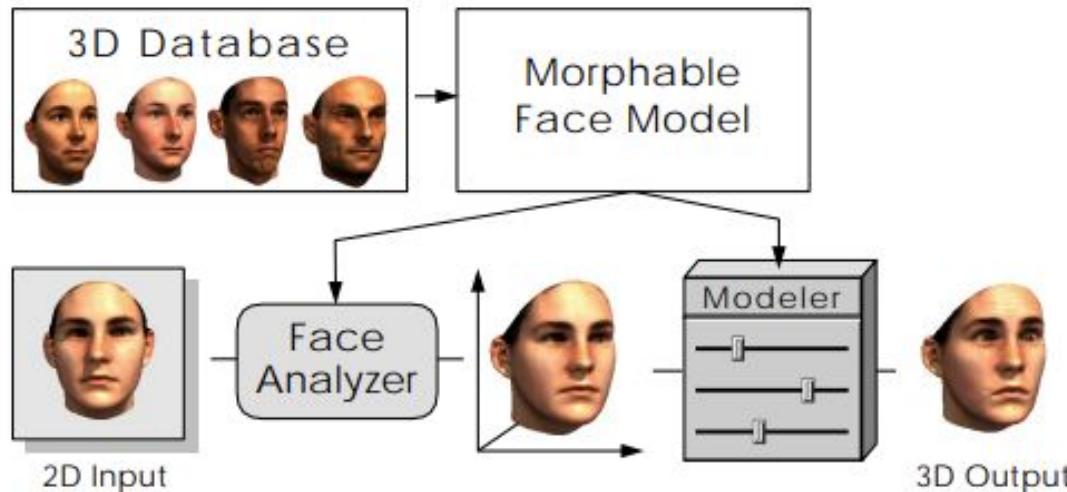
Cow and Face data: Hertzmann 2020

Pipeline



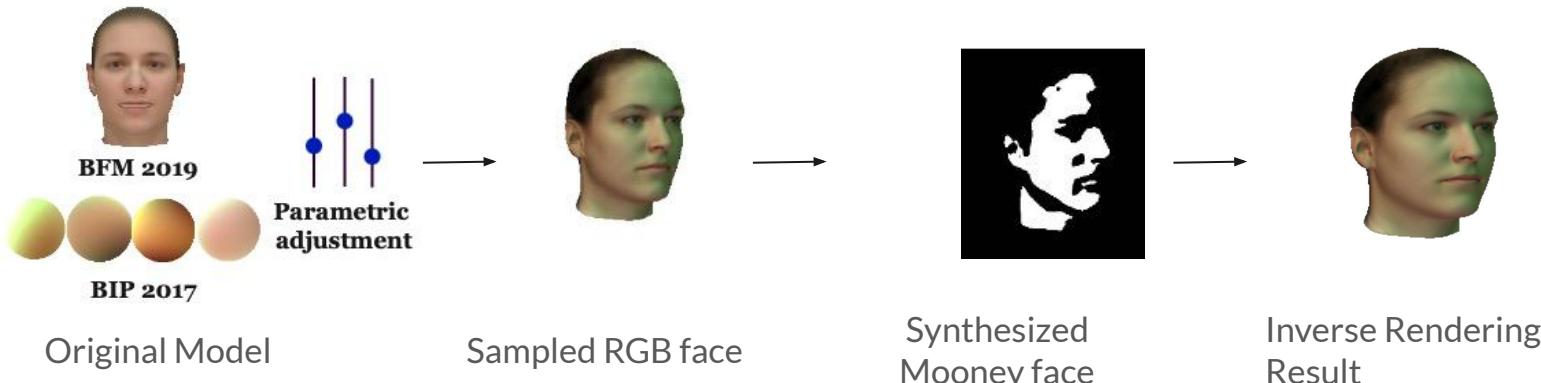
BFM - Basel Face Model: Gerig *et al.* 2018; BIP- Basel Illumination Prior: Egger, Schönborn, Schneider, A. *et al.*

Pipeline: Sampling a new face



Blanz and Vetter 199

Pipeline



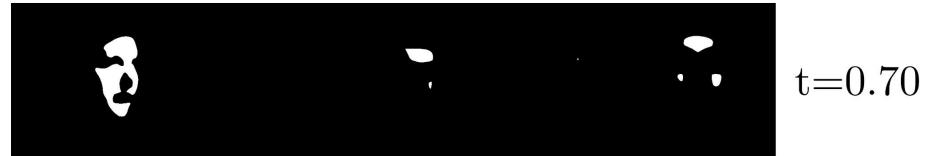
BFM - Basel Face Model: Gerig *et al.* 2018; BIP- Basel Illumination Prior: Egger, Schönborn, Schneider, A. *et al.*

