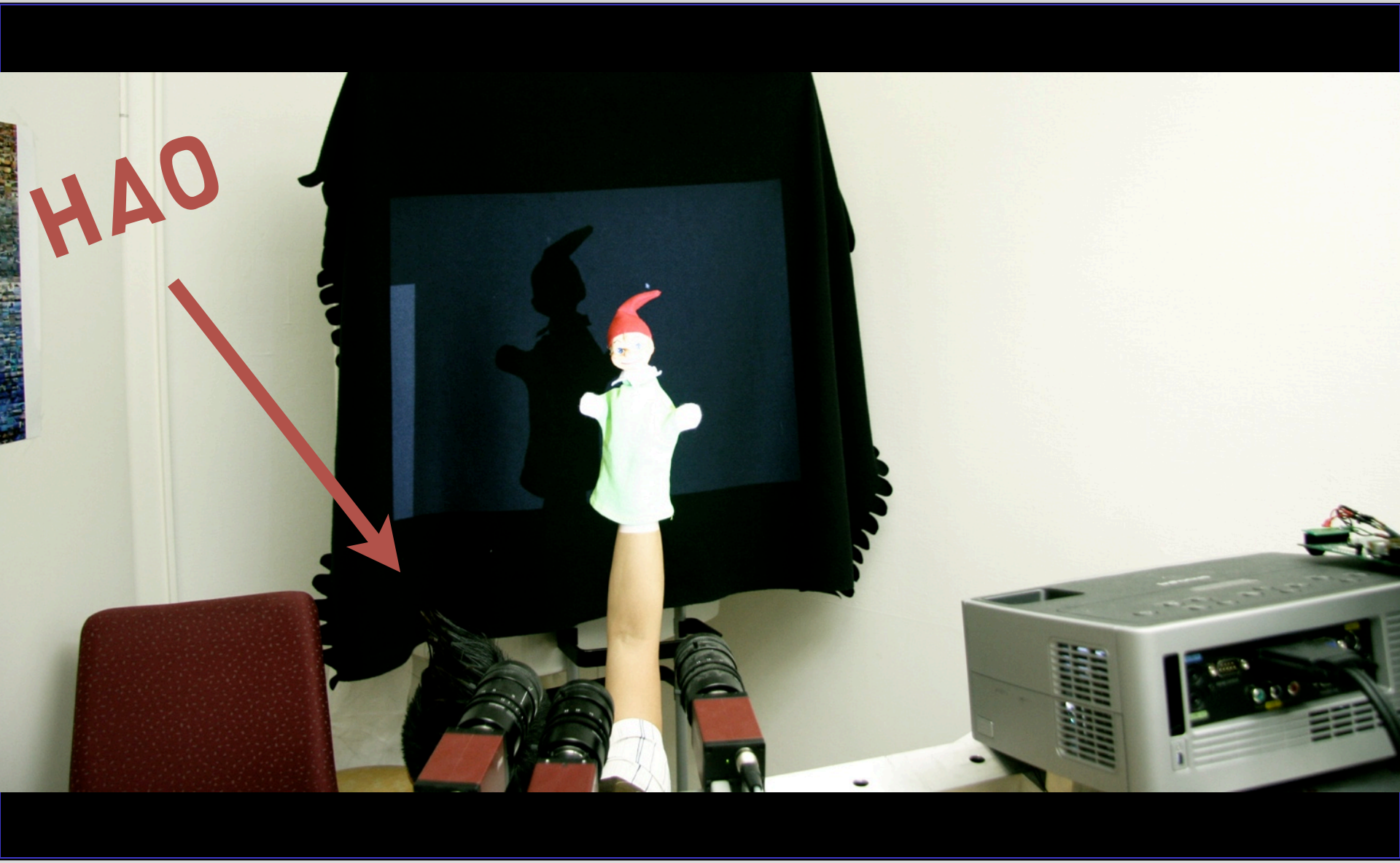
Geometric Registration for Deformable Shapes

4.3 Practical Animation Reconstruction

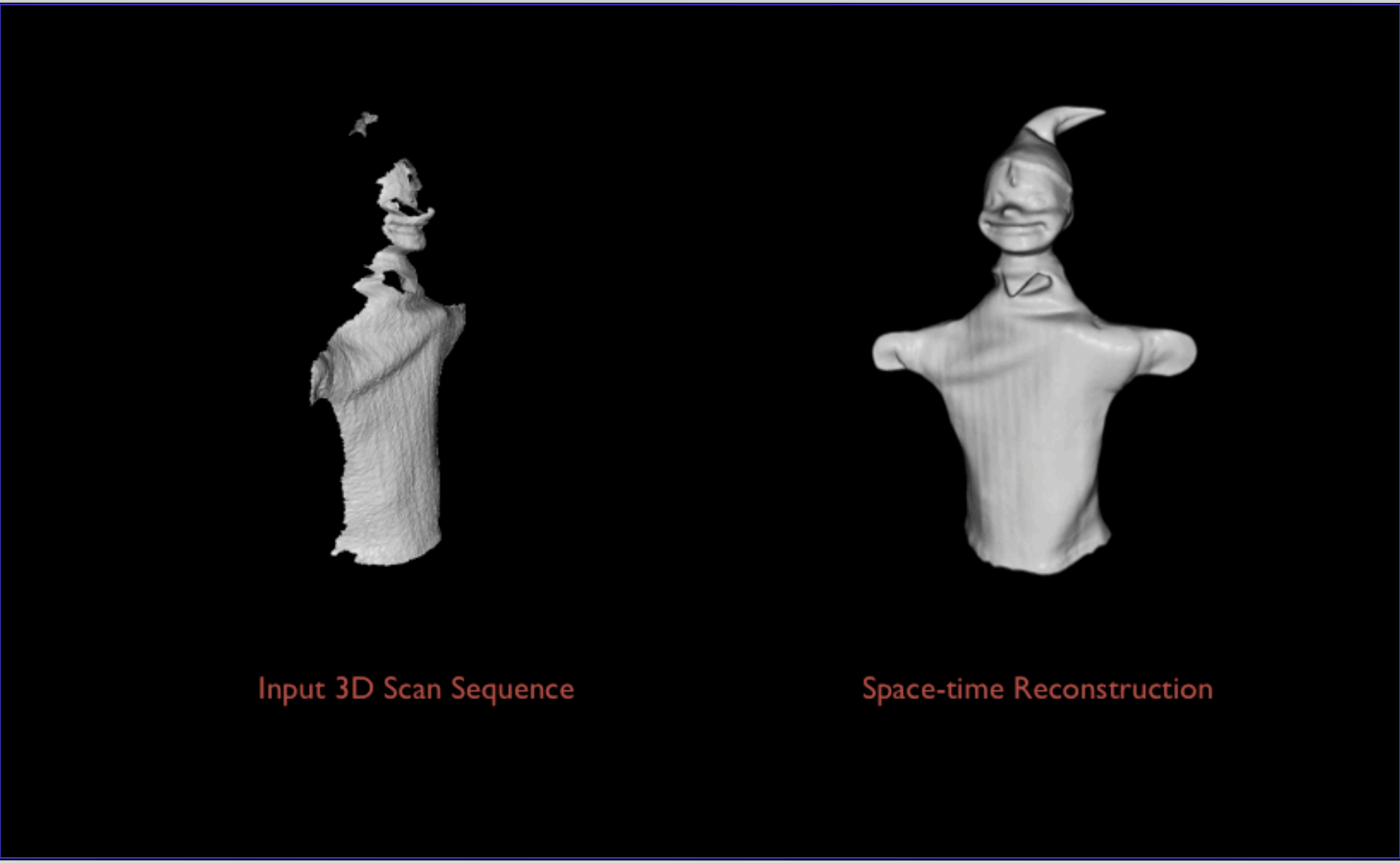
31st Annual Conference of the
European Association for Computer Graphics
eurographics 2010

Digitizing Dynamic Objects

Real-Time 3D Scanner



Geometry and Motion Reconstruction



State of the Art

Industry Standard

3D Scanning

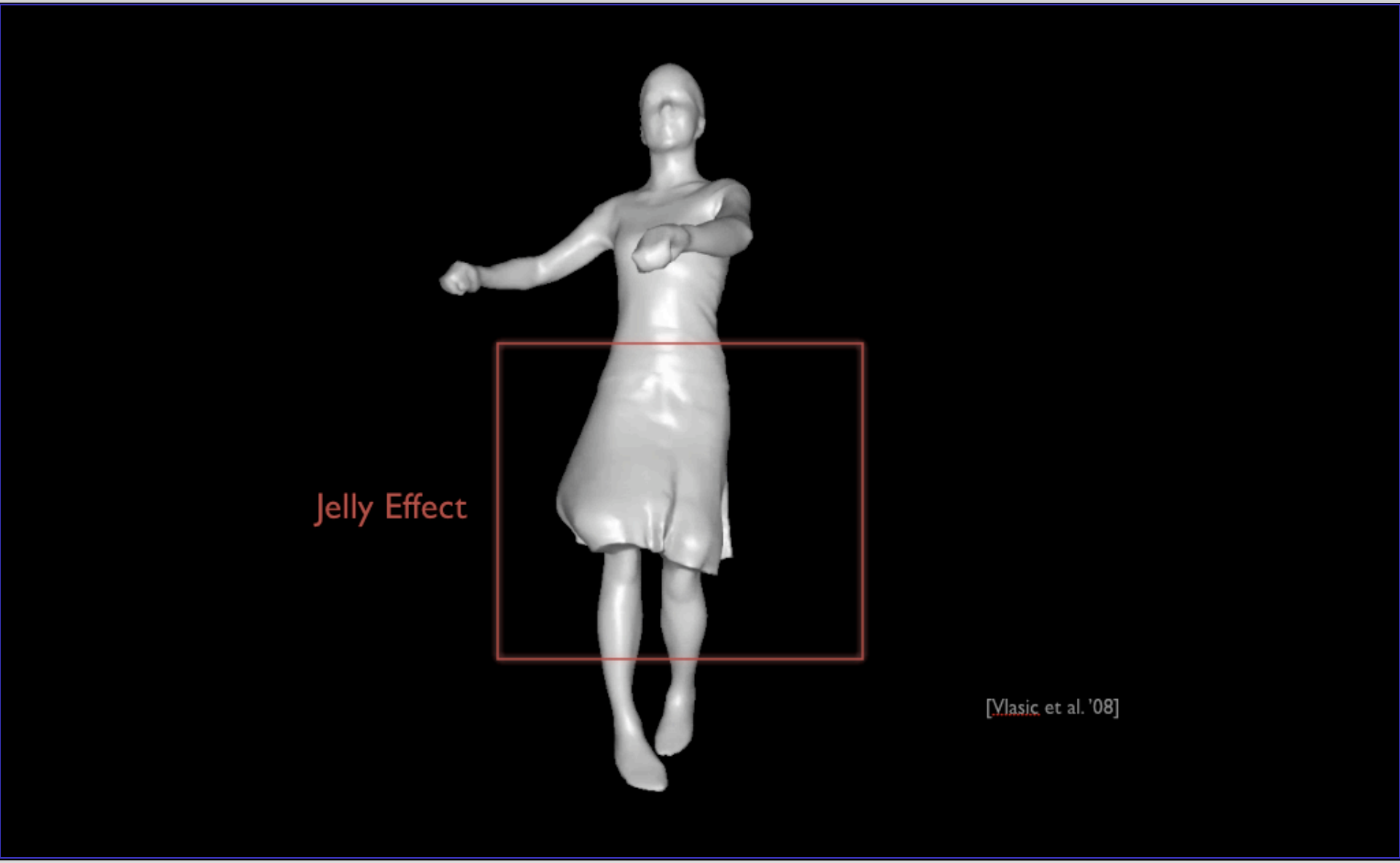
XYZRGB

Motion Capture

[Park & Hodgins '06]

