Practical Animation Reconstruction

Hao Li

Correspondence Problem Classification

How many meshes?

More than two: multi-view registration

Initial registration available?

Yes: Local optimization methods

Class of transformations?

Non-rigid deformations

Performance Capture

Performance Capture

Performance Capture

surface reconstruction → rigging → animation

[XYZRGB '09]

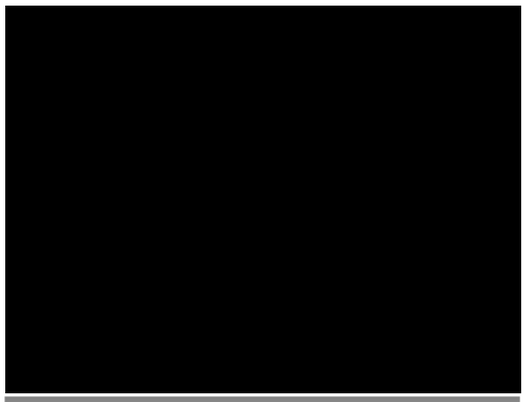
Performance Capture

surface reconstruction → automatic rigging → animation

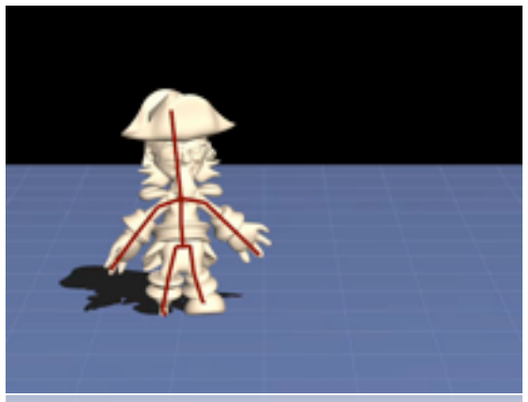
[XYZRGB ’09]

Performance Capture

surface reconstruction → automatic rigging → animation



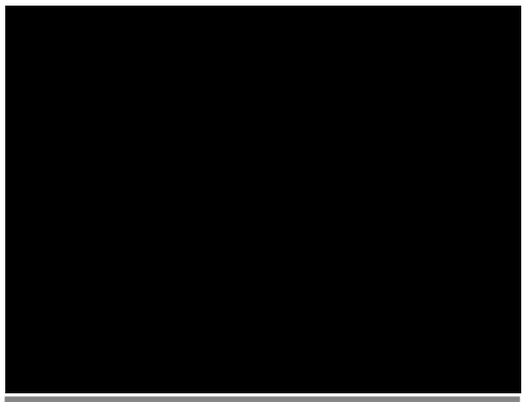
[XYZRGB '09]



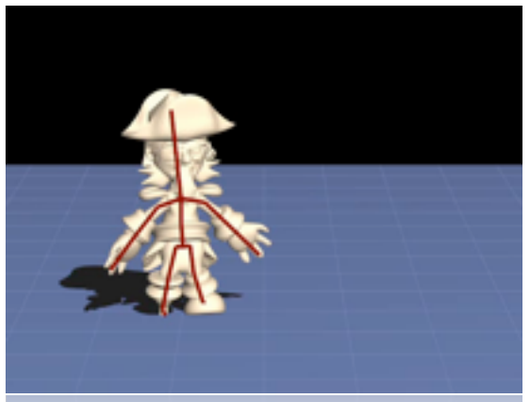
[Baran & Popović '07]

Performance Capture

surface reconstruction → automatic rigging → motion capture



[XYZRGB '09]

