Real-time Performance-Based Facial Animation

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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

expression model

animation prior

input data

Stable Tracking

temporal coherence

expression parameters
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

smile

mouth open
N-Dim Expression Space
N-Dim Expression Space

smile

mouth open
Animation Manifold

- smile
- mouth open
Probabilistic Expression Prior
Probabilistic Animation Prior

smile

mouth open

correction

$\alpha^t$

$\alpha^{t-M}$
Temporal Joint Probabilistic Distribution

\[ p(\alpha_t^t, \ldots, \alpha_t^{t-M}) = \sum_{k=1}^{K} \pi_k N(\alpha_t^t, \ldots, \alpha_t^{t-M} | \mu_k, C_k C_k^T + \sigma_k^2 I). \]

MPPCA model weights mean principal components Gaussian noise
MAP Estimation

\[ \alpha^t = \arg \max_{\alpha} p(\alpha | D, \alpha^{t-1}, \ldots, \alpha^{t-M}) \]

≈ \arg \max_{\alpha} \frac{p(D | \alpha) p(\alpha, \alpha^{t-1}, \ldots, \alpha^{t-M})}{\text{likelihood} \quad \text{prior}}

\[
\begin{align*}
p(G | x) &= \prod_{i=1}^{V} k_{\text{geo}} \exp(-\frac{||n_i^T(v_i - v_i^*)||^2}{2\sigma_{\text{geo}}^2}) \\
p(I | x) &= \prod_{i=1}^{V} k_{\text{im}} \exp(-\frac{||\nabla I_i^T(p_i - p_i^*)||^2}{2\sigma_{\text{im}}^2})
\end{align*}
\]
Demo

www.faceshift.com