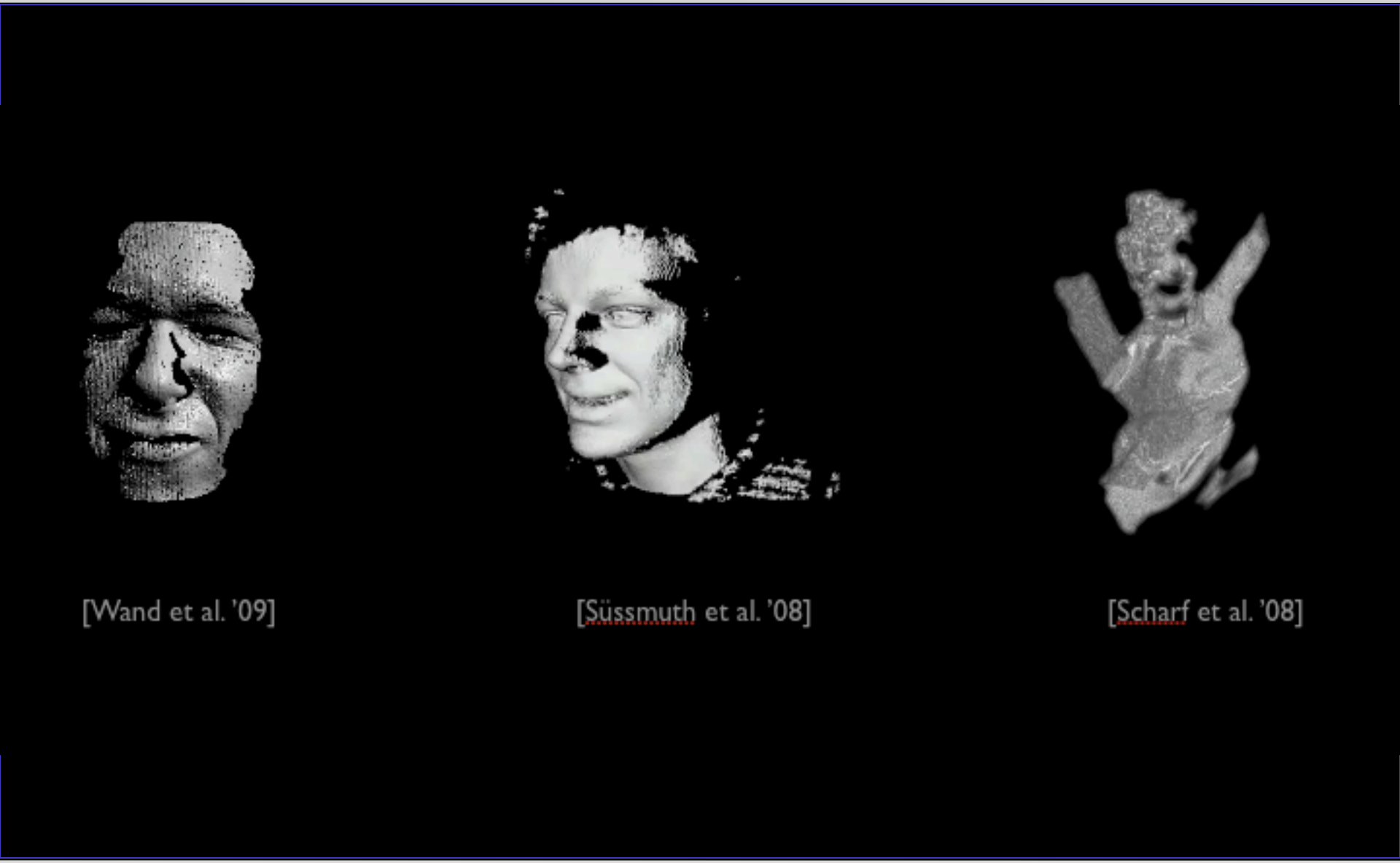
Markerless Performance Capture

Limitations

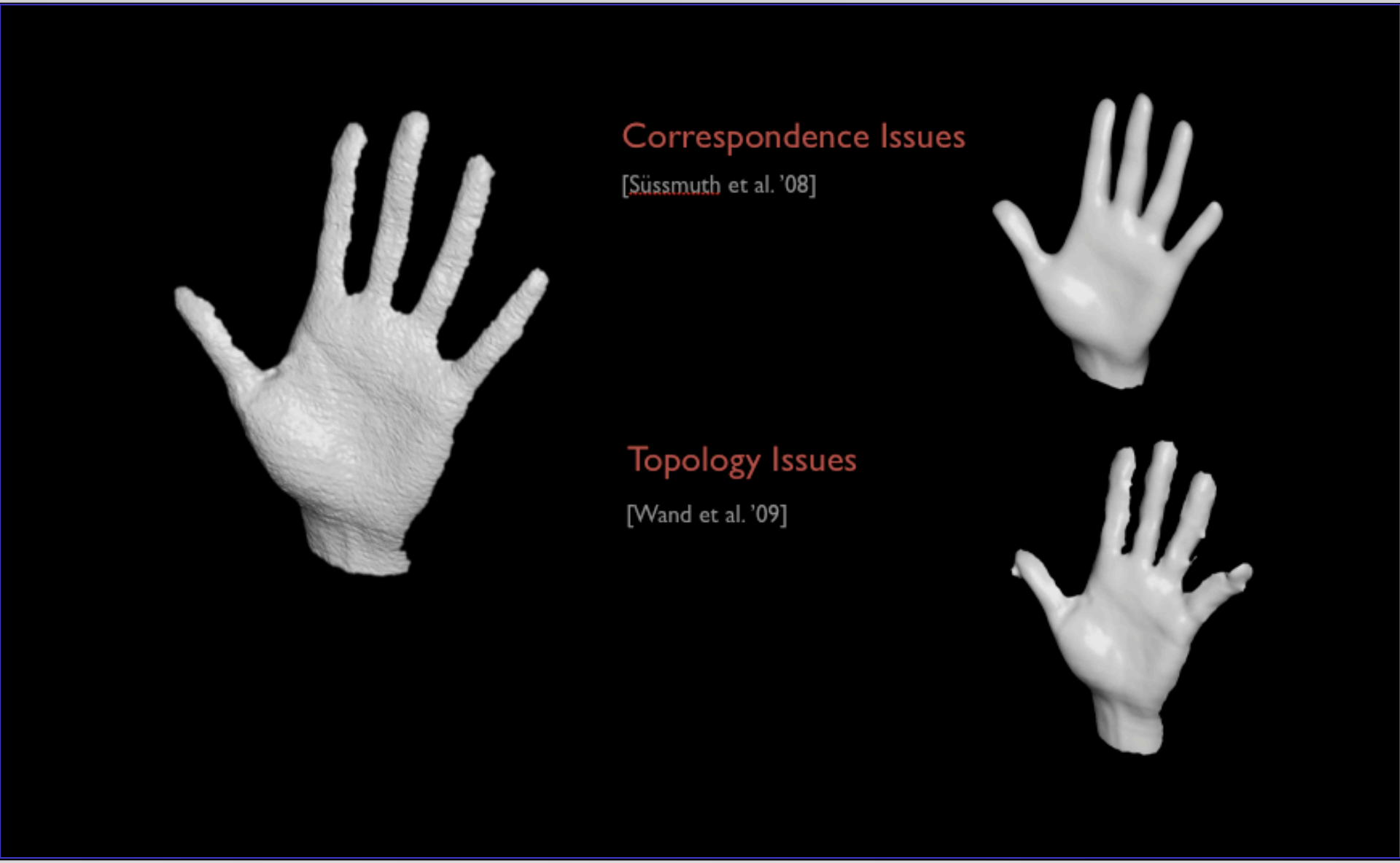


Real-Time 3D Scanner

Dense Space-Time Reconstruction

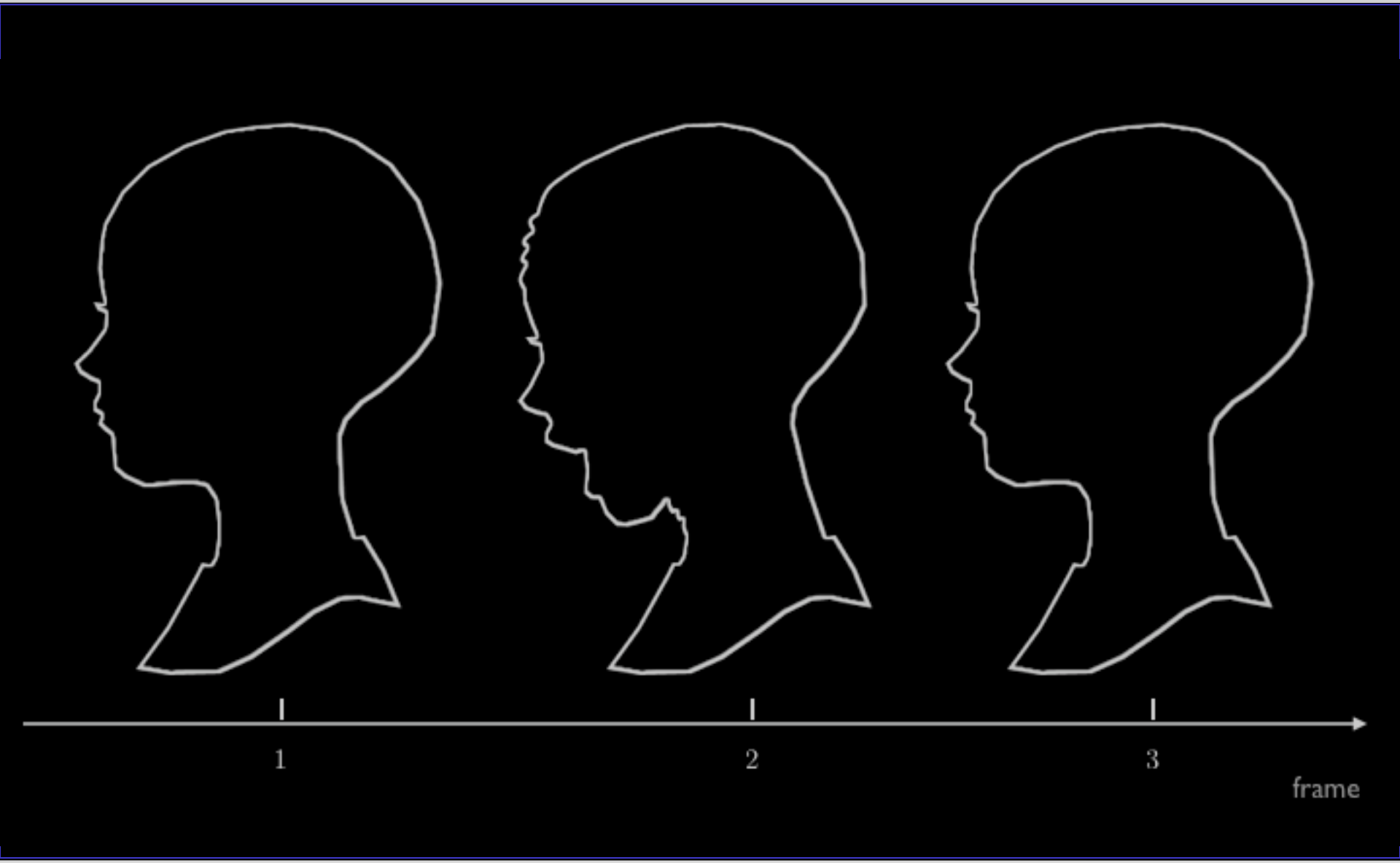


Early Test – 34 Frames

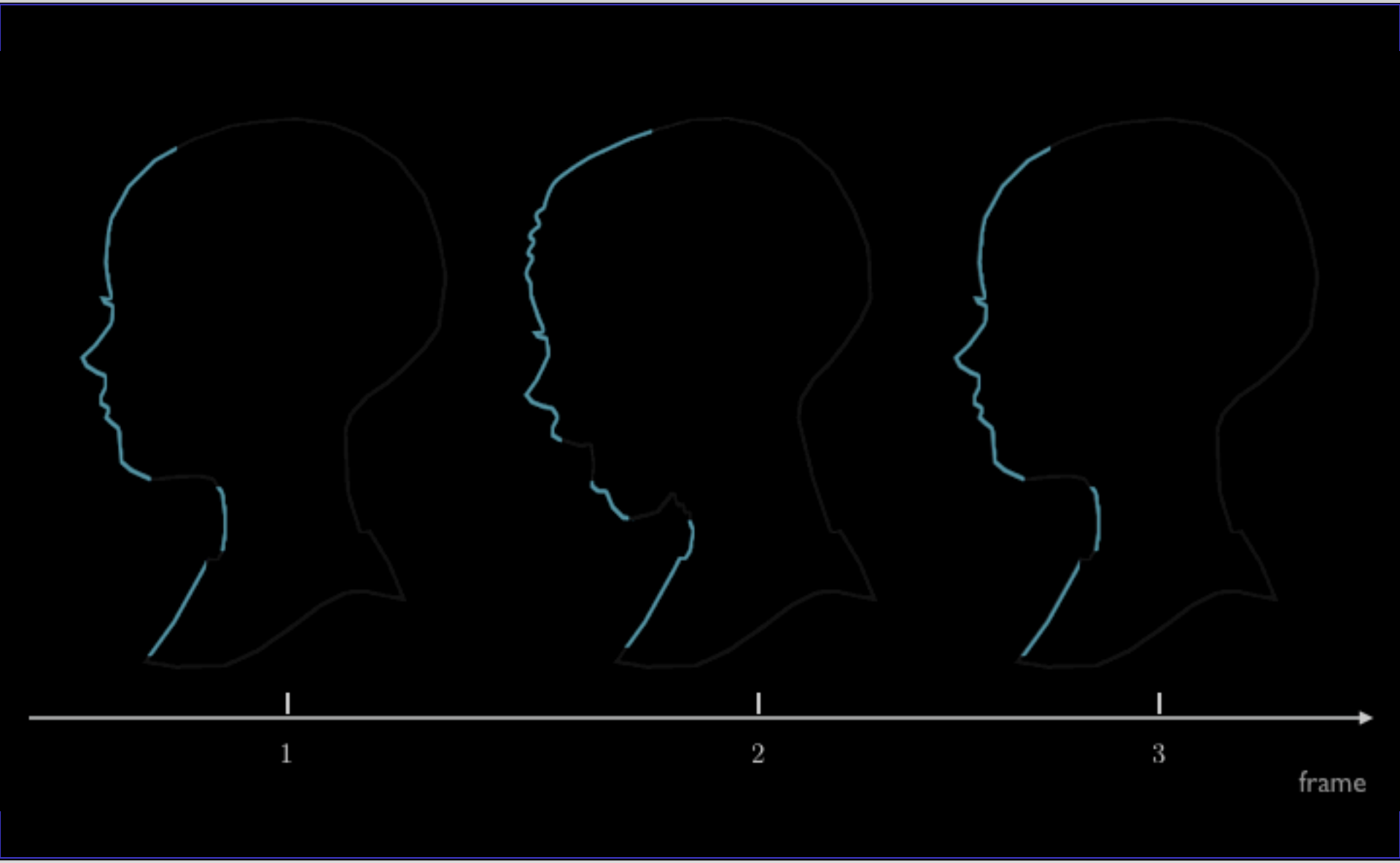


Bi-Resolution Approach

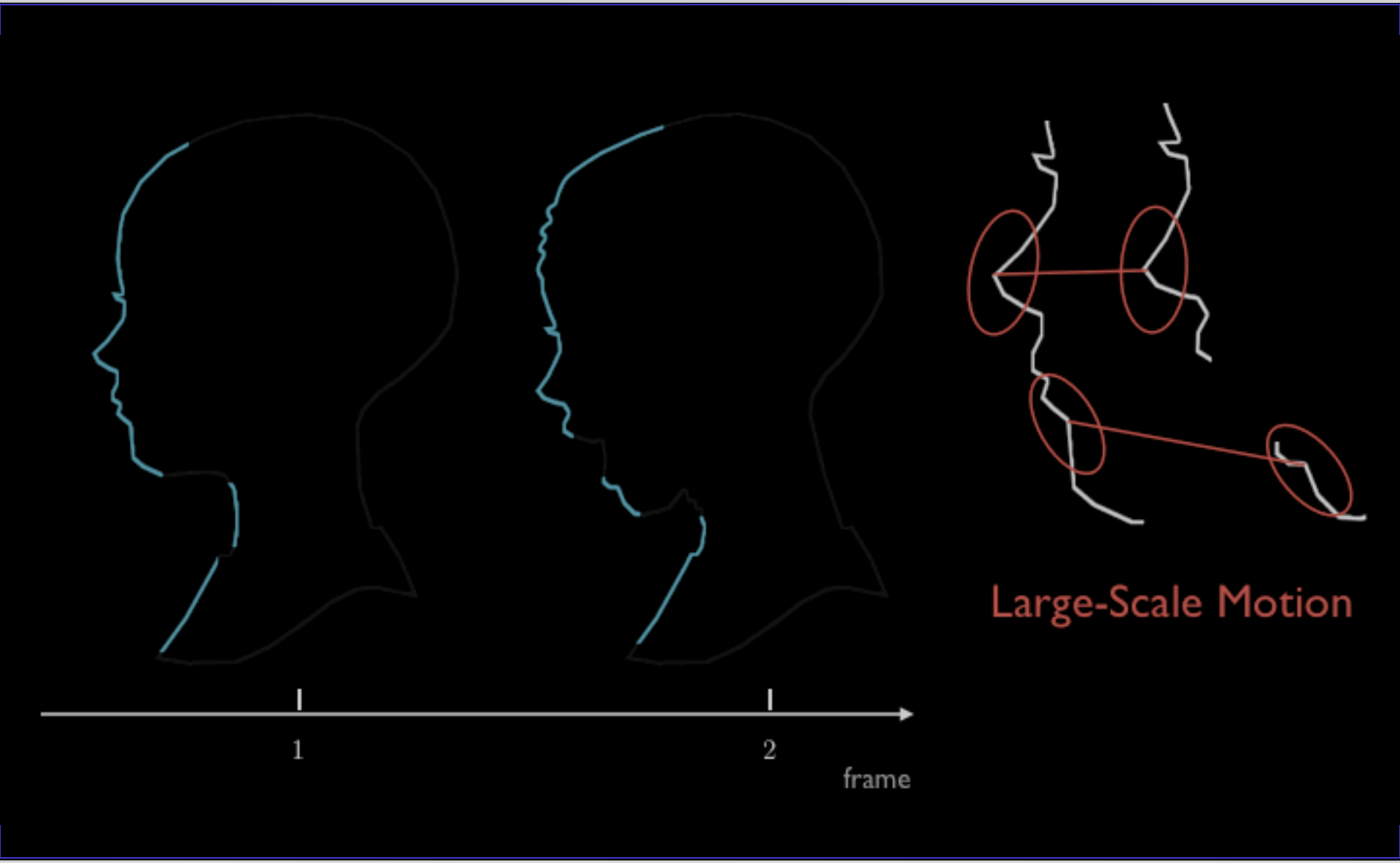
