Real-time Performance-Based Facial Animation

Mark Pauly

Introduction
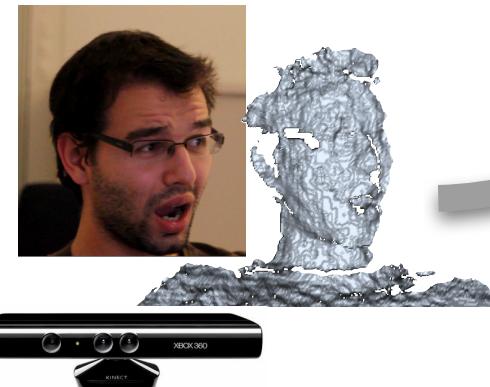
Overview

Facial Tracking using Blendshape Model

- rigid transformation + blendshape weights per frame

Personalized Blendshape Model

- static face capture
- example based facial rigging

Tracking

- rigid & nonrigid registration
- **animation prior**

# Animation Pipeline
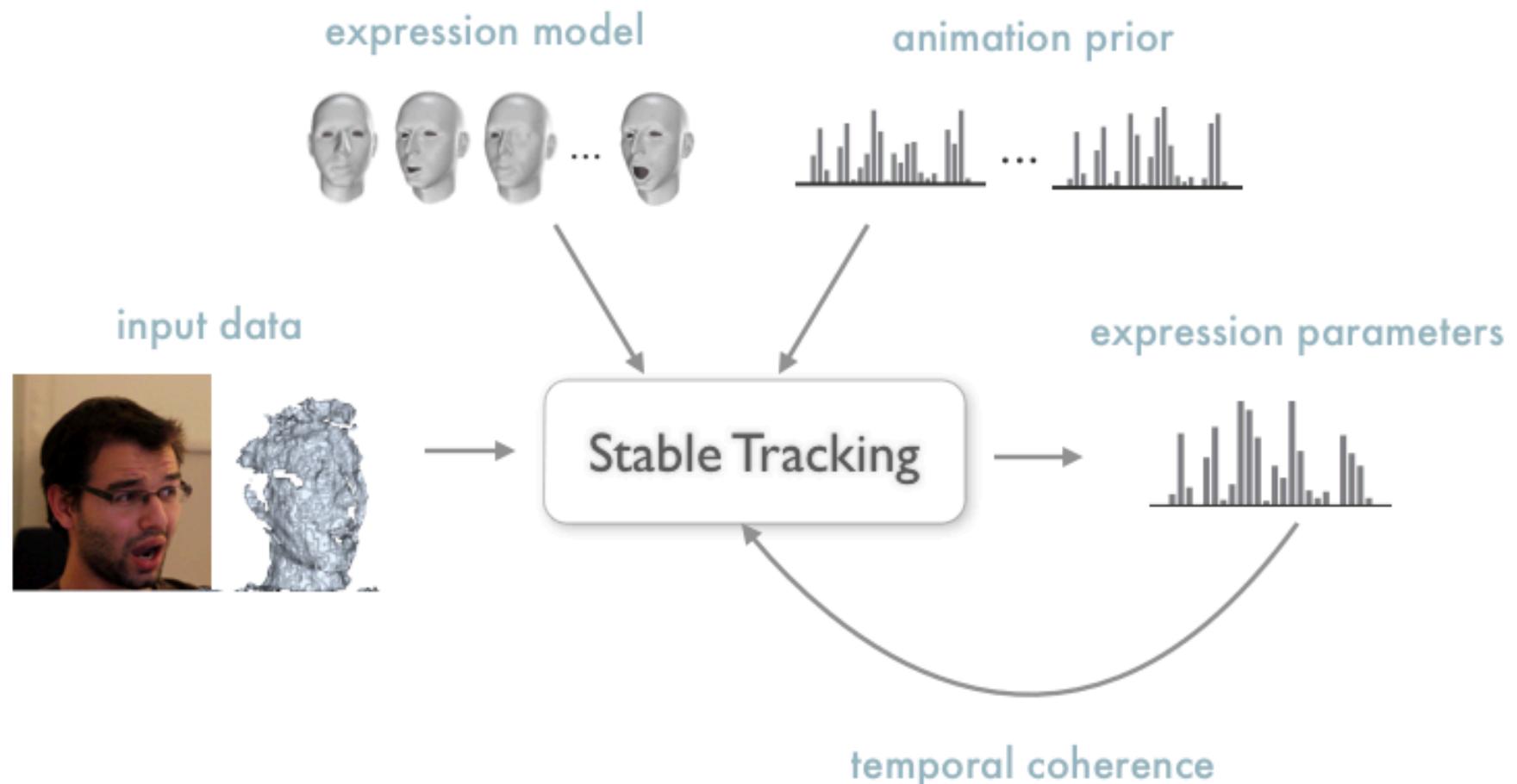
Facial Expression Model

Static Face Capture
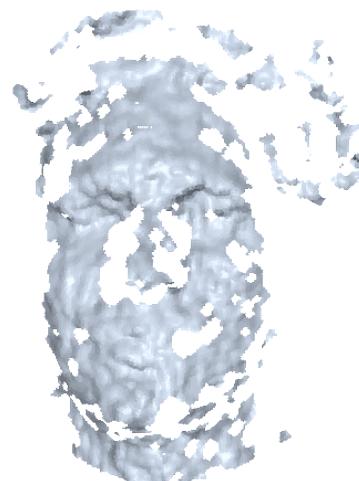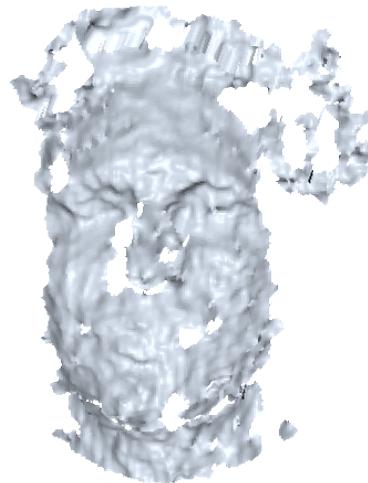
[Weise et al, 2009]

# Facial Expression Model

Face Fitting
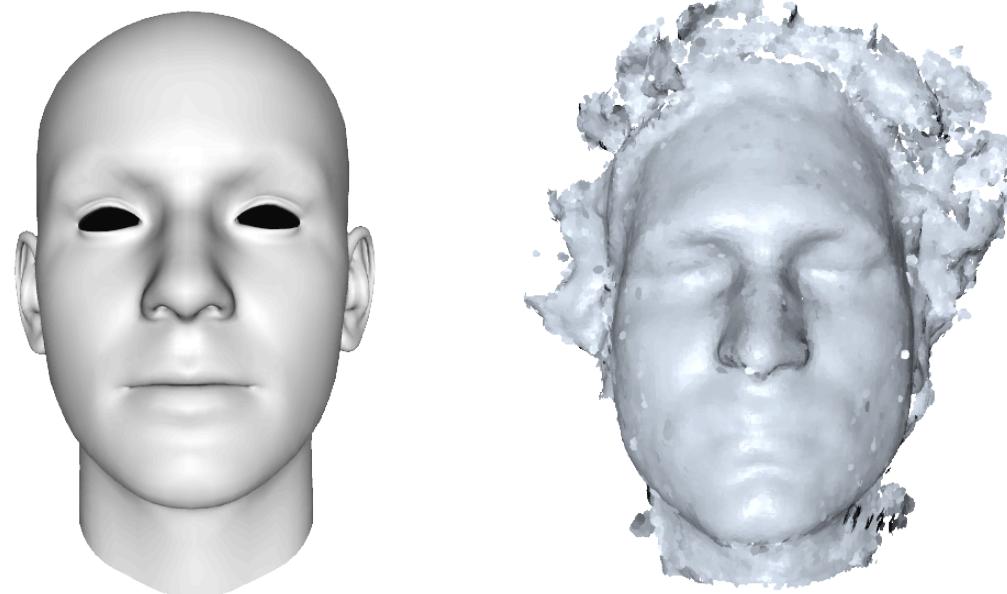
[Li et al, 2009]

# Facial Expression Model

Texture Reconstruction
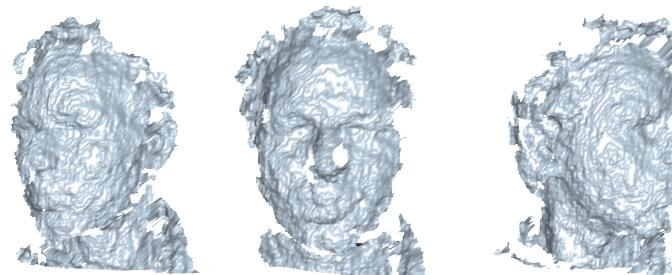
Poisson Image Editing
[Pérez et al, 2003]