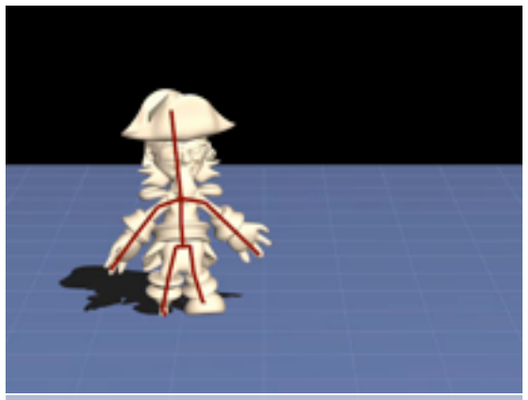


[Baran & Popović '07]

Performance Capture

surface reconstruction → automatic rigging → motion capture

[XYZRGB '09]



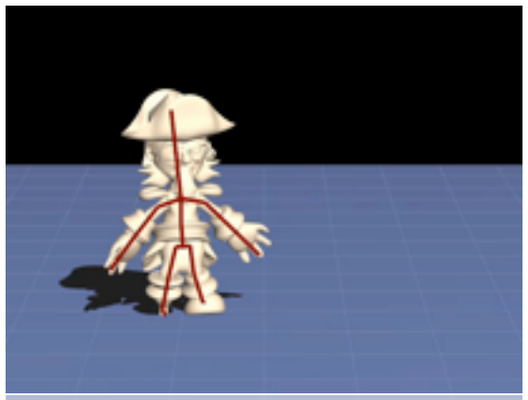
[Baran & Popović '07]

[Vicon '08]

Performance Capture

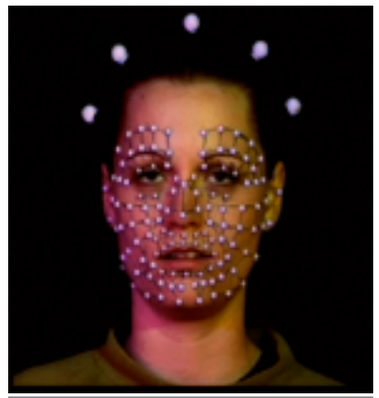
surface reconstruction → automatic rigging → motion capture

[XYZRGB '09]



[Baran & Popović '07]

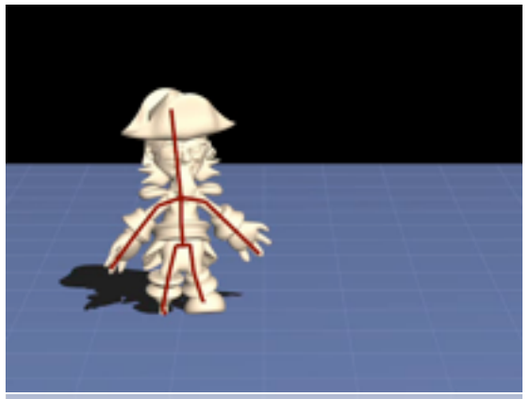
[Vicon '08]



Performance Capture

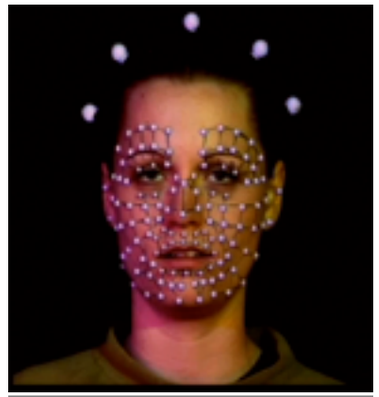
surface reconstruction → automatic rigging → motion capture → post processing

[XYZRGB '09]



[Baran & Popović '07]

[Vicon '08]