Deforming Subject



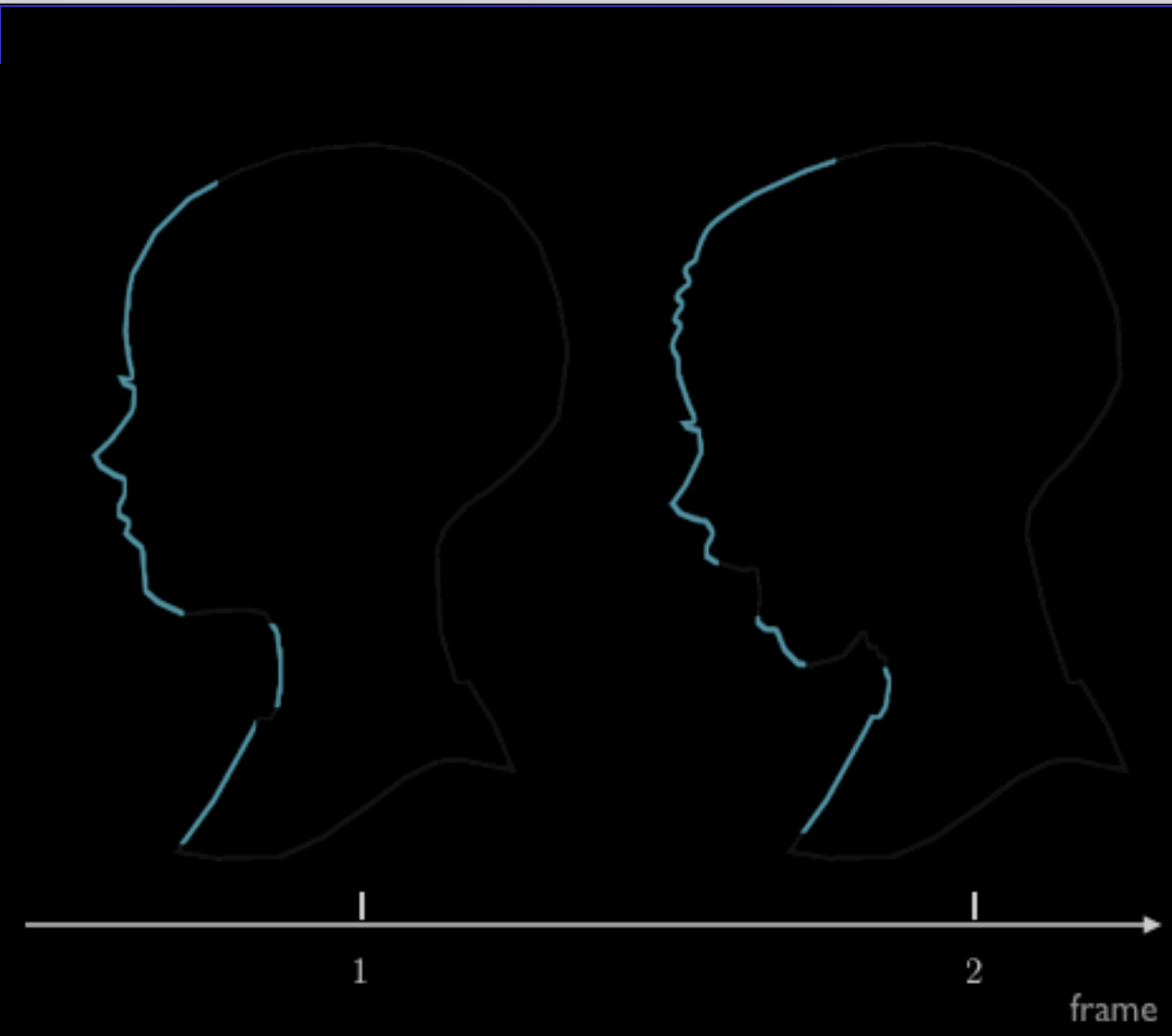
Partial Scans



Partial and Non-Rigid Registration

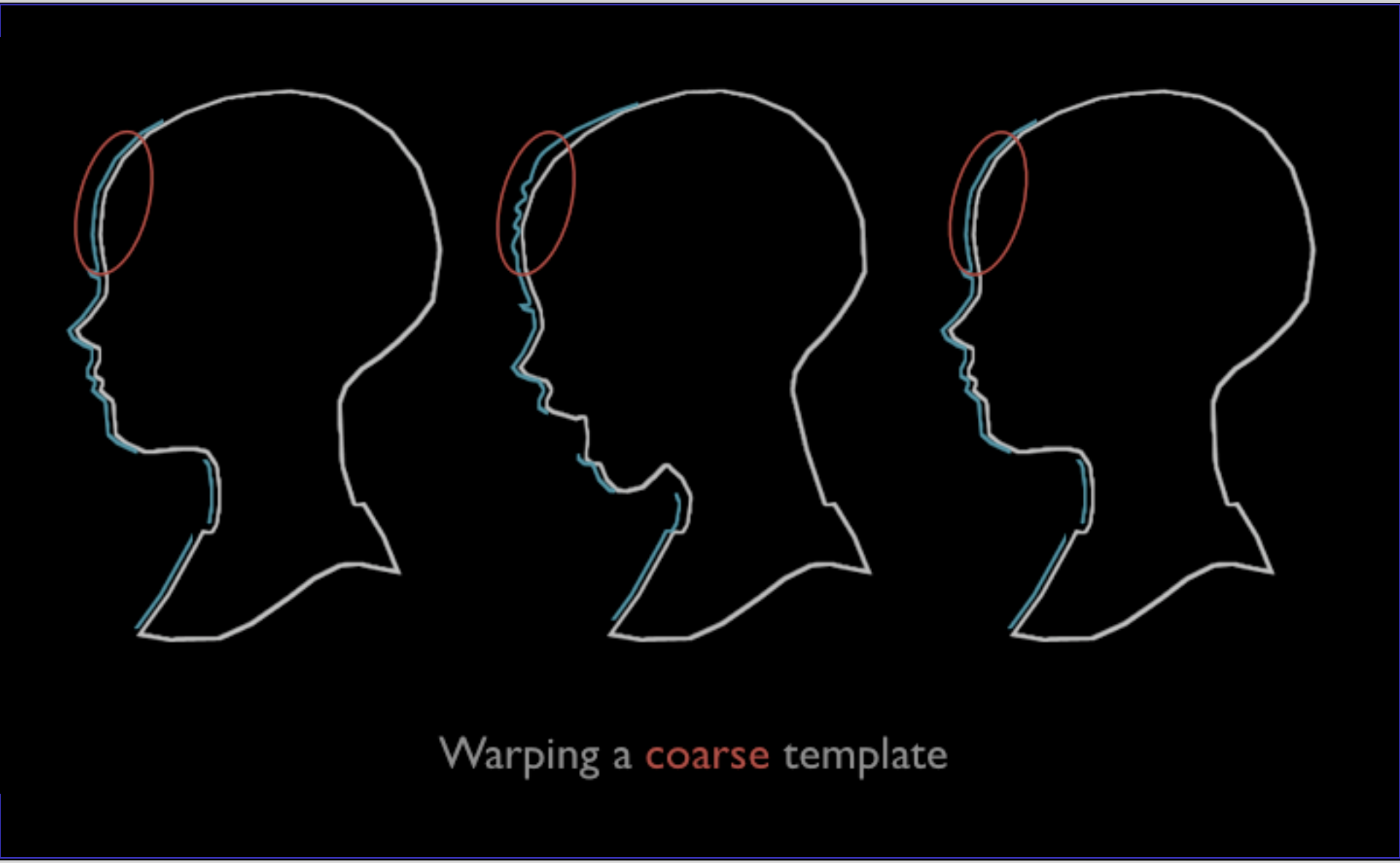


Partial and Non-Rigid Registration

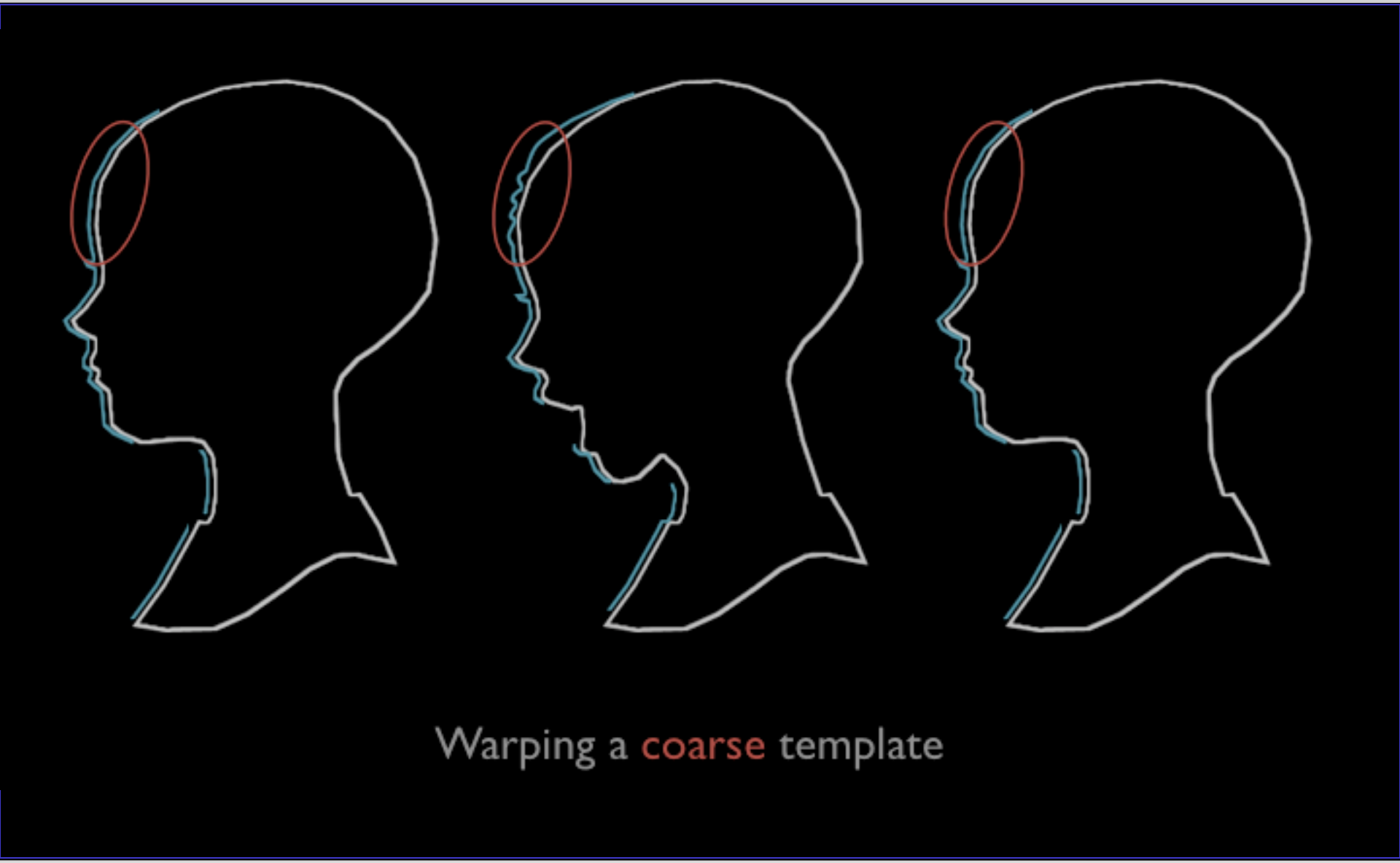


Small-Scale Dynamics

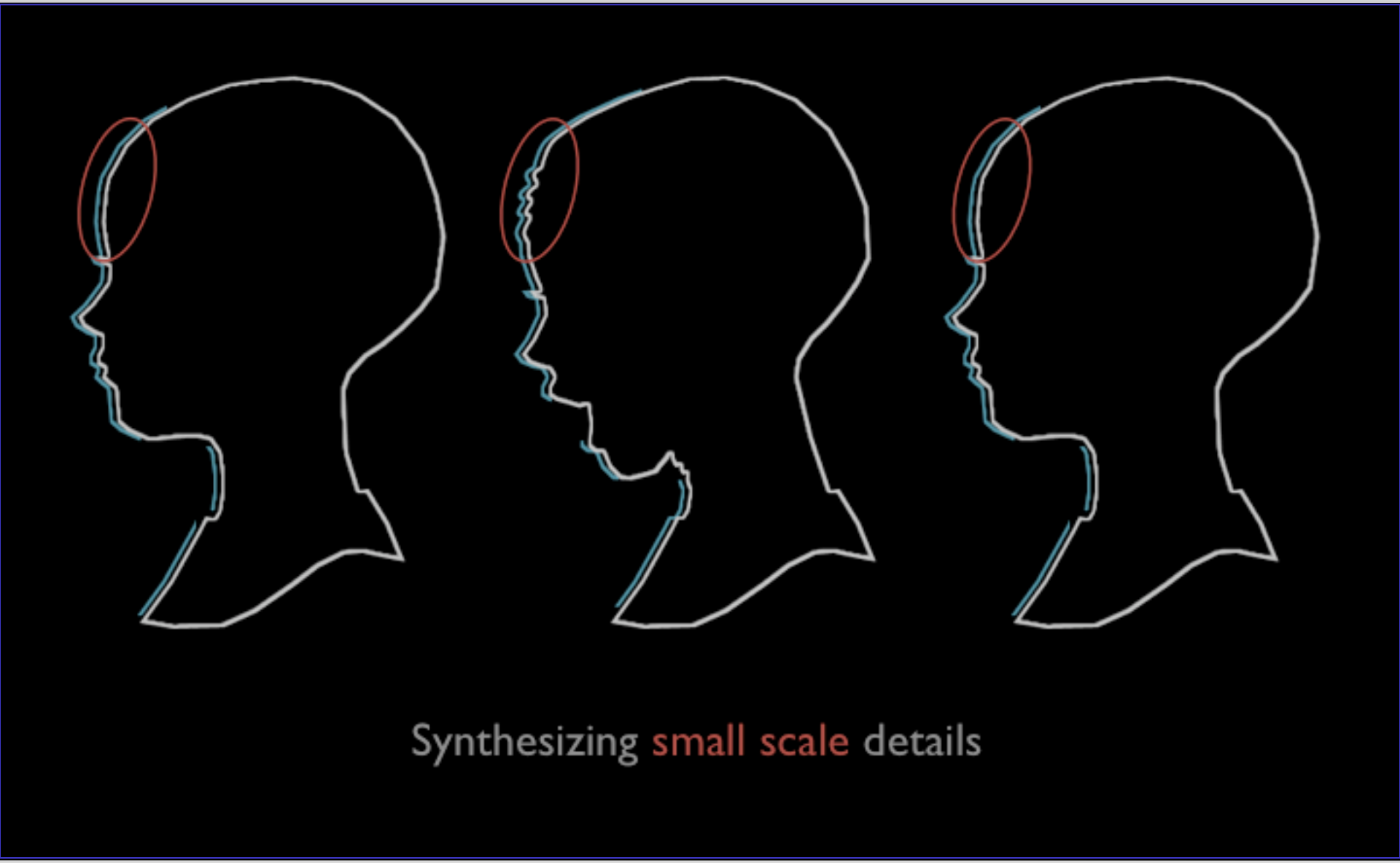
Bi-Resolution Approach



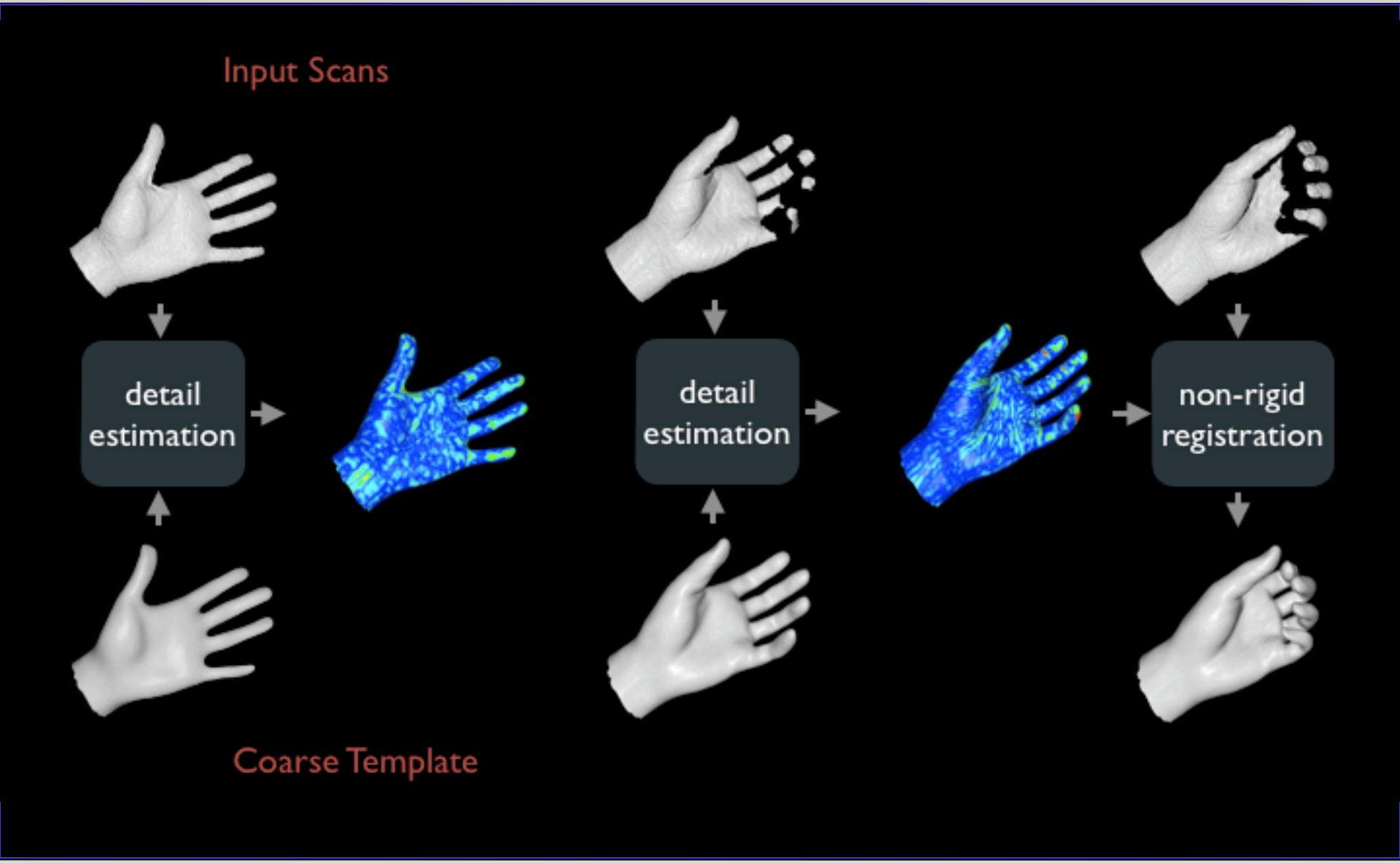