The need for a new way to generate Mooney faces

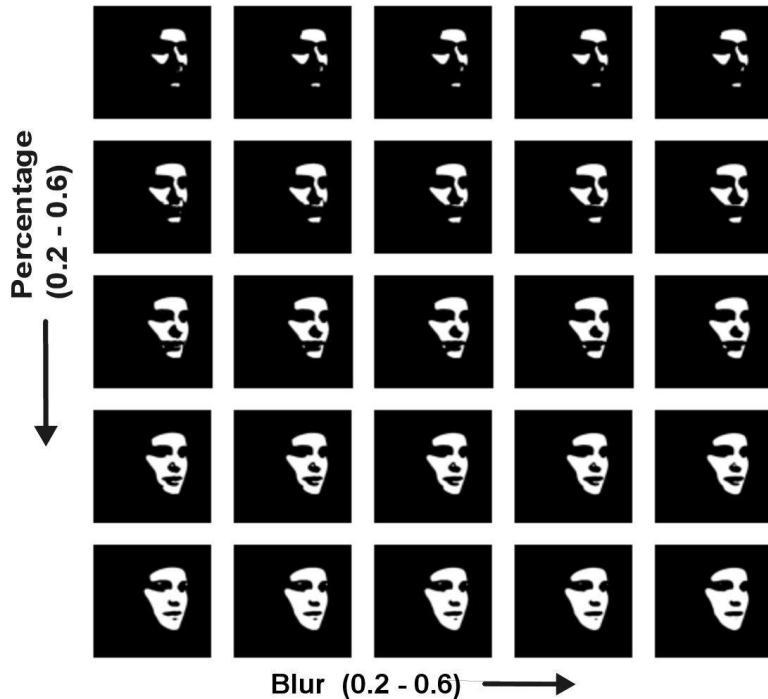
Blur



Threshold



A new way of generating Mooney faces

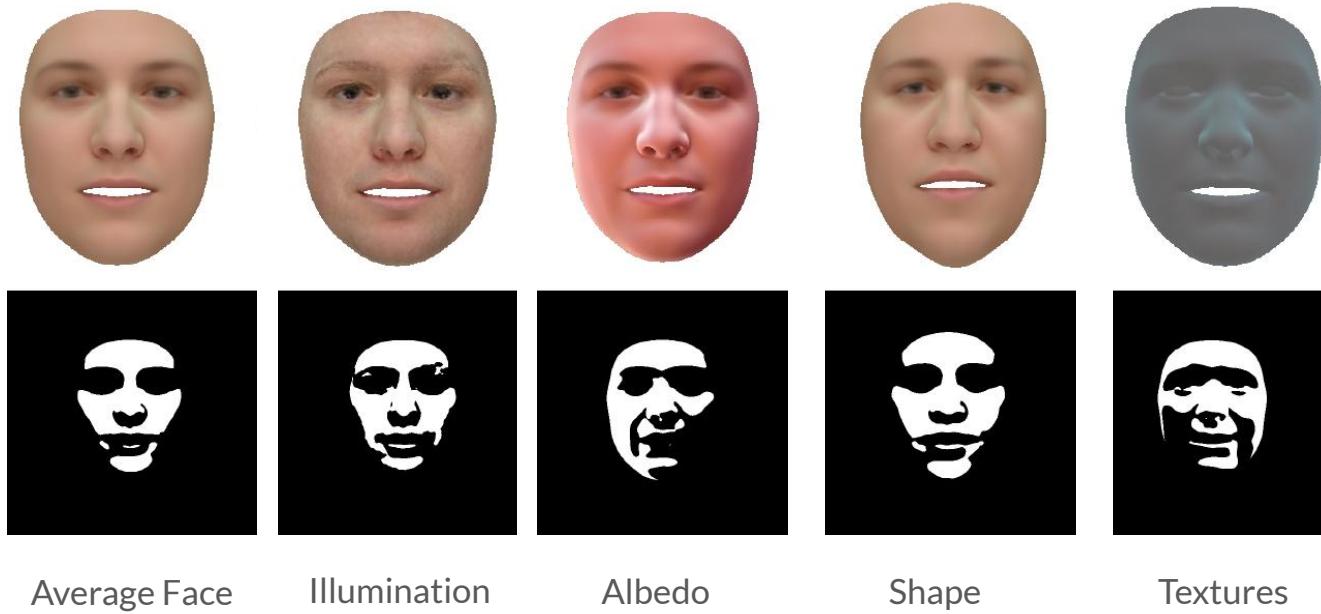


$$c = N_B^t / N_w^t$$

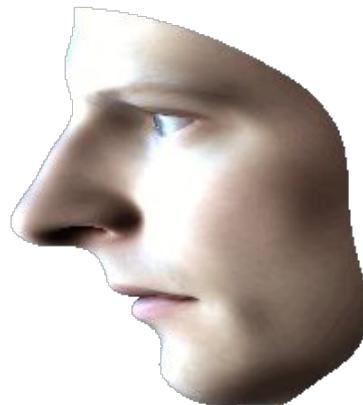
N_B^t - no. of black pixels at threshold t