Performance Retargeting

Performance Retargeting

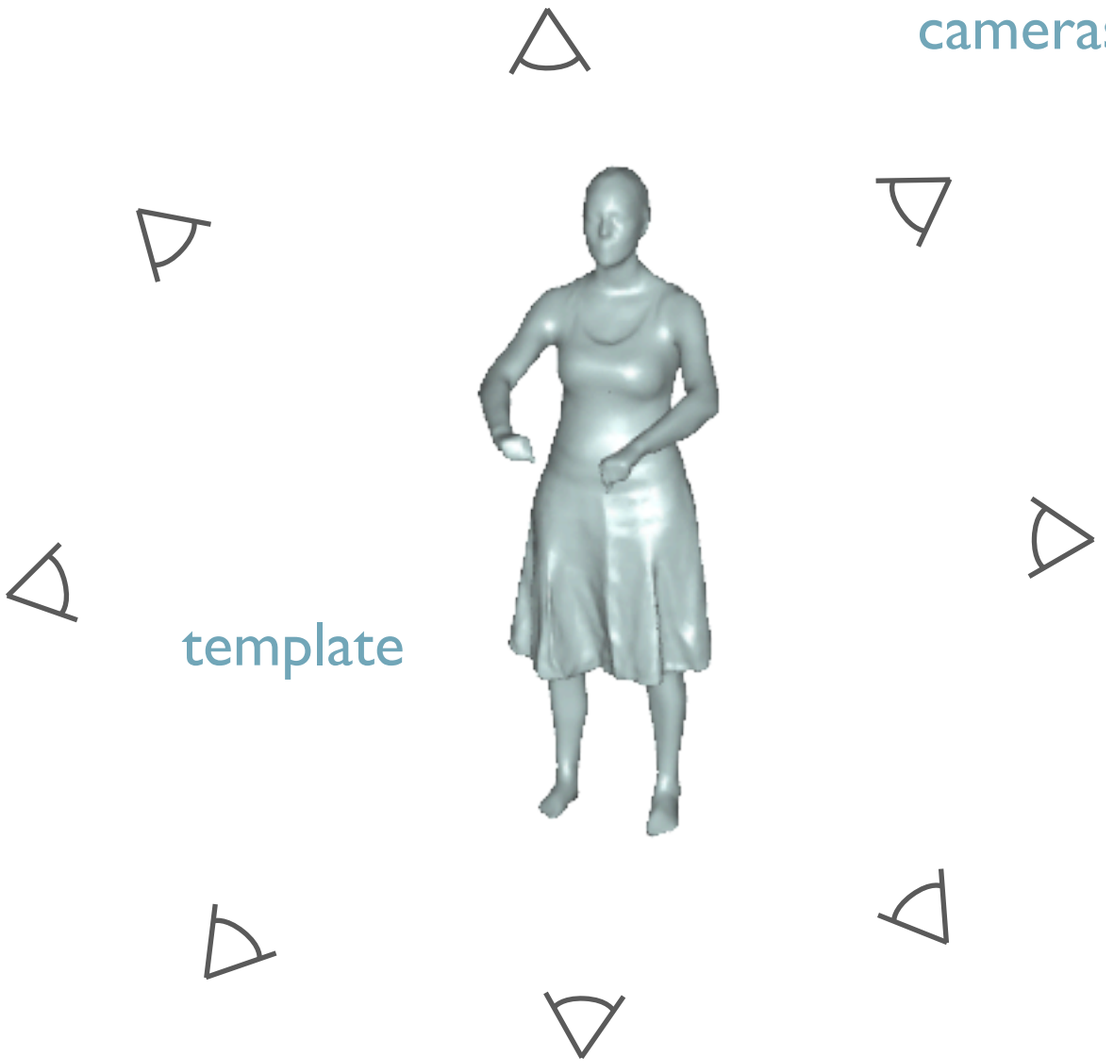
Performance Retargeting

Markerless Performance Capture