Bi-Resolution Approach



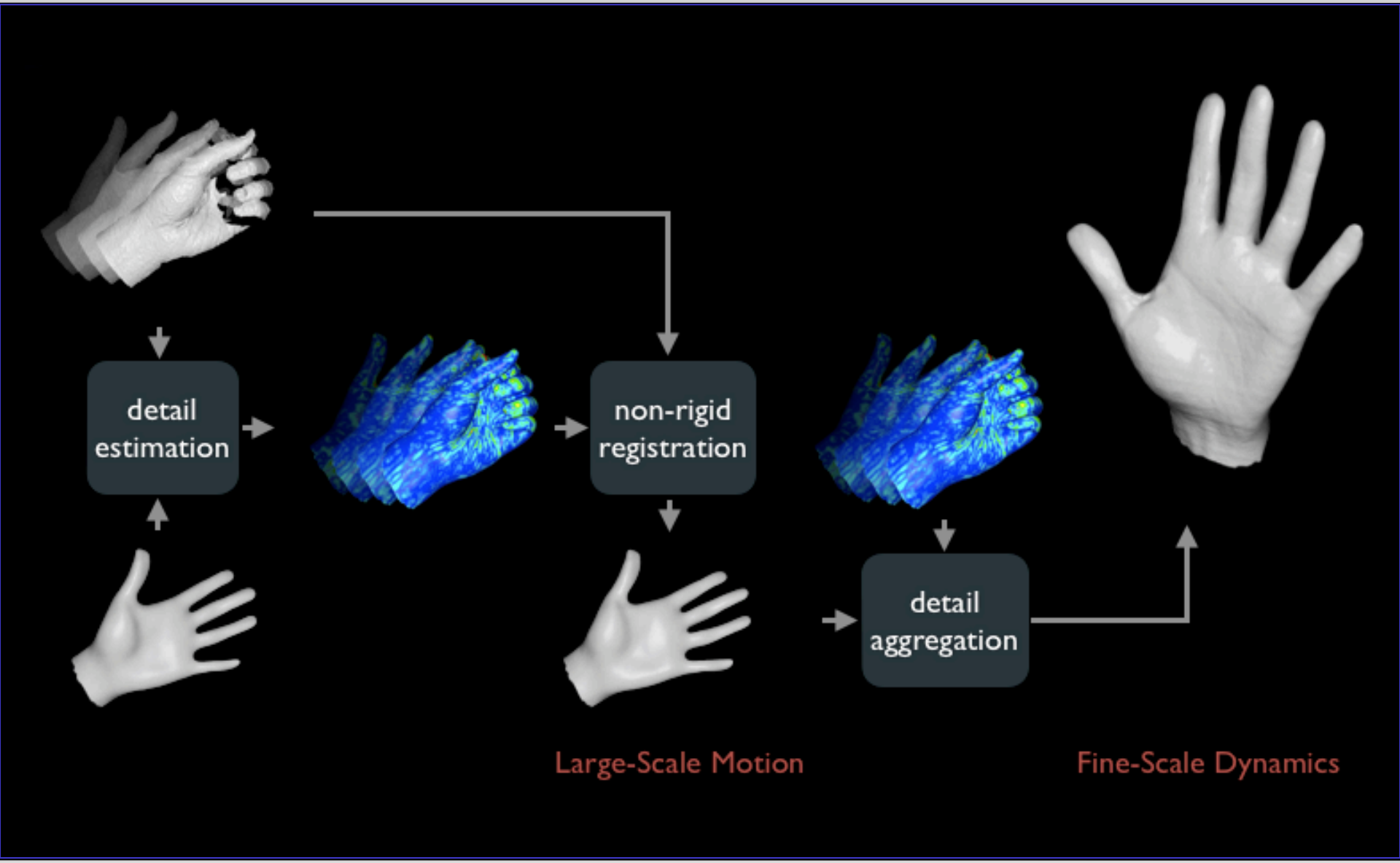
Bi-Resolution Approach



Reconstruction Framework



Reconstruction Framework



Non-Rigid ICP

Non-Linear Optimization

$$E_{\text{tot}} = \alpha_{\text{fit}} E_{\text{fit}} + \alpha_{\text{rigid}} E_{\text{rigid}} + \alpha_{\text{smooth}} E_{\text{smooth}}$$

Too few nodes:

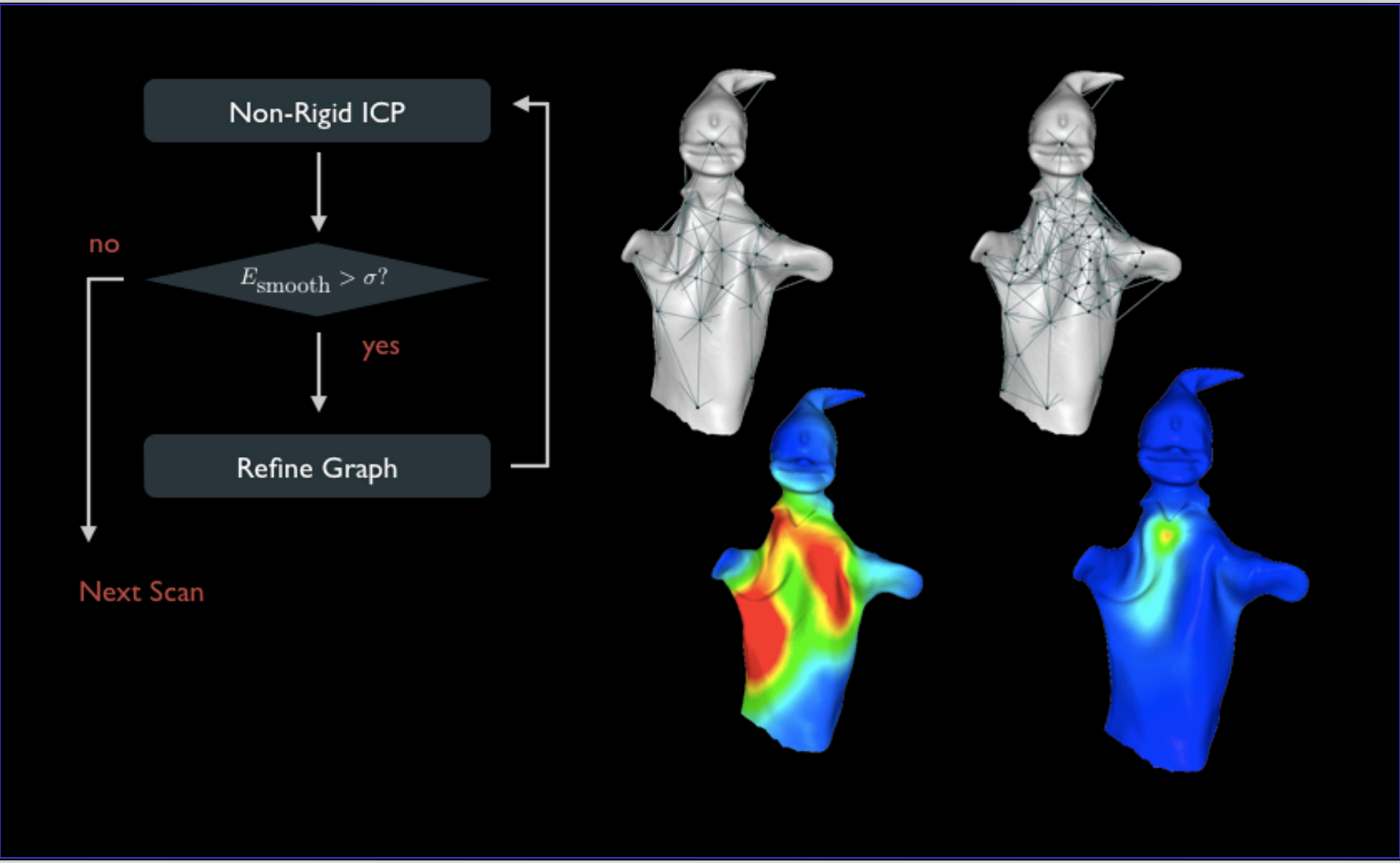
- inaccurate

Too many nodes:

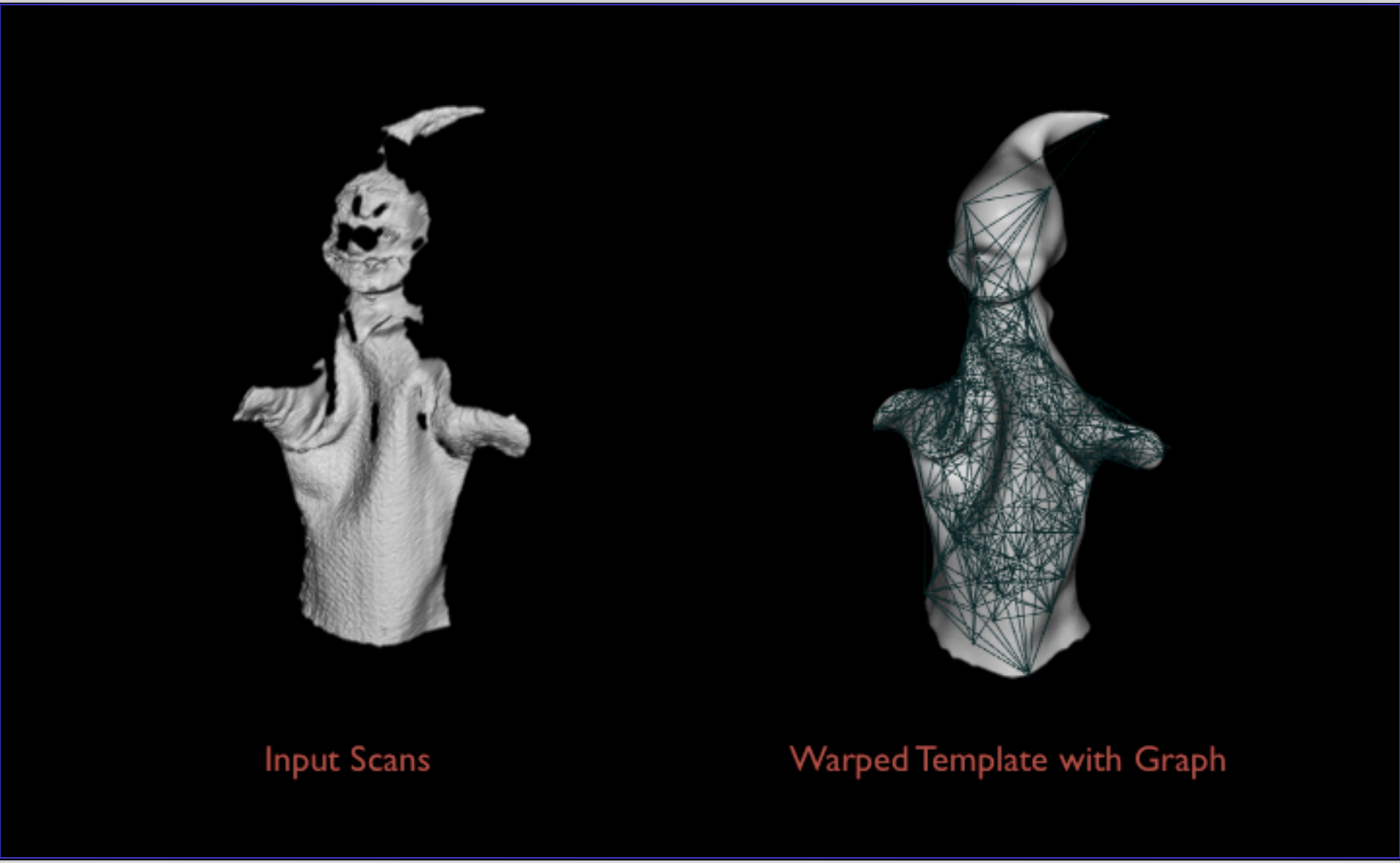
- inefficient
- less robust

Extension of [Li et al. '08]

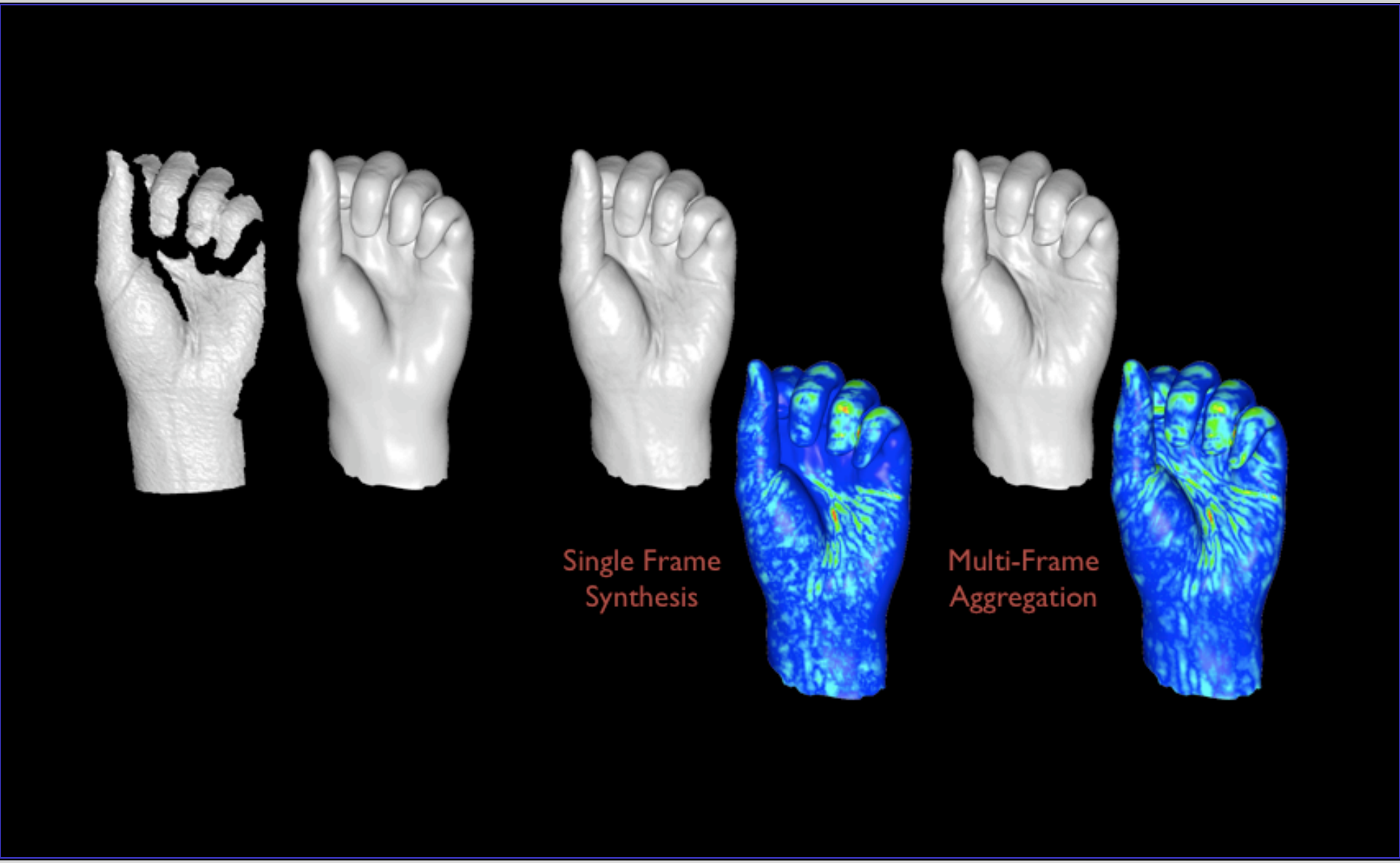
Adaptive Deformation Model



Adaptive Deformation Model



Detail Aggregation

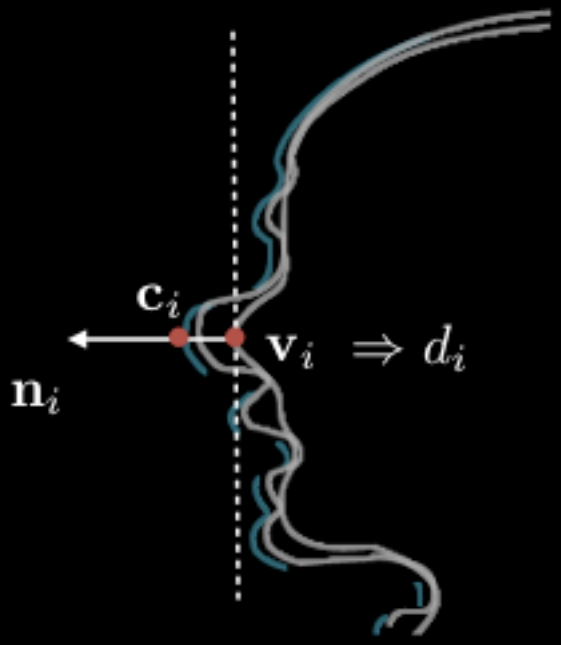


Detail Estimation

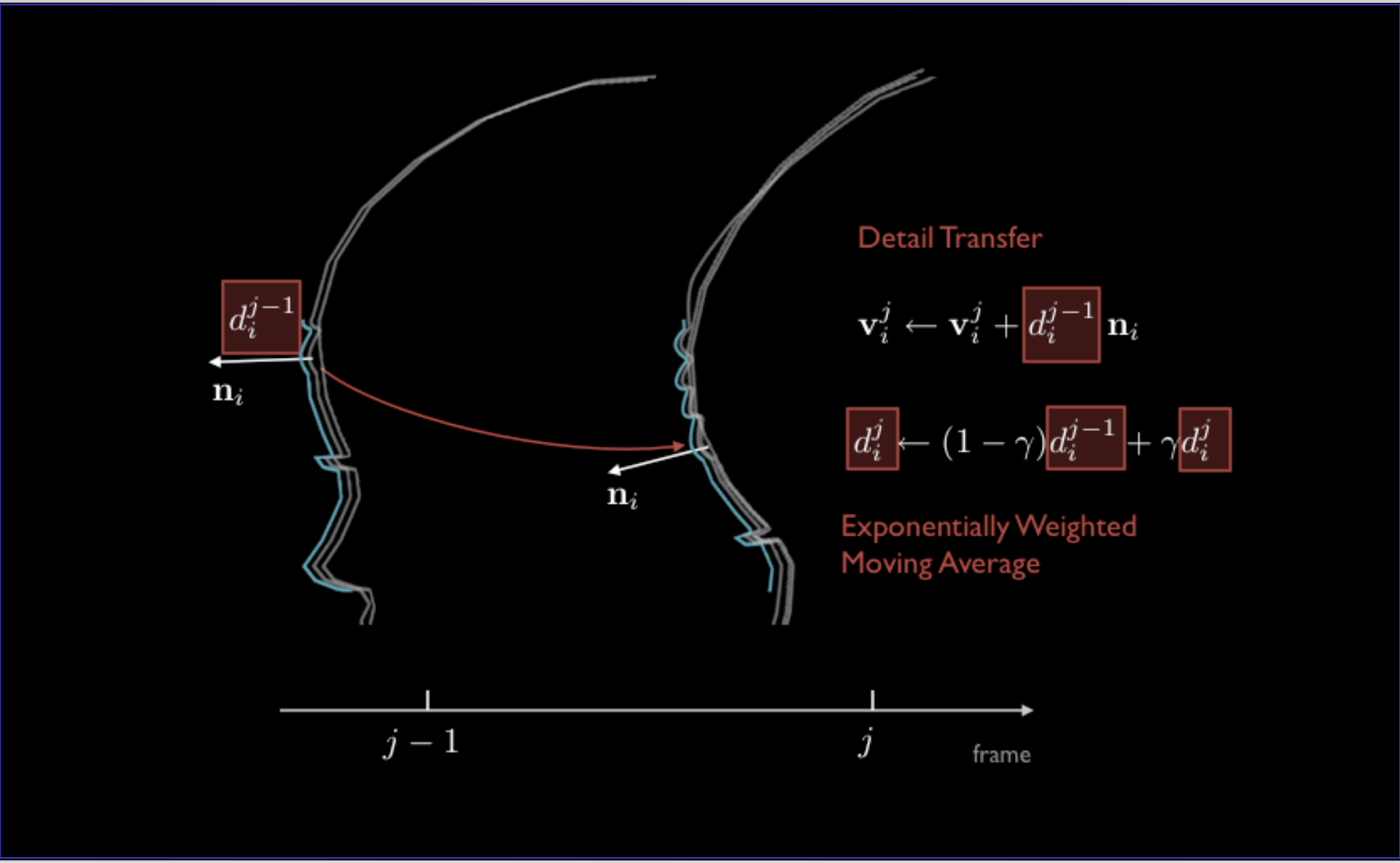
$$E_{\text{detail}} = \sum_{i \in \mathcal{V}} \|\mathbf{v}_i + d_i \mathbf{n}_i - \mathbf{c}_i\|^2 + \beta \sum_{(i,j) \in \mathcal{E}} |d_i - d_j|^2$$