Facial Expression Model

Example-based Facial Rigging
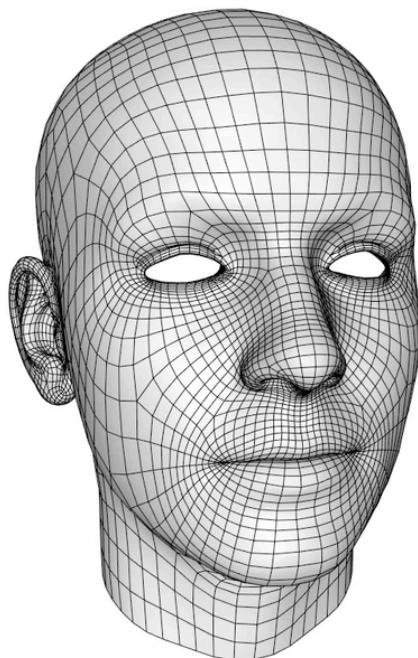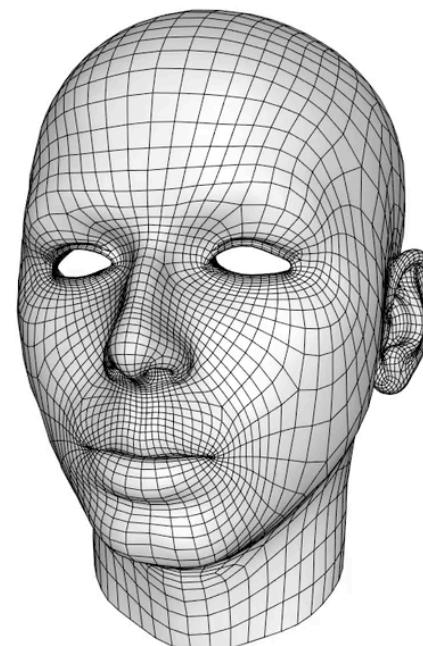
generic template   personalized expression model

[Li et al, 2010]

Rigid Tracking

Stable rigid head tracking

front

side

Non-rigid Tracking

Estimate blendshape weights

- similar to scans & color image
- plausible animation

MAP estimation

- non-rigid registration based on geometry & texture
- animation prior from existing animation sequences