template

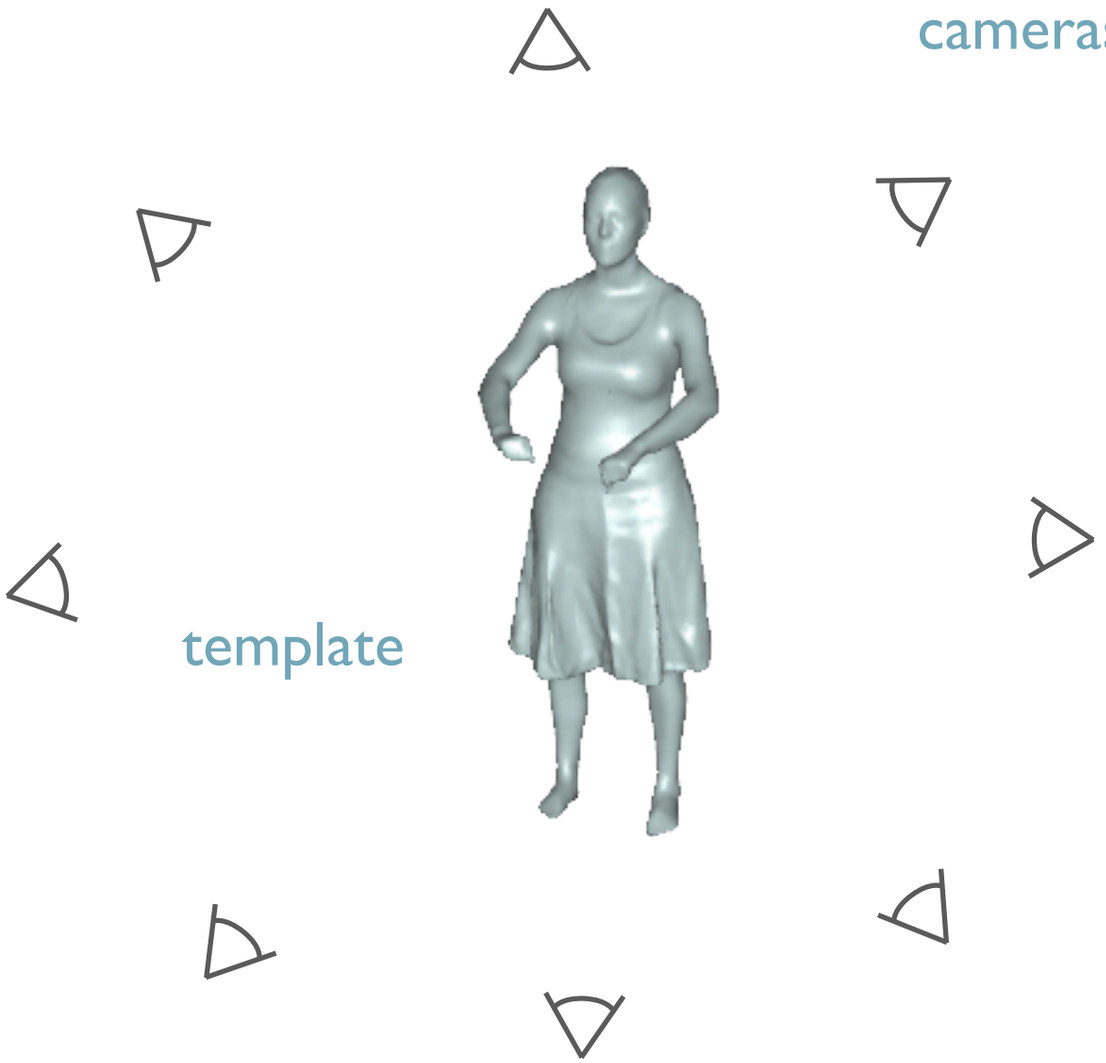
[de Aguiar et al. '08]

Markerless Performance Capture



[de Aguiar et al. '08]