Point Constraint

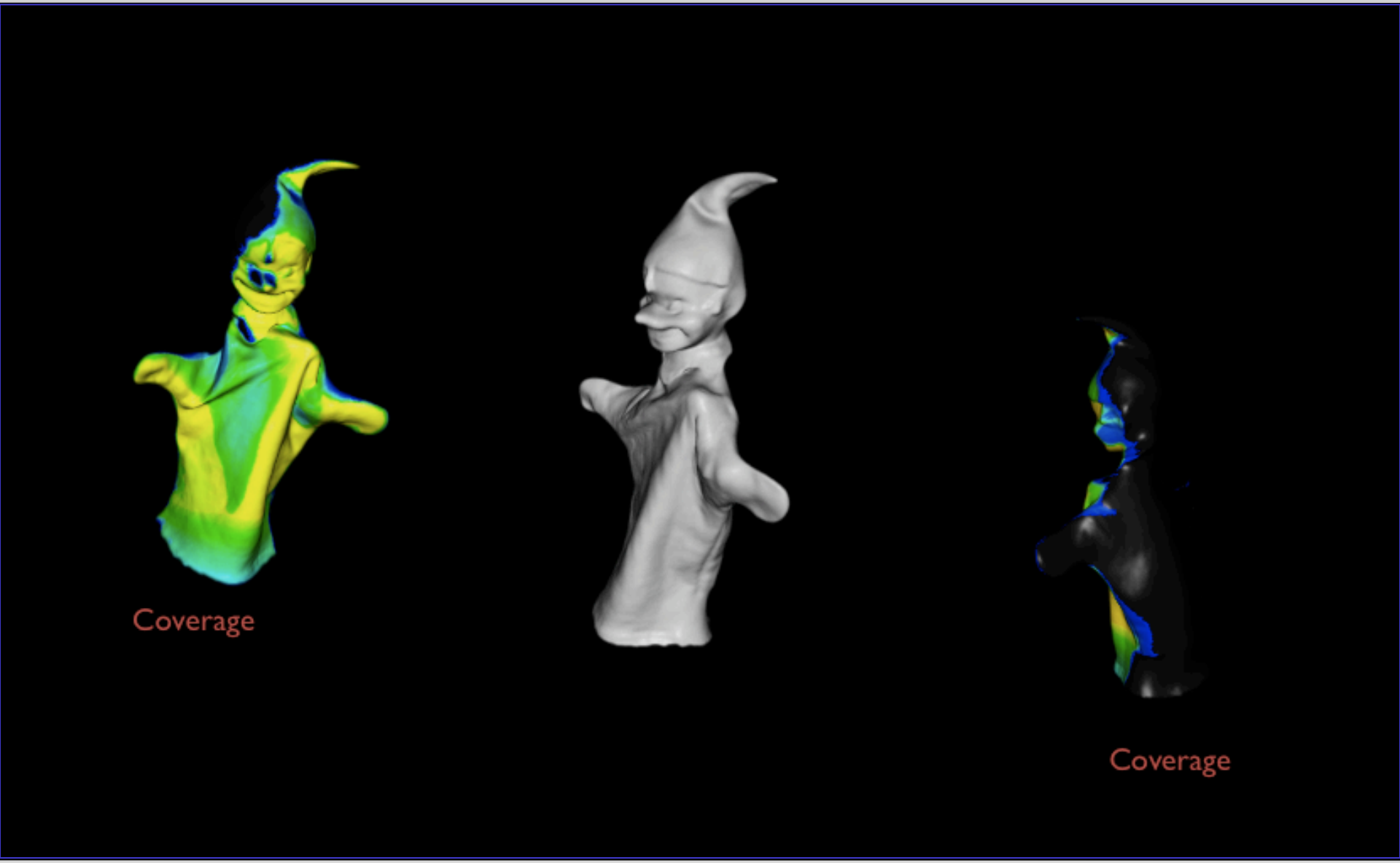
Regularization



Detail Estimation



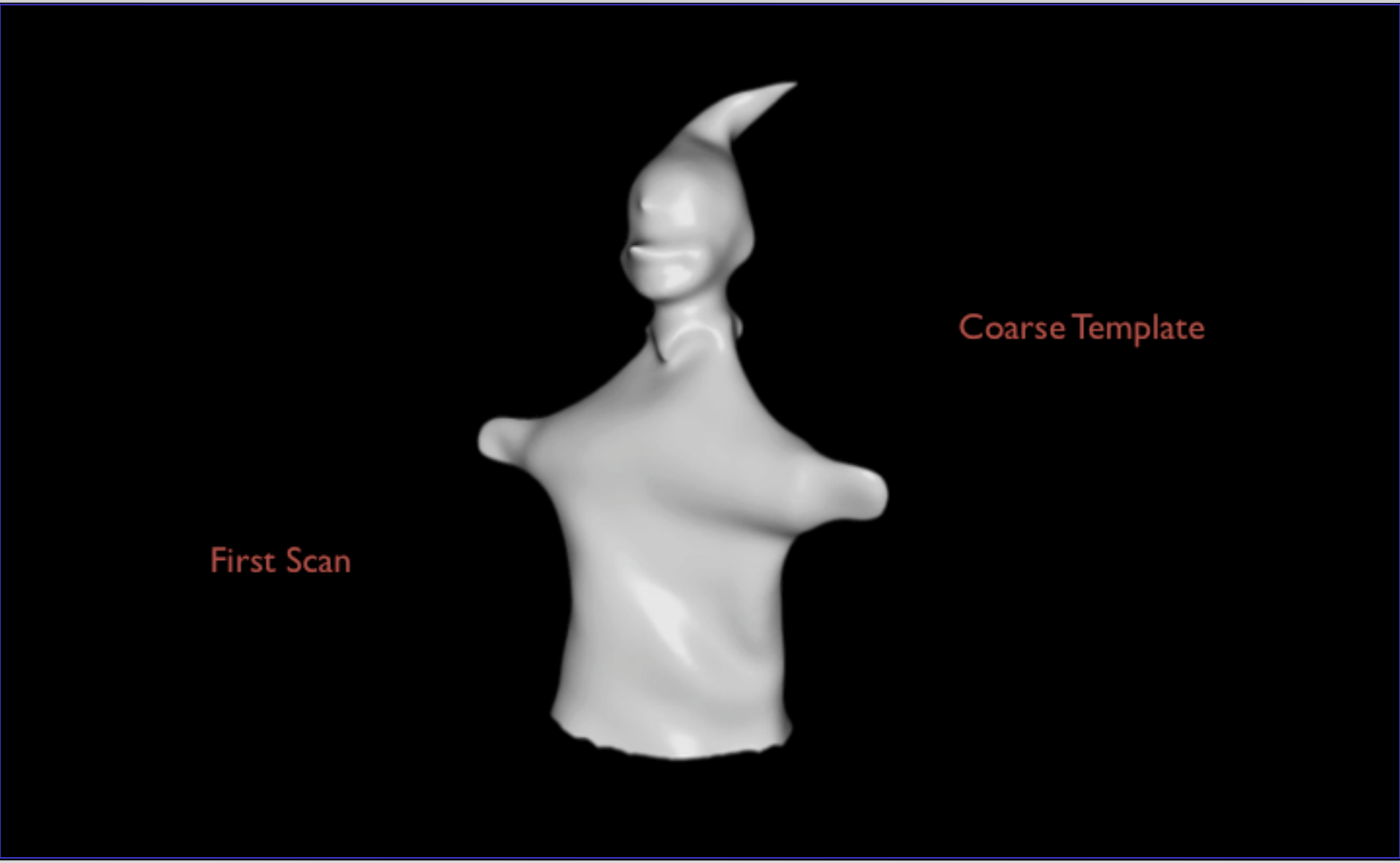
Forward-Backward Propagation



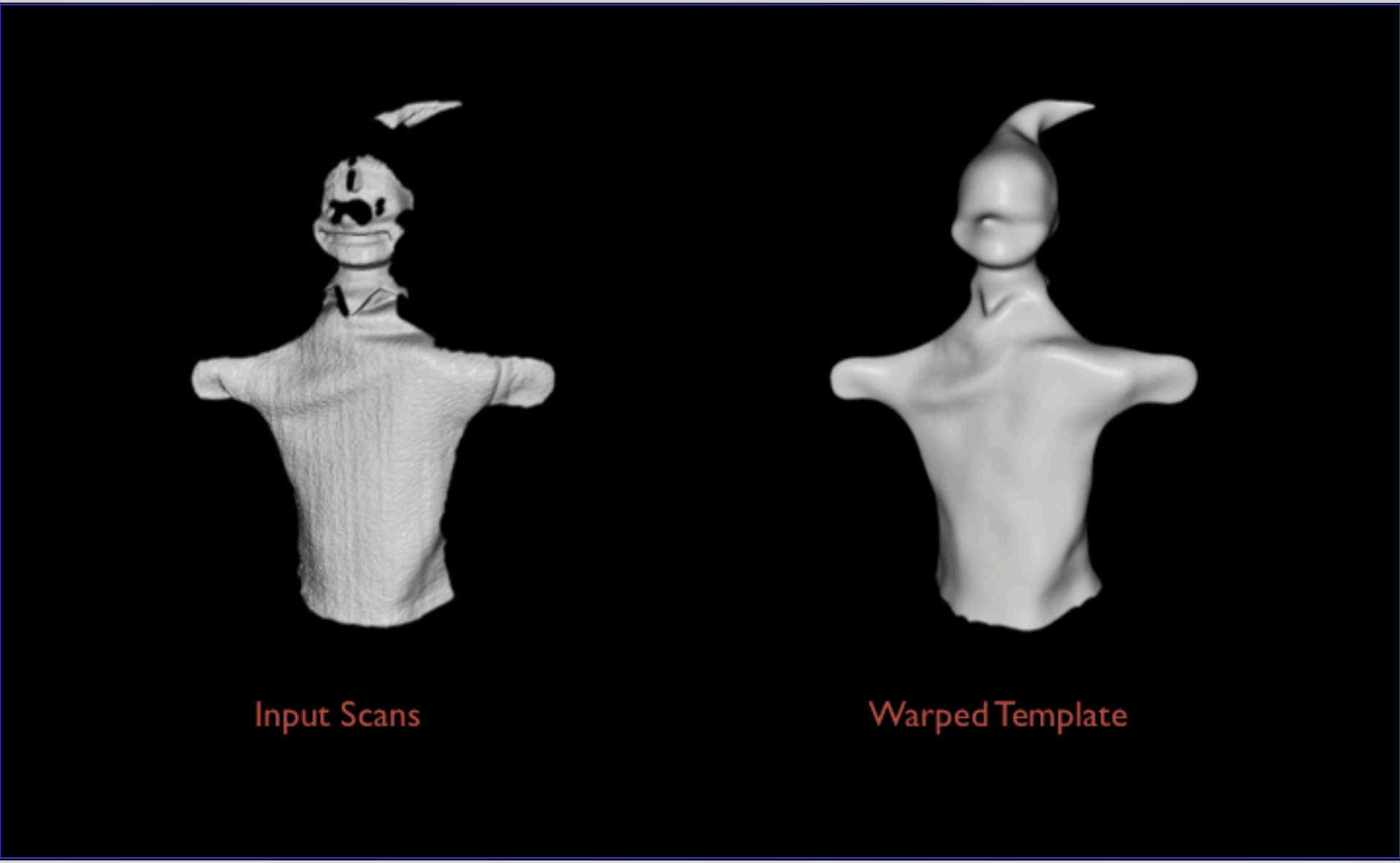
Reconstruction Process
The Puppet

3D Acquisition – 100 Frames

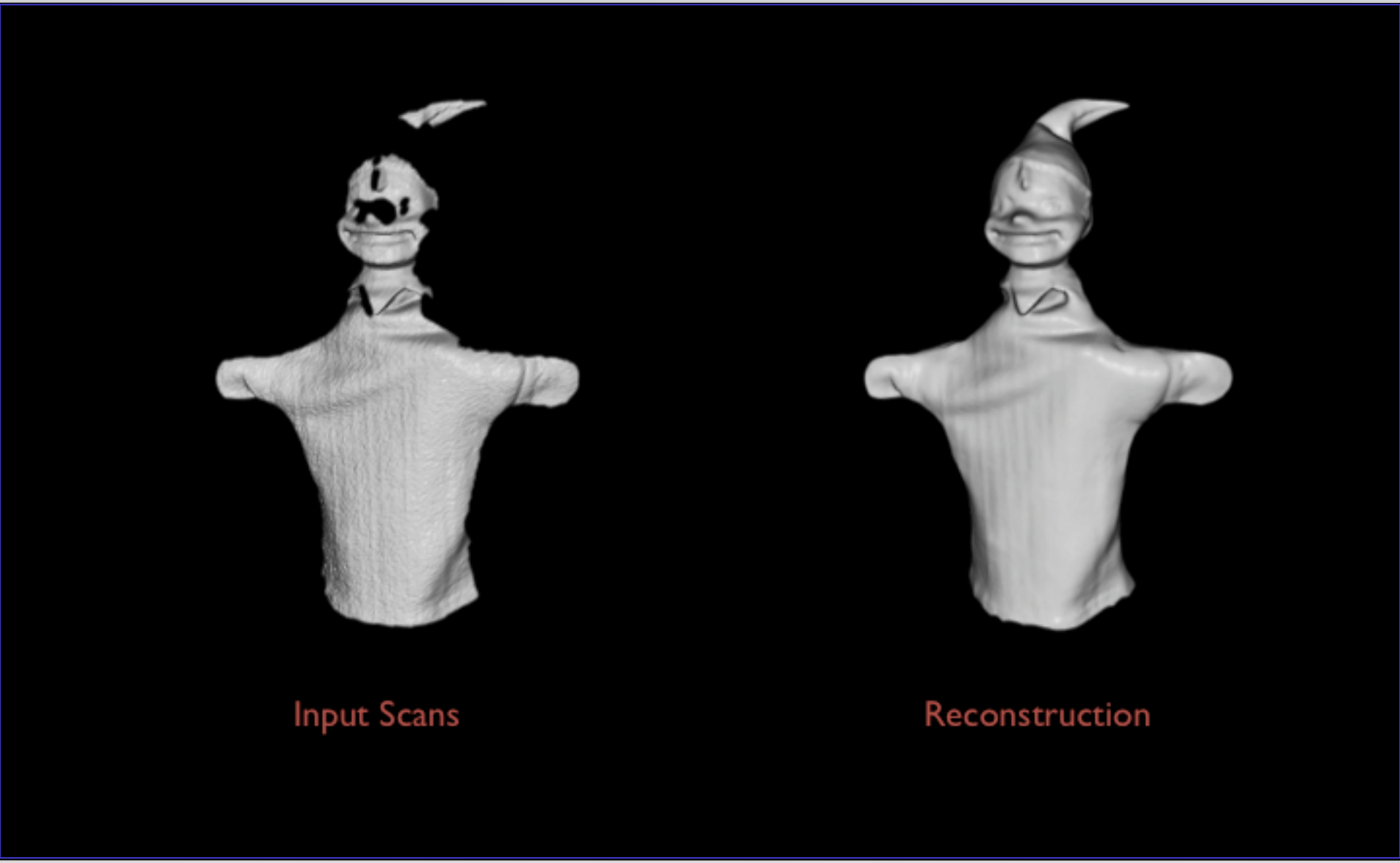
Initial Registration



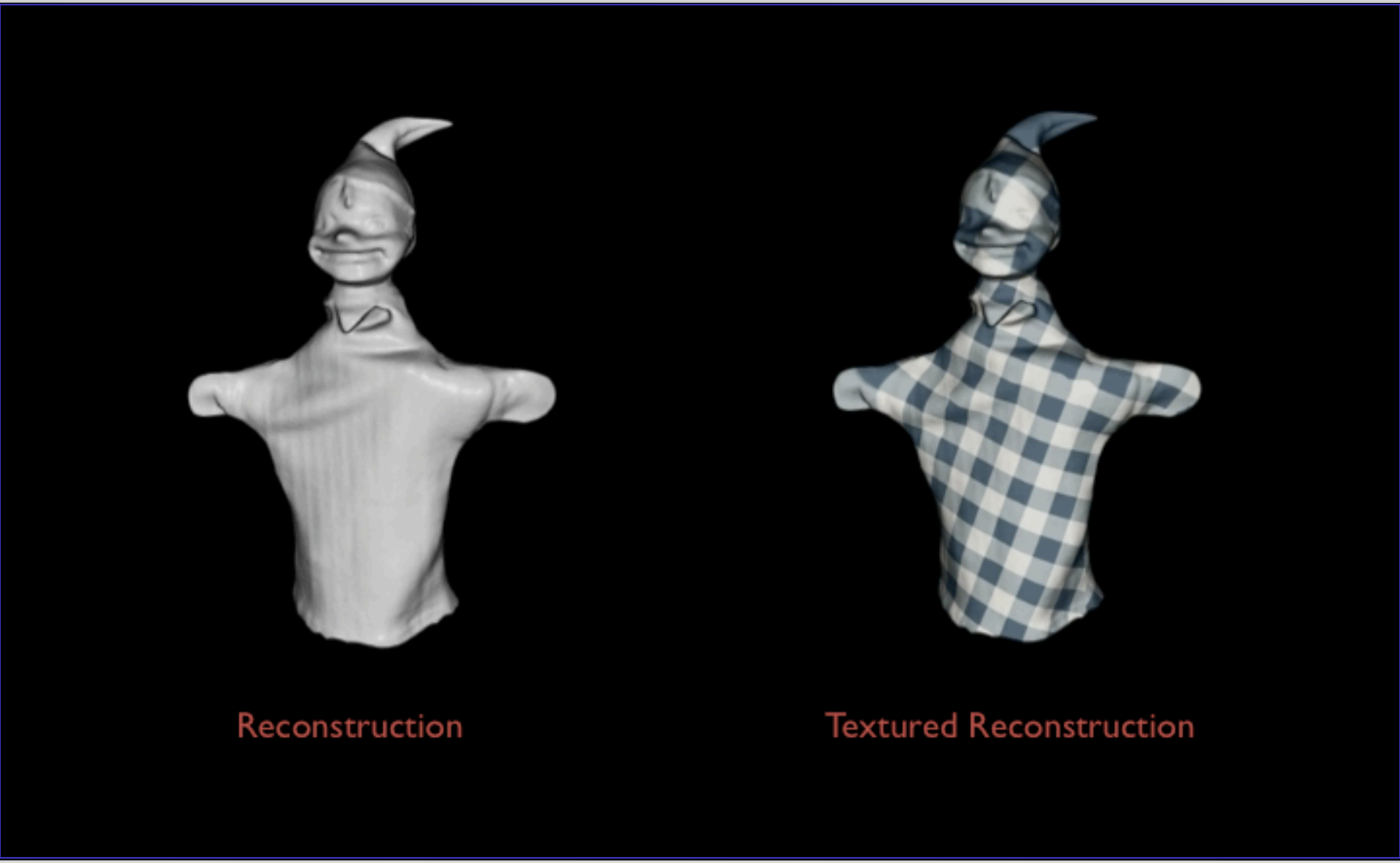