N-Dim Expression Space
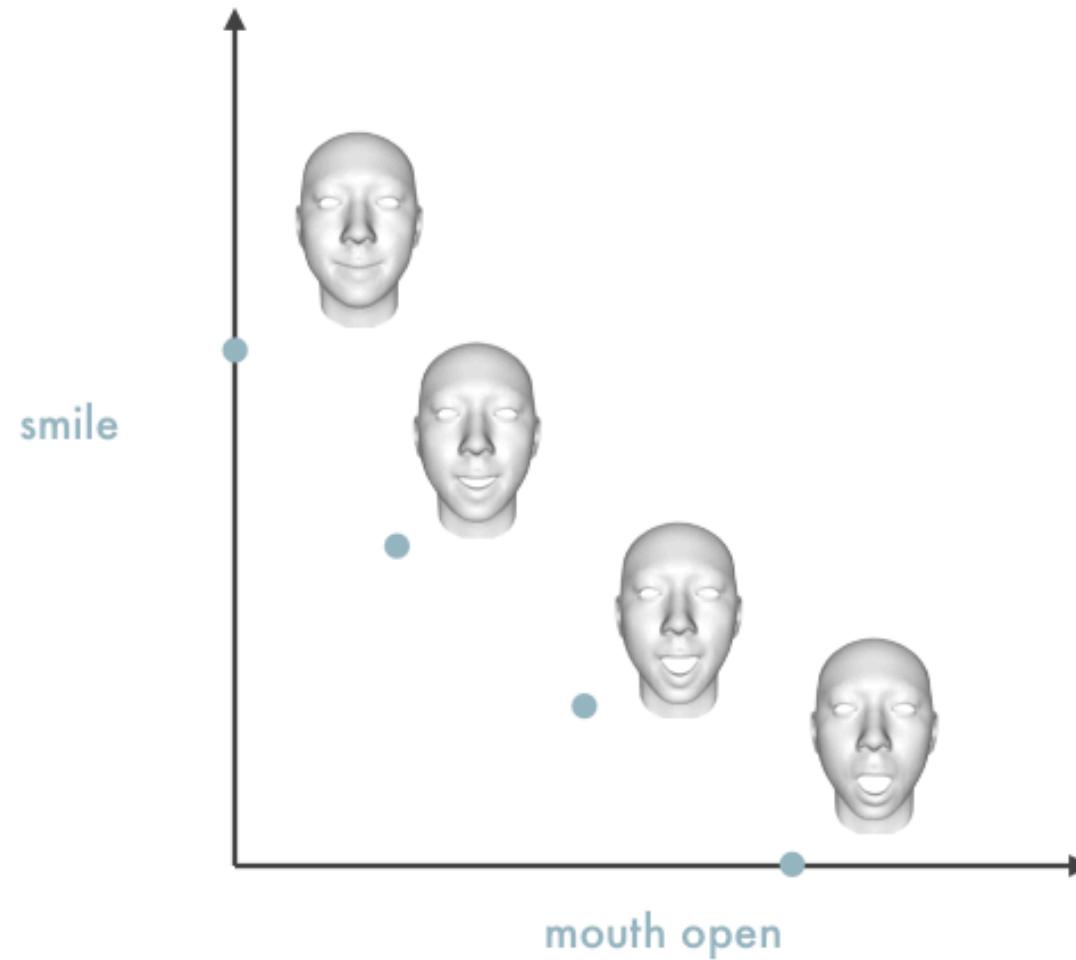
N-Dim Expression Space
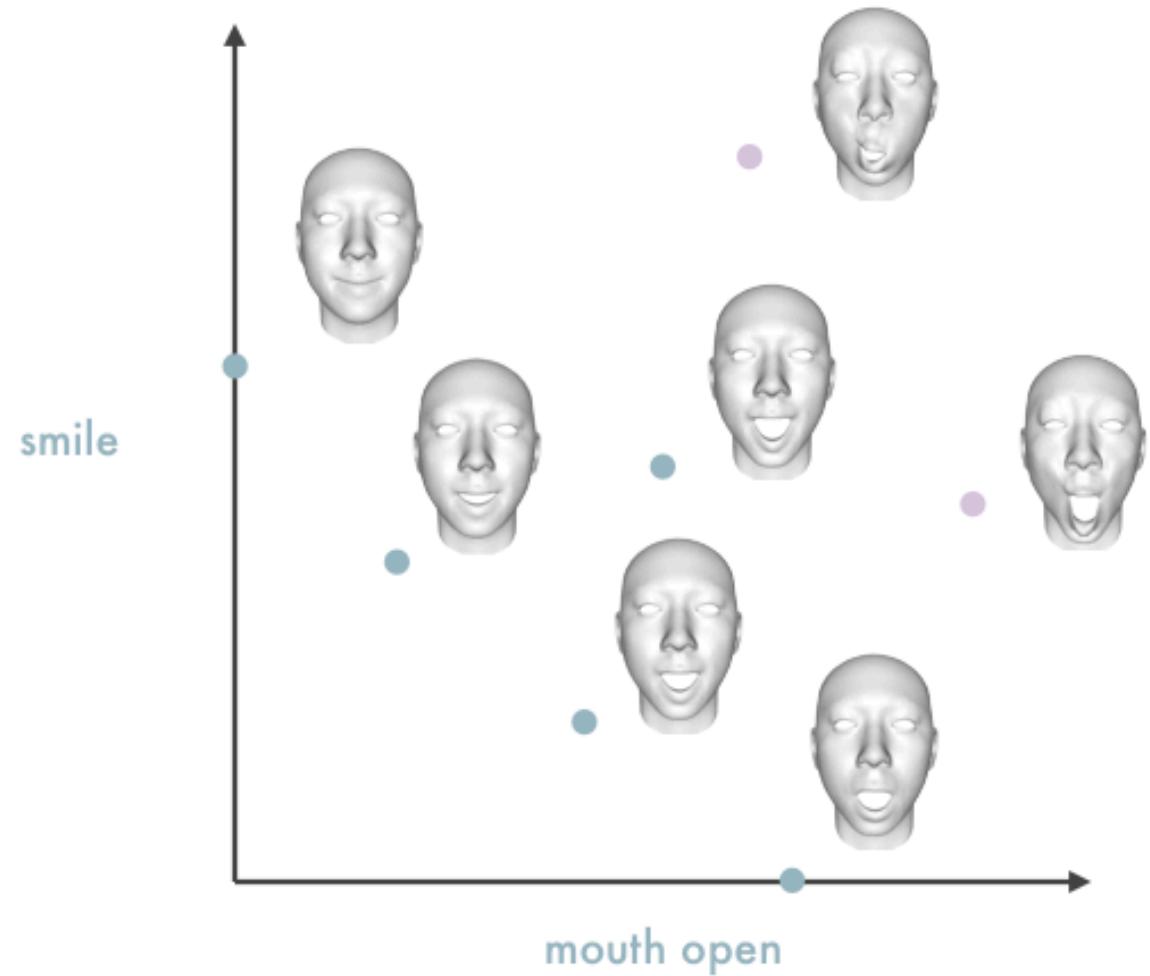