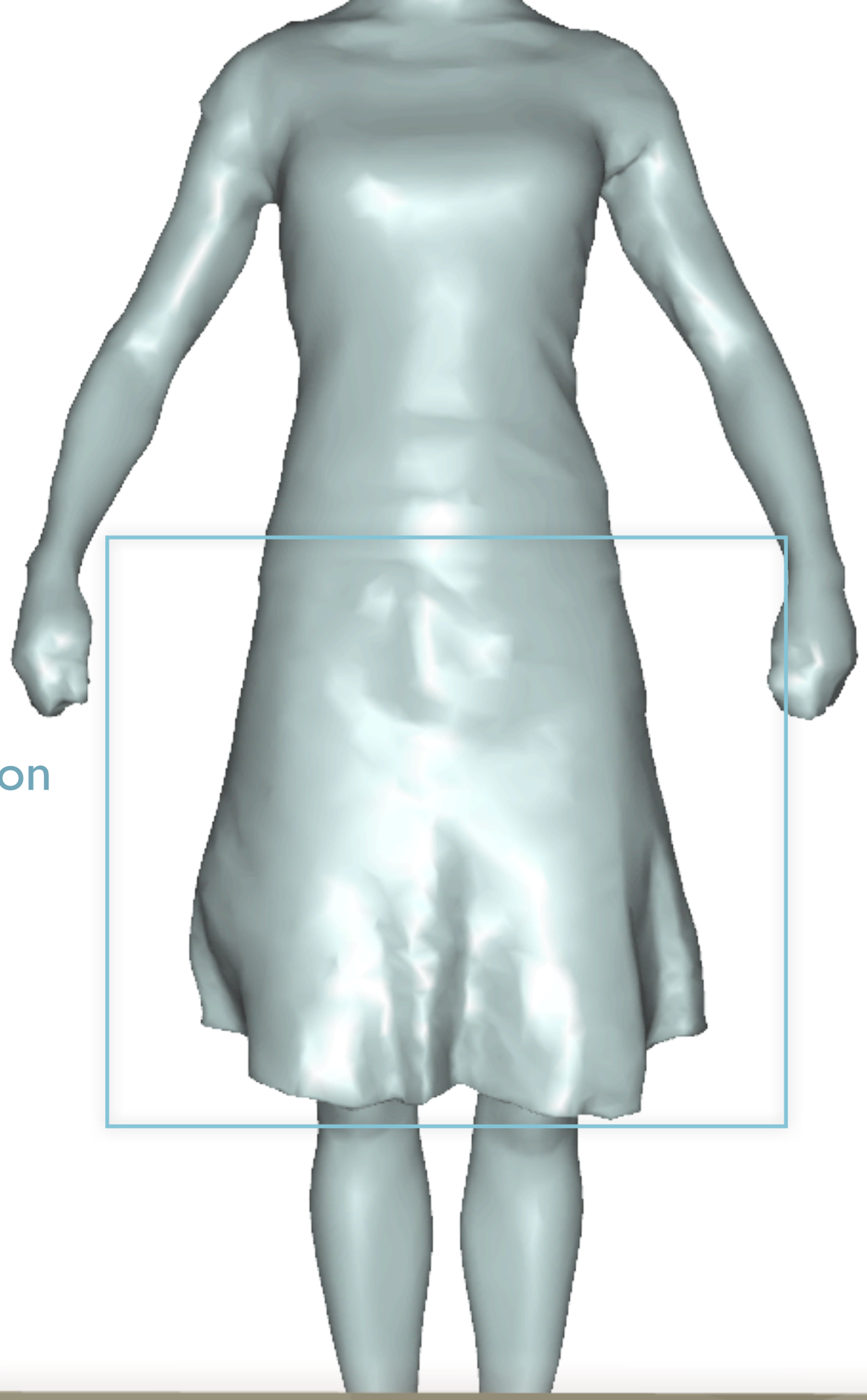
Markerless Performance Capture



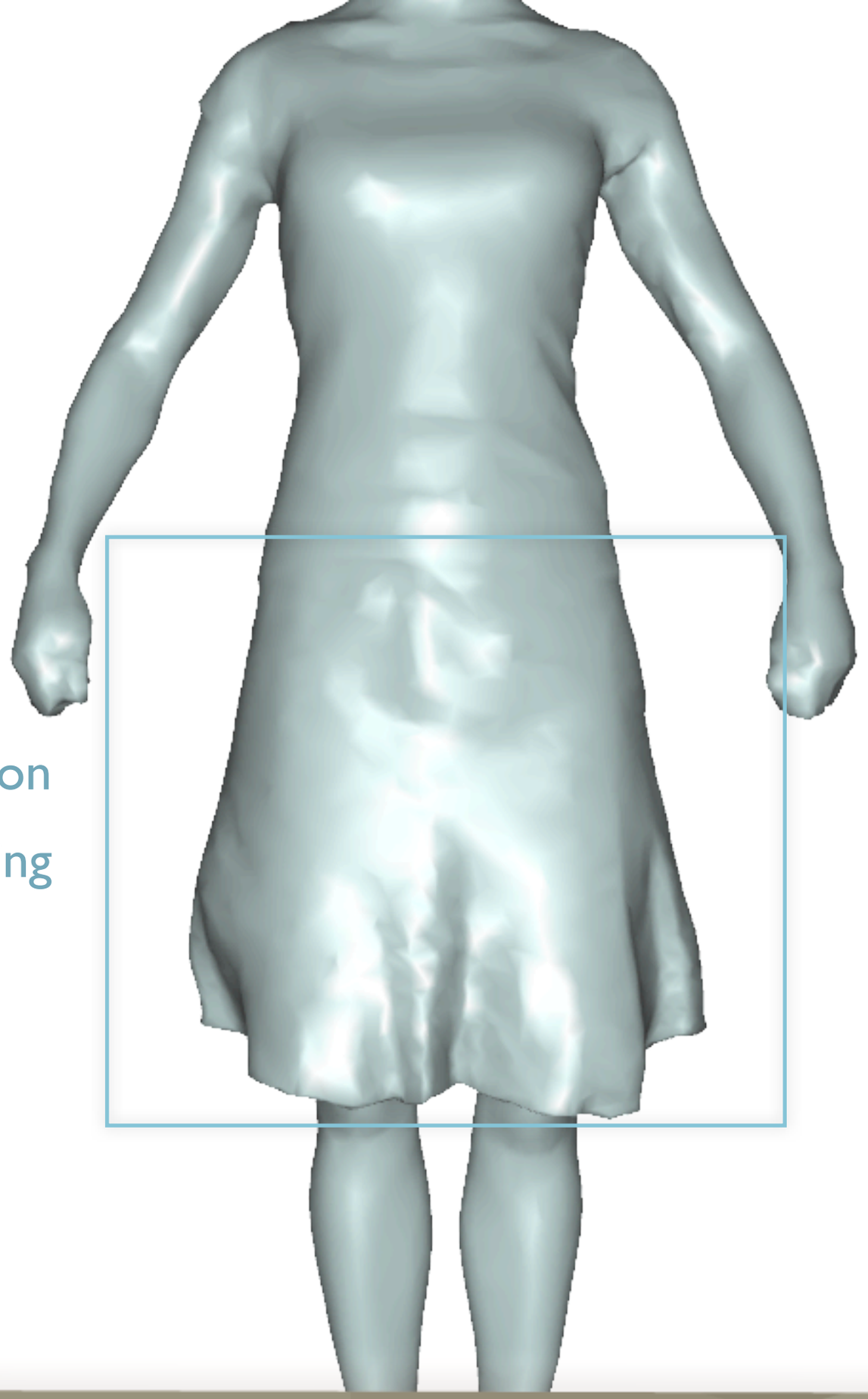
[de Aguiar et al. '08]

[Vlasic et al. ’08]

Elastic Deformation



[Vlasic et al. '08]