N_w^t - no. of white pixels at threshold t

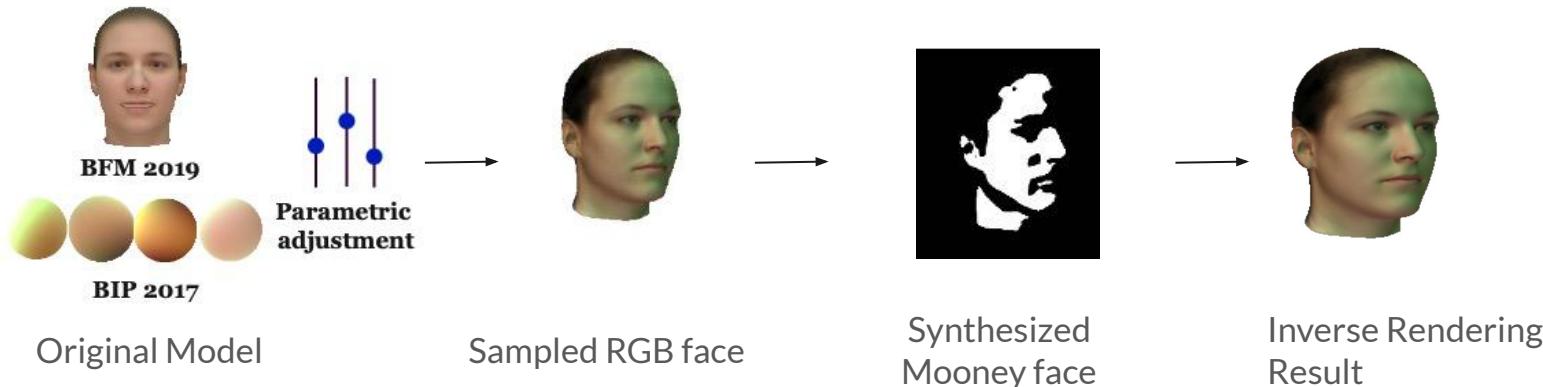
Factors affecting Mooney formation



Mooneys in Motion

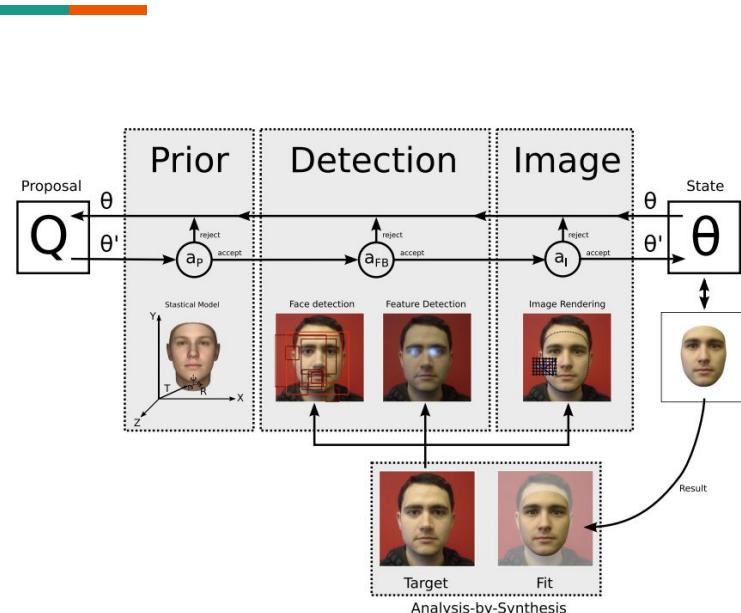


Pipeline



BFM - Basel Face Model: Gerig *et al.* 2018; BIP- Basel Illumination Prior: Egger, Schönborn, Schneider, A. *et al.*

Pipeline: Inverse Rendering, Analysis by Synthesis?