N-Dim Expression Space
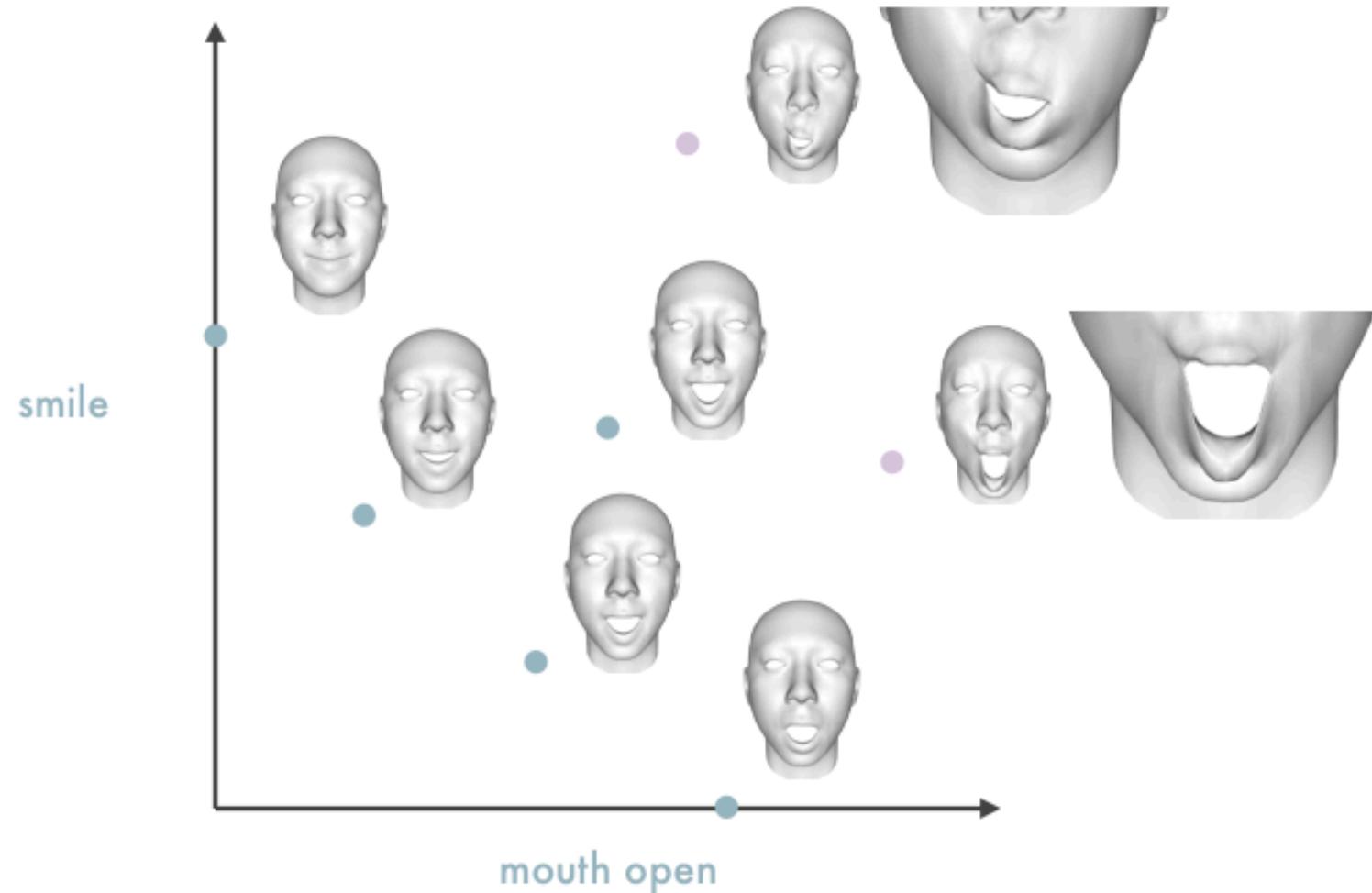
Animation Manifold
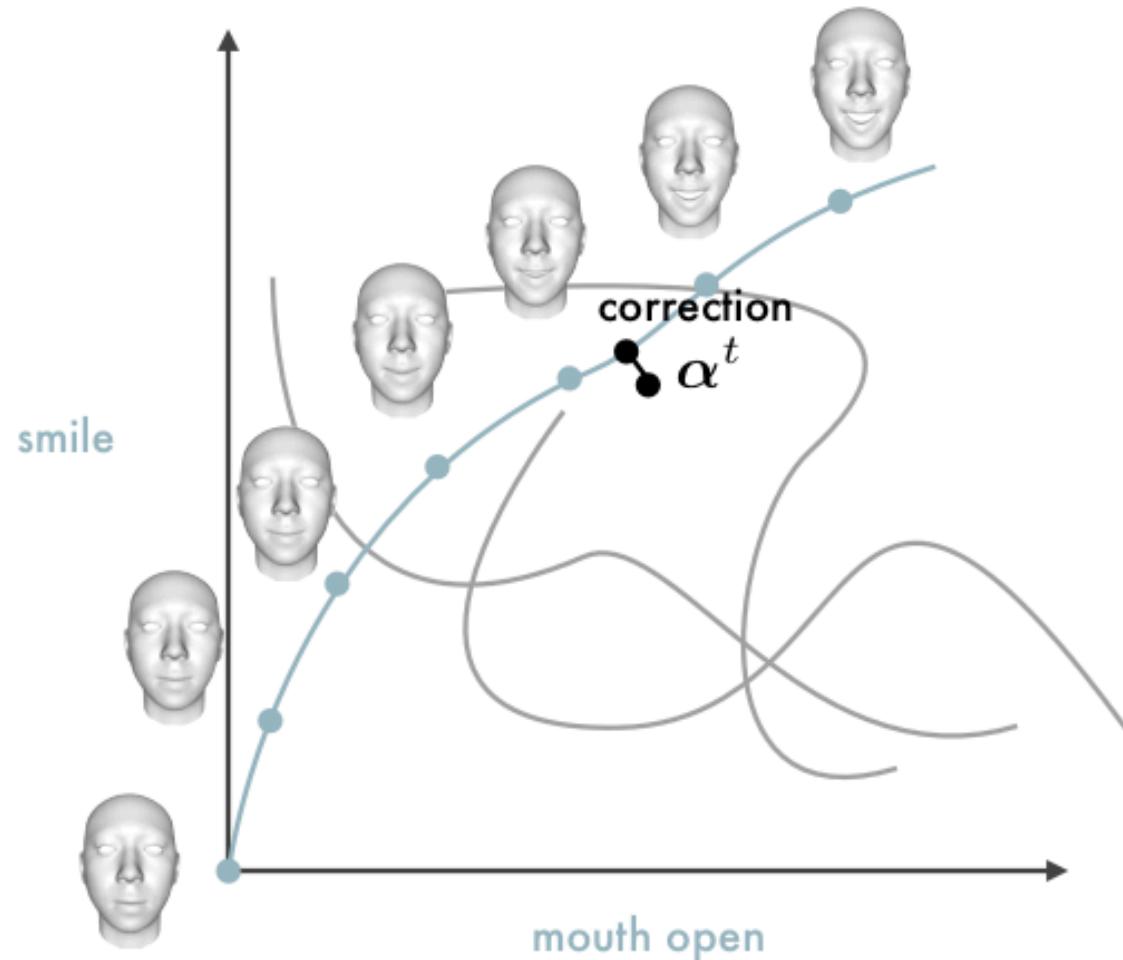
Probabilistic Expression Prior