Elastic Deformation

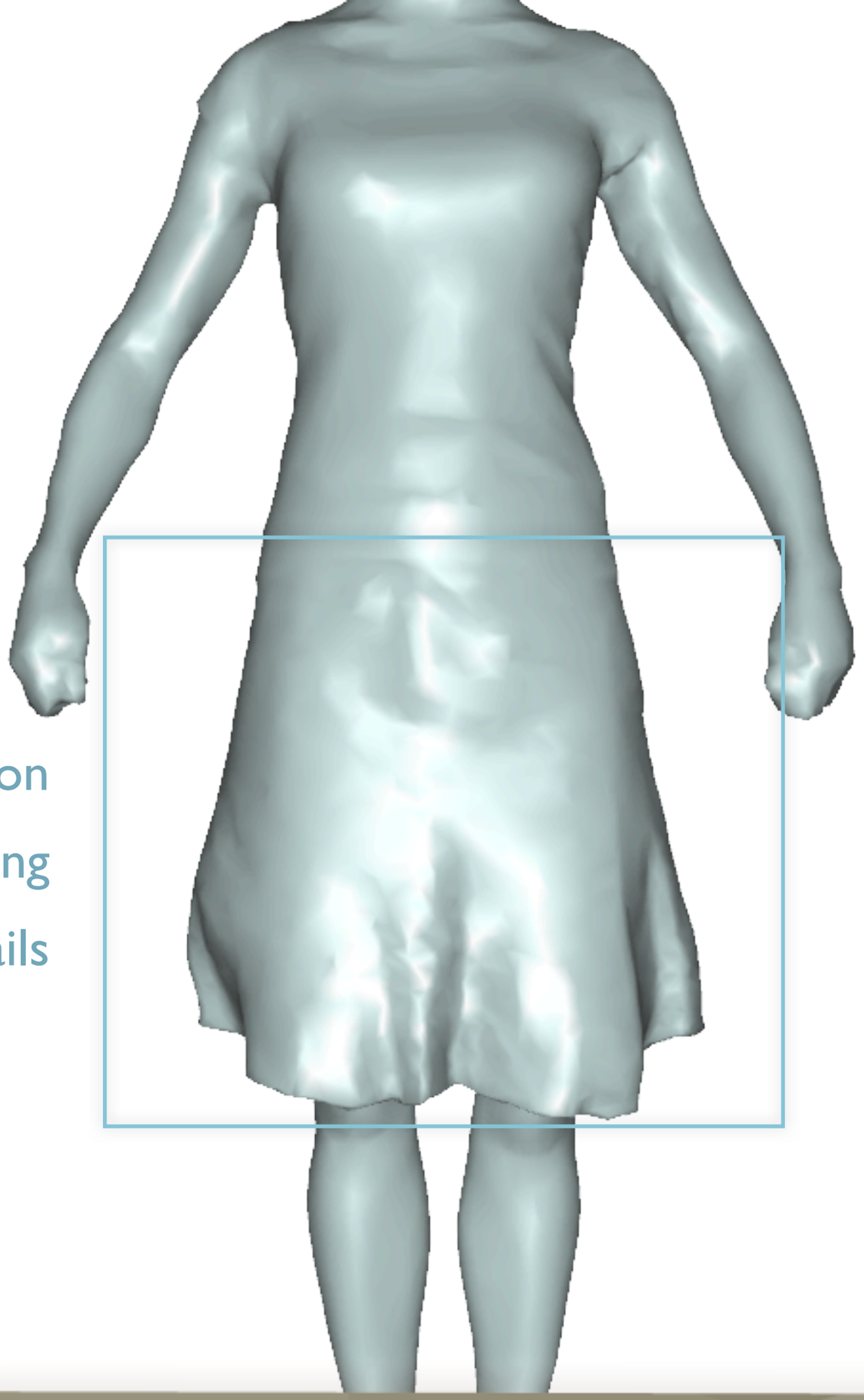
Sparse Tracking

[Vlasic et al. '08]