Target



Illumination Only



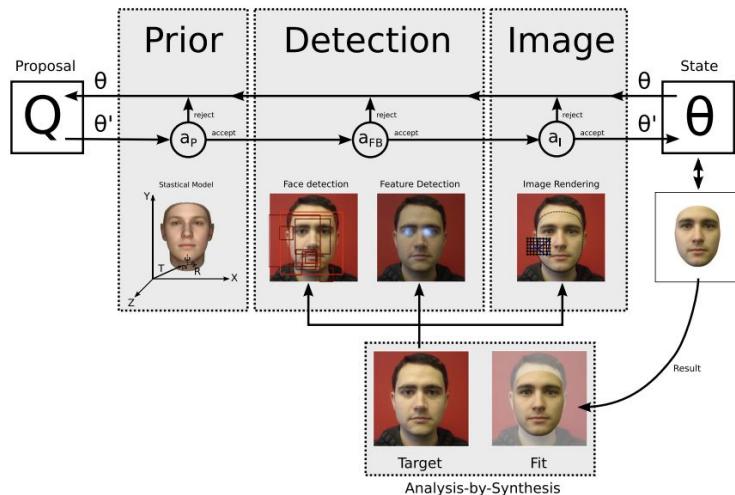
Transform Layer



Gerig, Morel-Forster, Blumer., Egger., Luthi., Schönborn., & Vetter 2018

Pipeline: Inverse Rendering, Analysis by Synthesis?

—



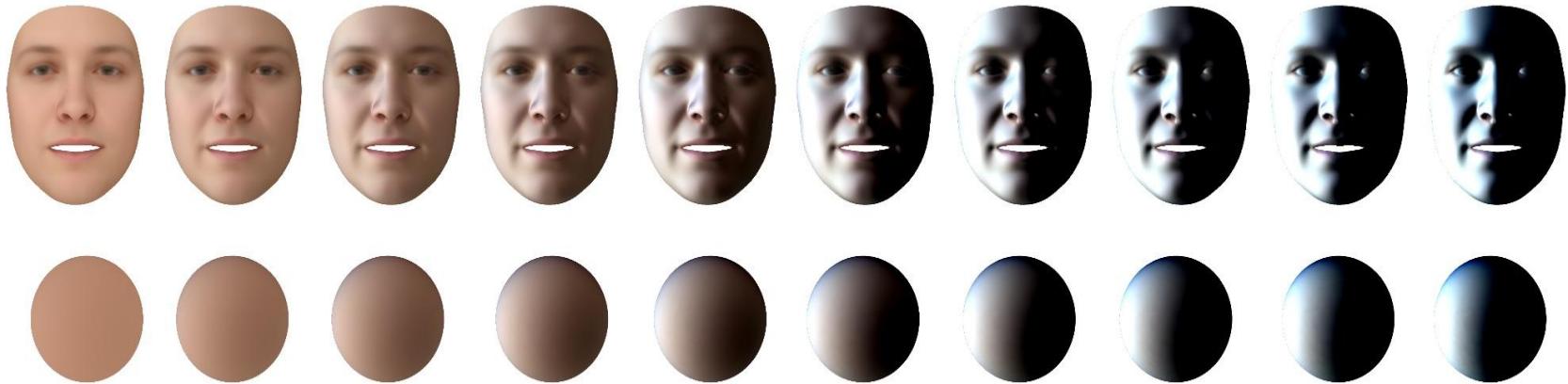
Target



Illumination Only

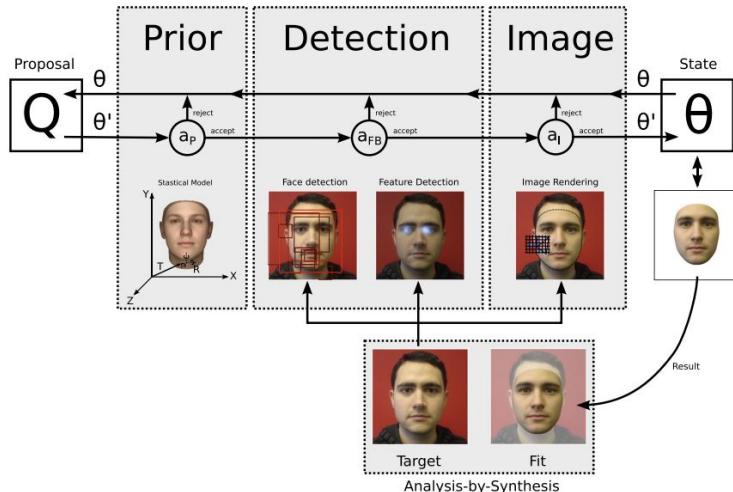
Gerig, Morel-Forster, Blumer., Egger., Luthi., Schönborn., & Vetter 2018

Interpretation via extreme illumination



Gerig., Morel-Forster, Blumer., Egger., Luthi., Schönborn., & Vetter 2018

Pipeline: Inverse Rendering, Analysis by Synthesis?