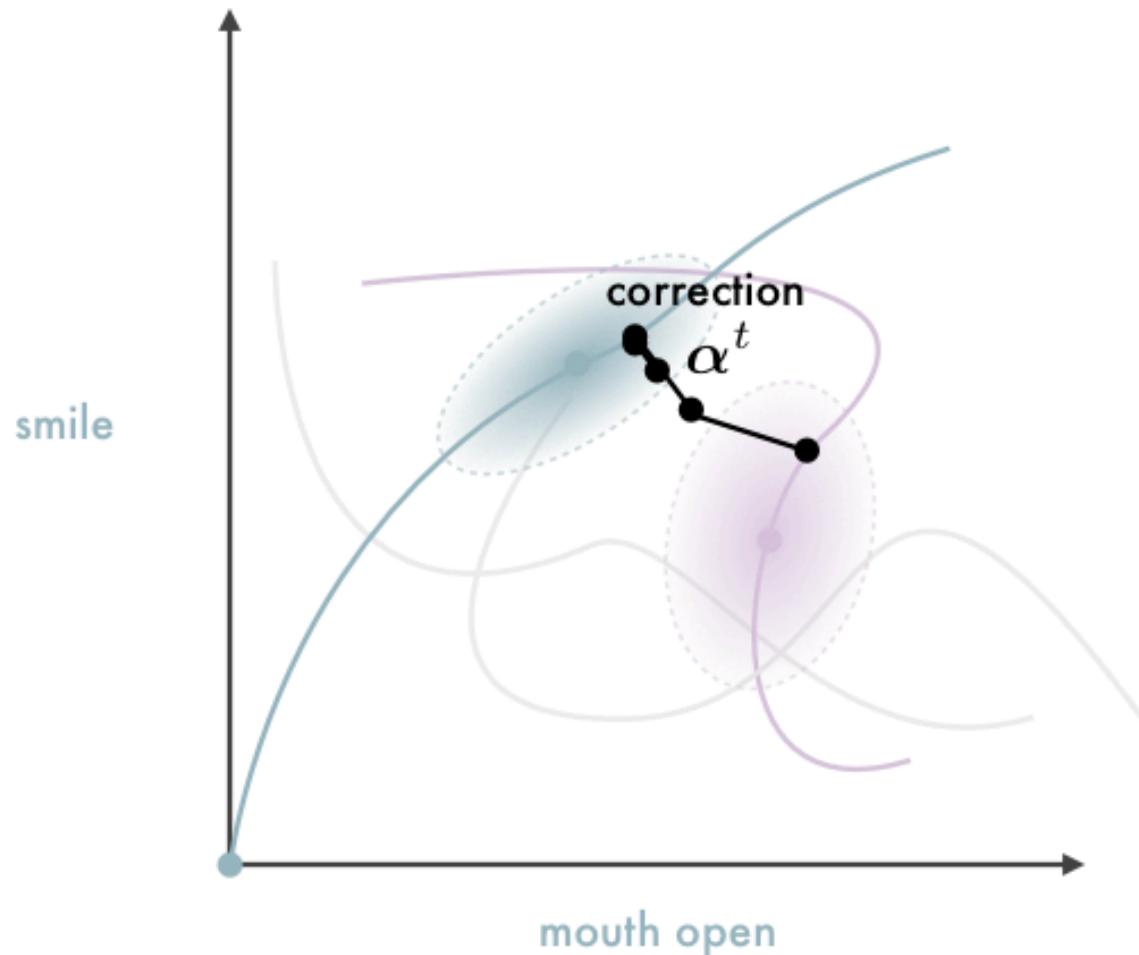
Probabilistic Animation Prior
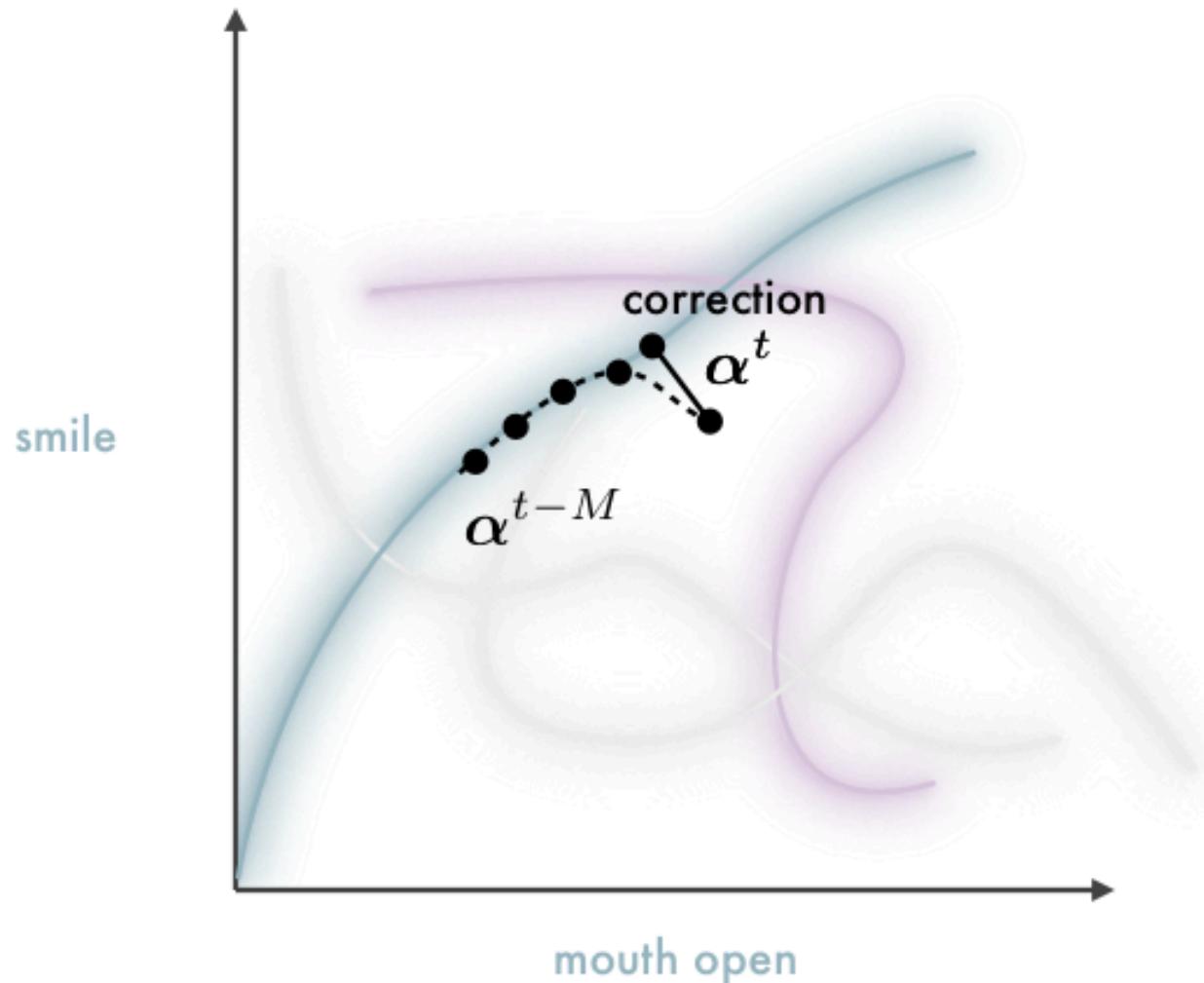