Template Warping



Final Reconstruction – 100 Frames

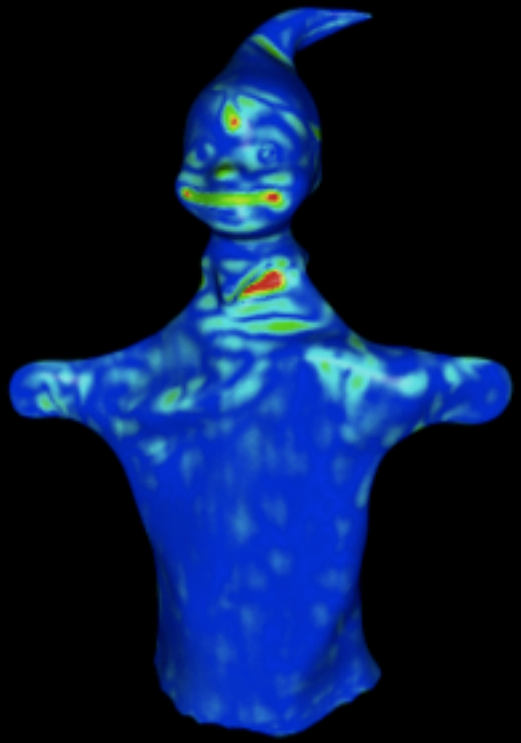


Correspondence Visualization



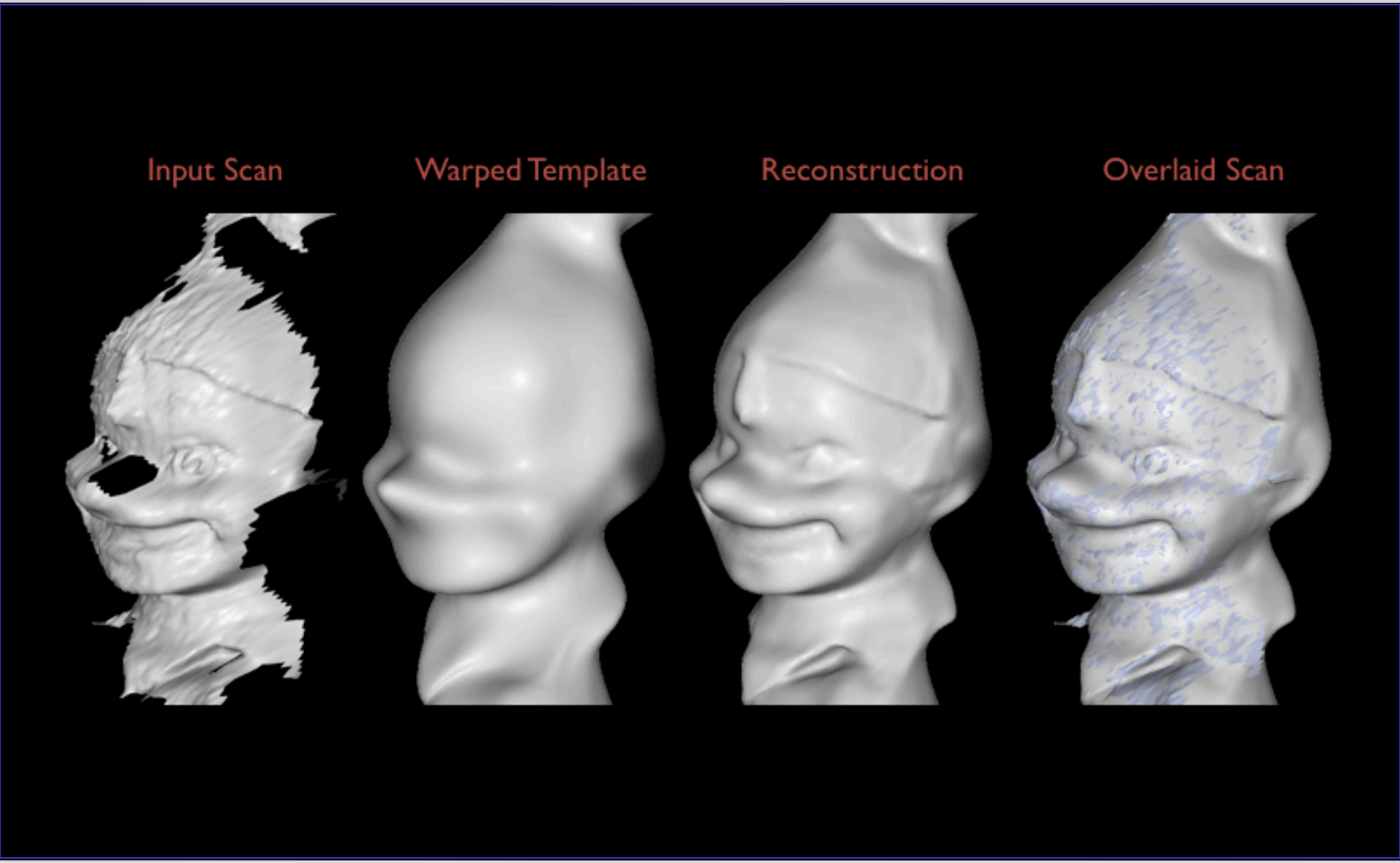
Detail-Coefficient Stability

Reconstruction



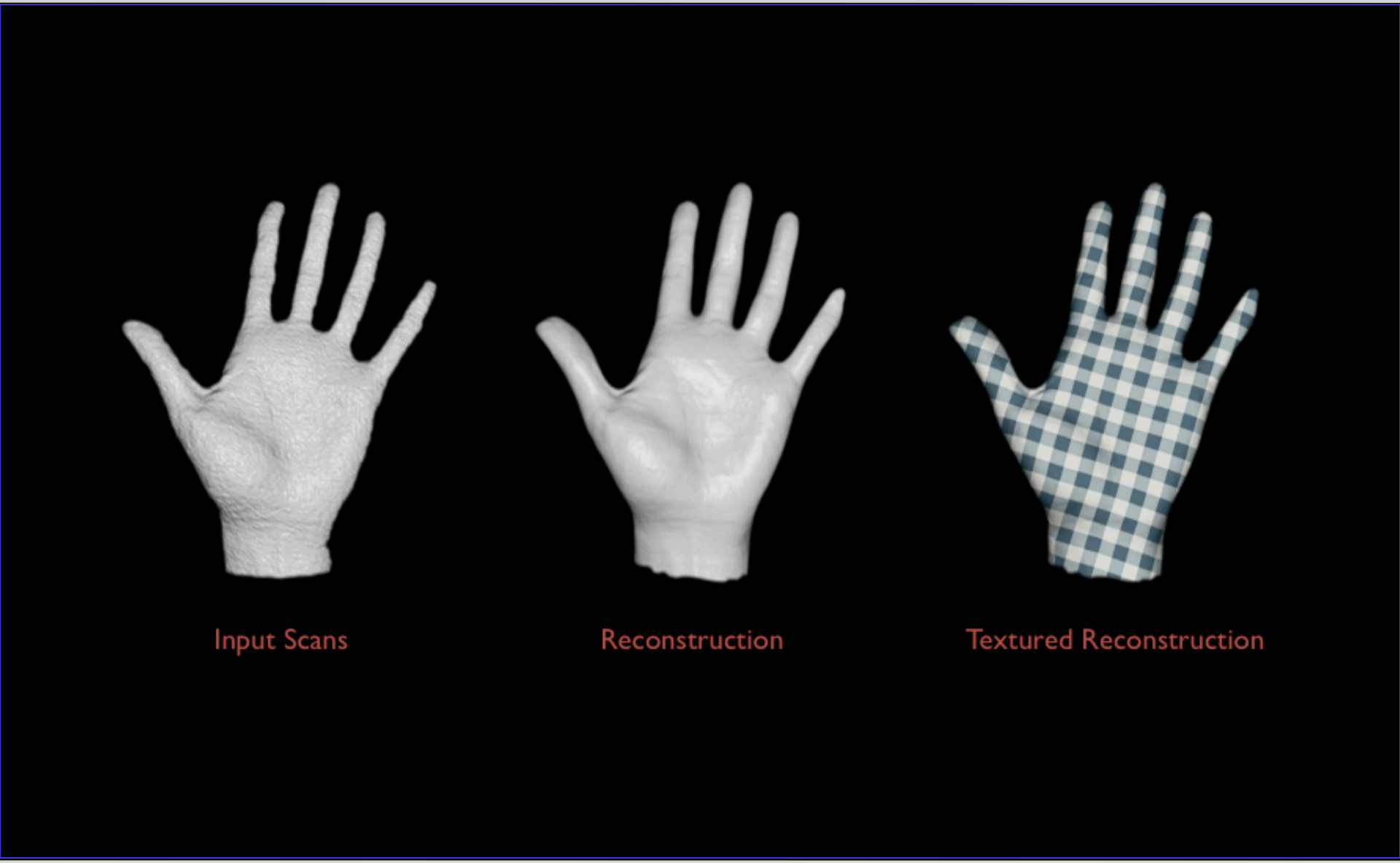
Detail Coefficients

Close-up Comparison

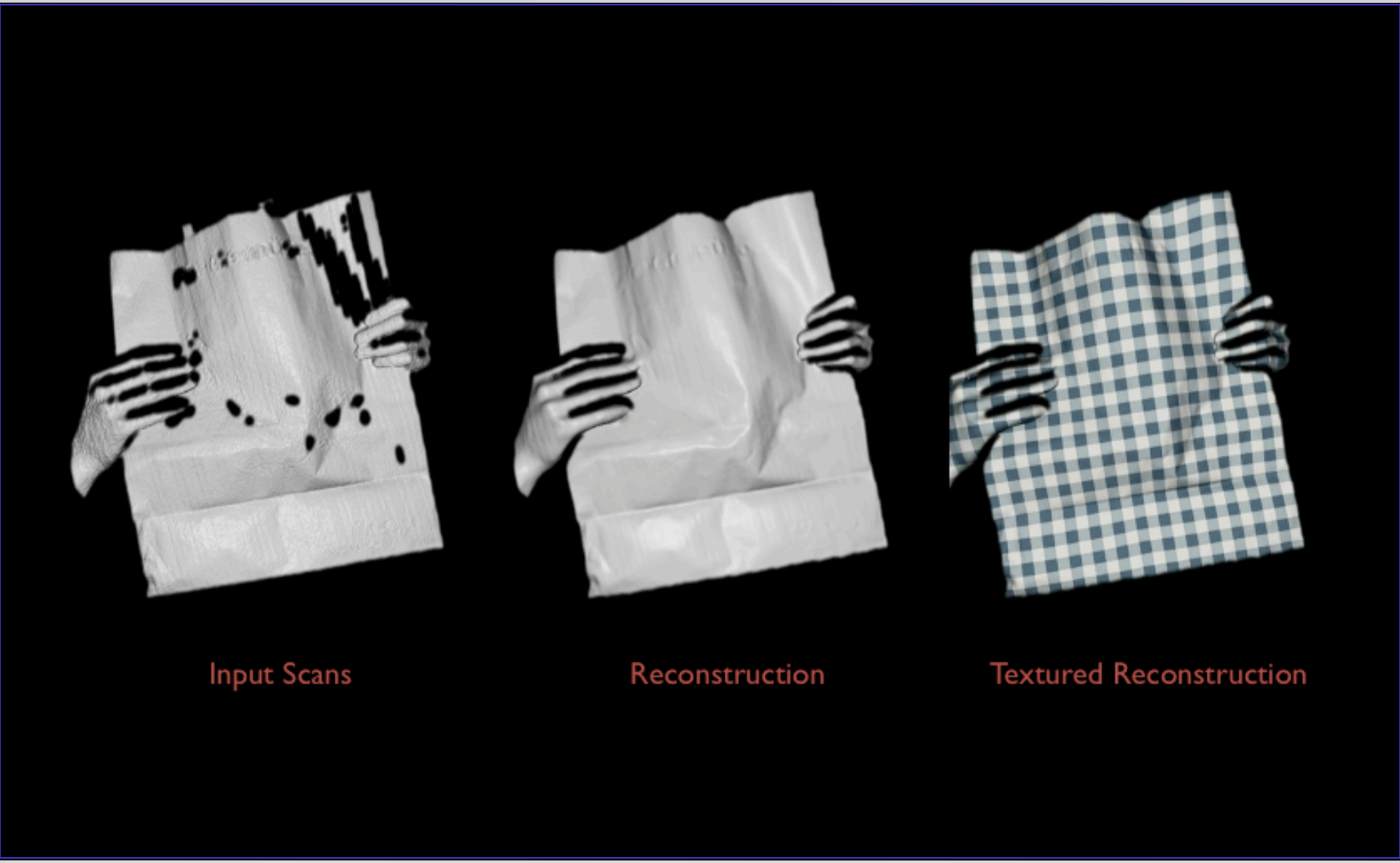