Transform Layer

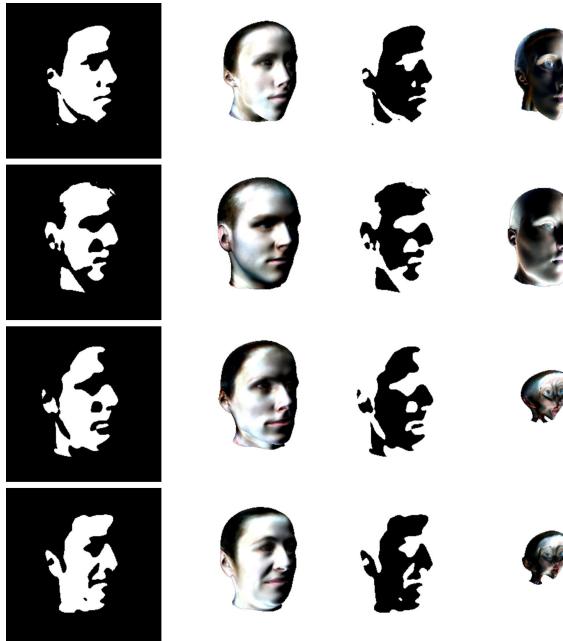
Additional layer during MCMC sampling, pixel wise log-likelihood

Gerig, Morel-Forster, Blumer, Egger, Luthi, Schönborn, & Vetter 2018

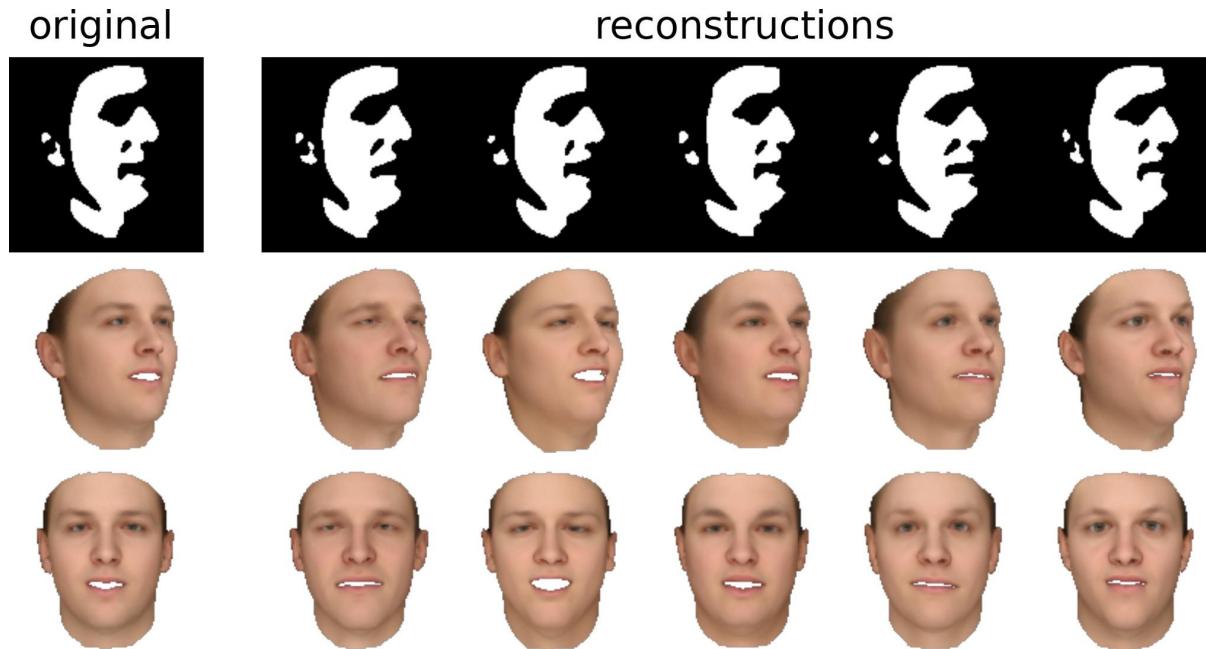
Analysis By Synthesis



Contrast inversion? How does it affect perception?



Reconstruction is ill-posed



Conclusion

- Mooney faces help to understand human perception
- They can be interpreted easily via extreme illumination
- Our contributions
 - We developed a new way to generate mooney faces
 - We demonstrate our hypothesis by showing that Mooney faces can be approximately explained with an inverse graphics model when we allow for strong illumination extrapolation



Thank You