Temporal Joint Probabilistic Distribution
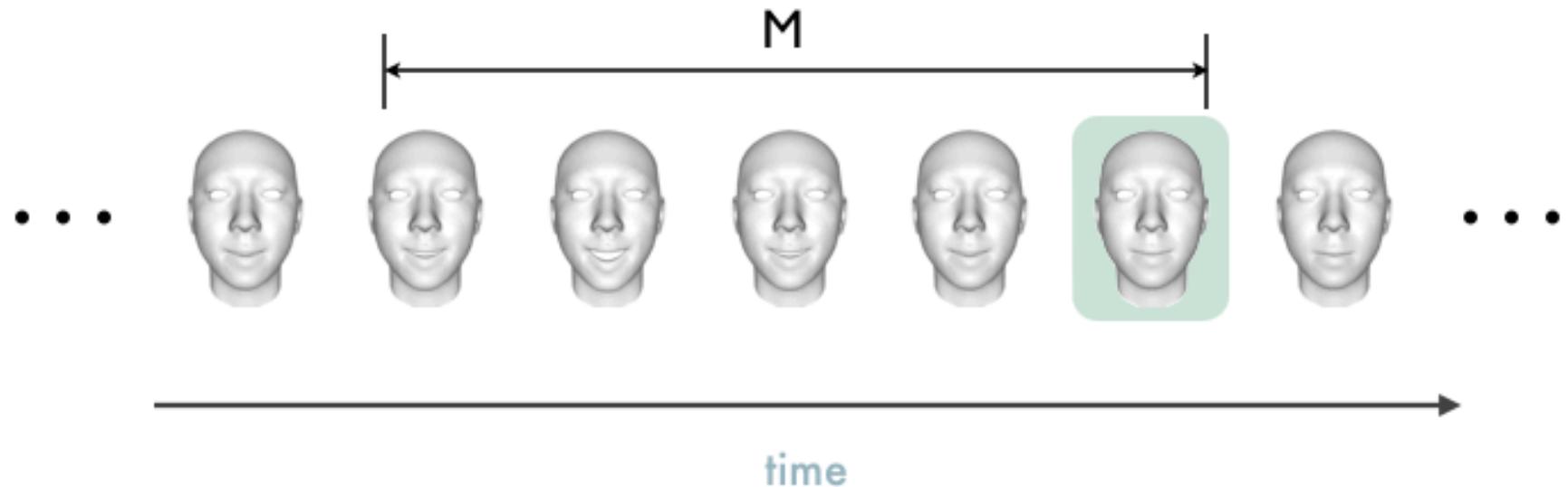
$$p(\boldsymbol{\alpha}^t, .., \boldsymbol{\alpha}^{t-M}) = \sum_{k=1}^{K} \pi_k \mathcal{N}(\boldsymbol{\alpha}^t, .., \boldsymbol{\alpha}^{t-M} | \boldsymbol{\mu}_k, C_k C_k^T + \sigma_k^2 I).$$