More Results

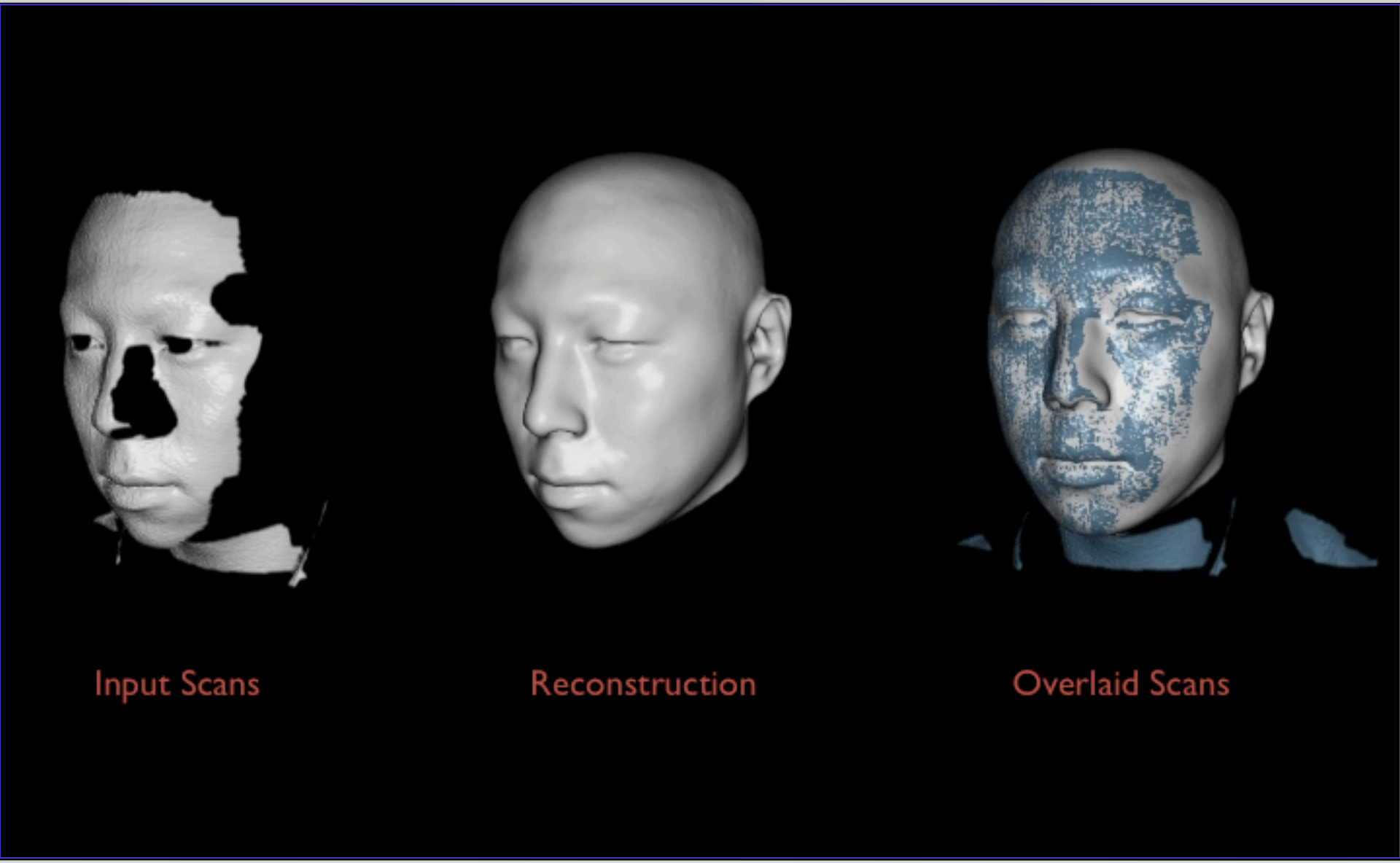
Grasping Hand – 34 Frames



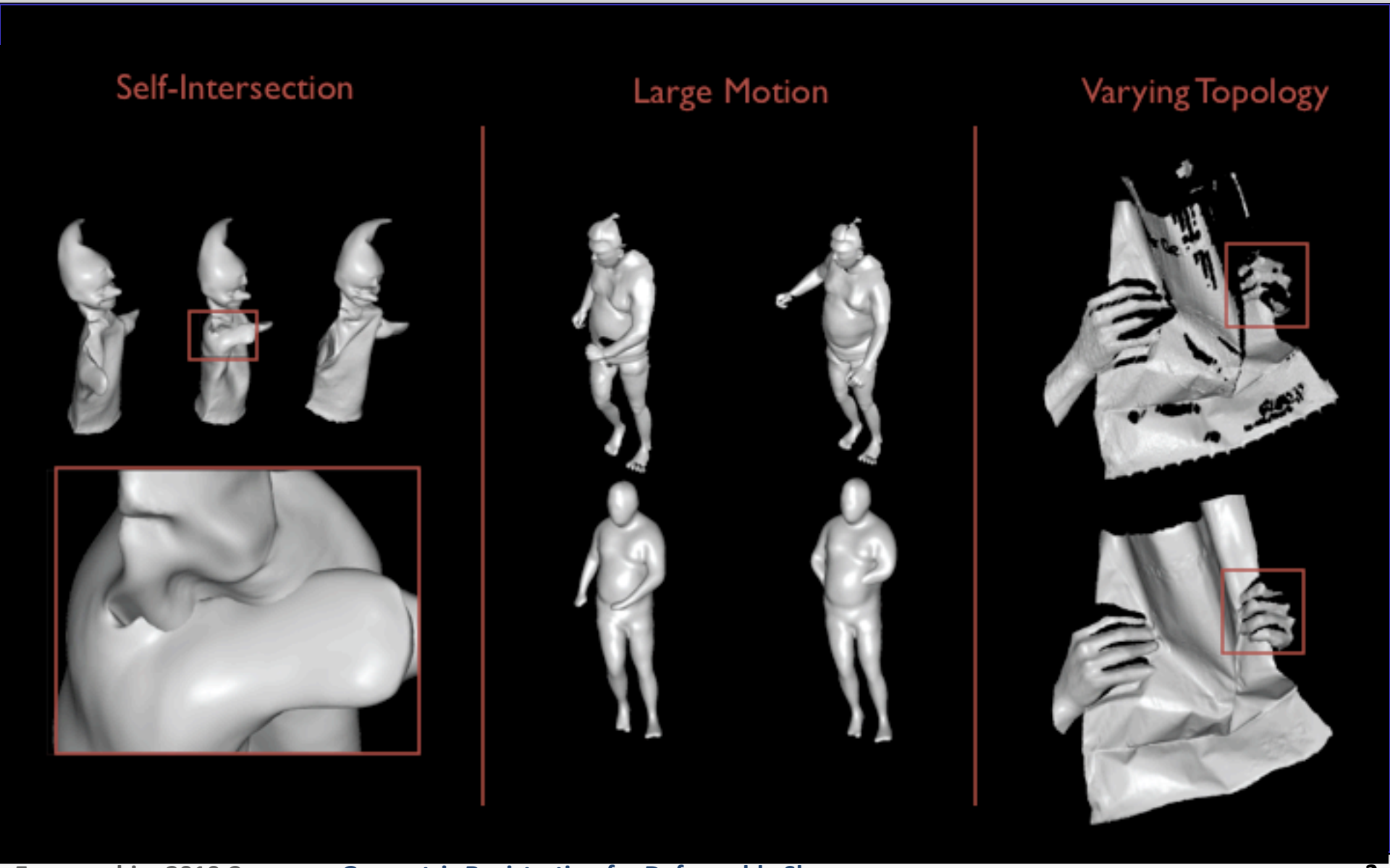
Crumpling Paper Bag – 85 Frames



Facial Expressions – 200 Frames



Limitations



What's Next?

Multi-View and Textures

[Vlasic et al. '09], Princeton, ICT

Complex Materials

National Geographic

Surface Segmentation

WordPress

www.hao-li.com