MPPCA model   weights   mean   principal components   Gaussian noise

MAP Estimation

$$\boldsymbol{\alpha}^t = \arg\max_{\boldsymbol{\alpha}} p(\boldsymbol{\alpha}|D, \boldsymbol{\alpha}^{t-1}, .., \boldsymbol{\alpha}^{t-M})$$

MPPCA

$$\approx \arg\max_{\boldsymbol{\alpha}} \underbrace{p(D|\boldsymbol{\alpha})}_{\text{likelihood}} \underbrace{p(\boldsymbol{\alpha}, \boldsymbol{\alpha}^{t-1}, .., \boldsymbol{\alpha}^{t-M})}_{\text{prior}}$$

geometry
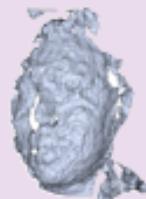
$$p(G|\mathbf{x}) = \prod_{i=1}^{V} k_{geo} \exp\left(-\frac{\|\mathbf{n}_i^T(\mathbf{v}_i - \mathbf{v}_i^*)\|^2}{2\sigma_{\text{geo}}^2}\right)$$

texture

$$p(I|\mathbf{x}) = \prod_{i=1}^{V} k_{im} \exp\left(-\frac{\|\nabla I_i^T(\mathbf{p}_i - \mathbf{p}_i^*)\|^2}{2\sigma_{\text{im}}^2}\right)$$

Demo

www.faceshift.com