Elastic Deformation

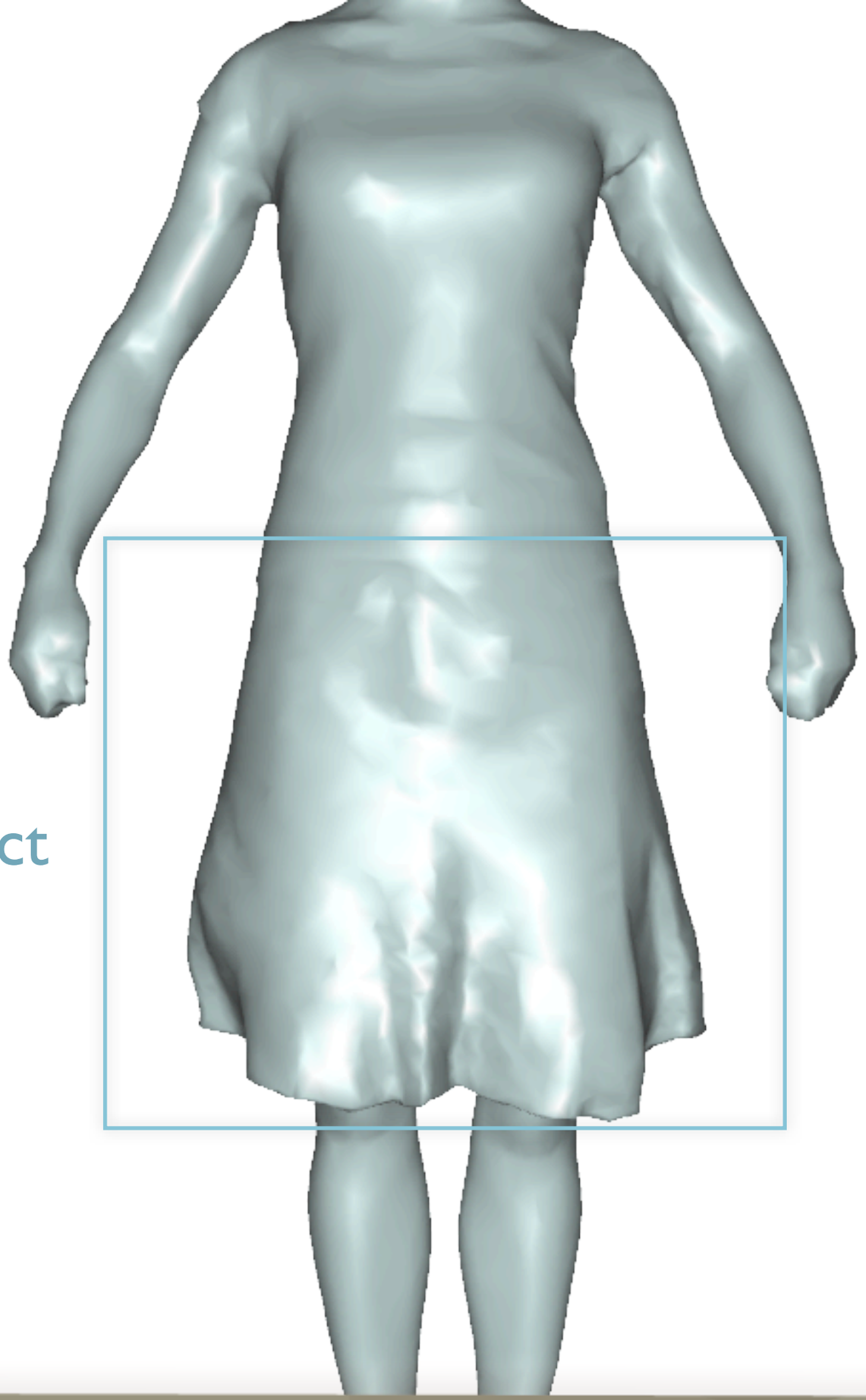
Sparse Tracking

Baked-in Details



[Vlasic et al. '08]

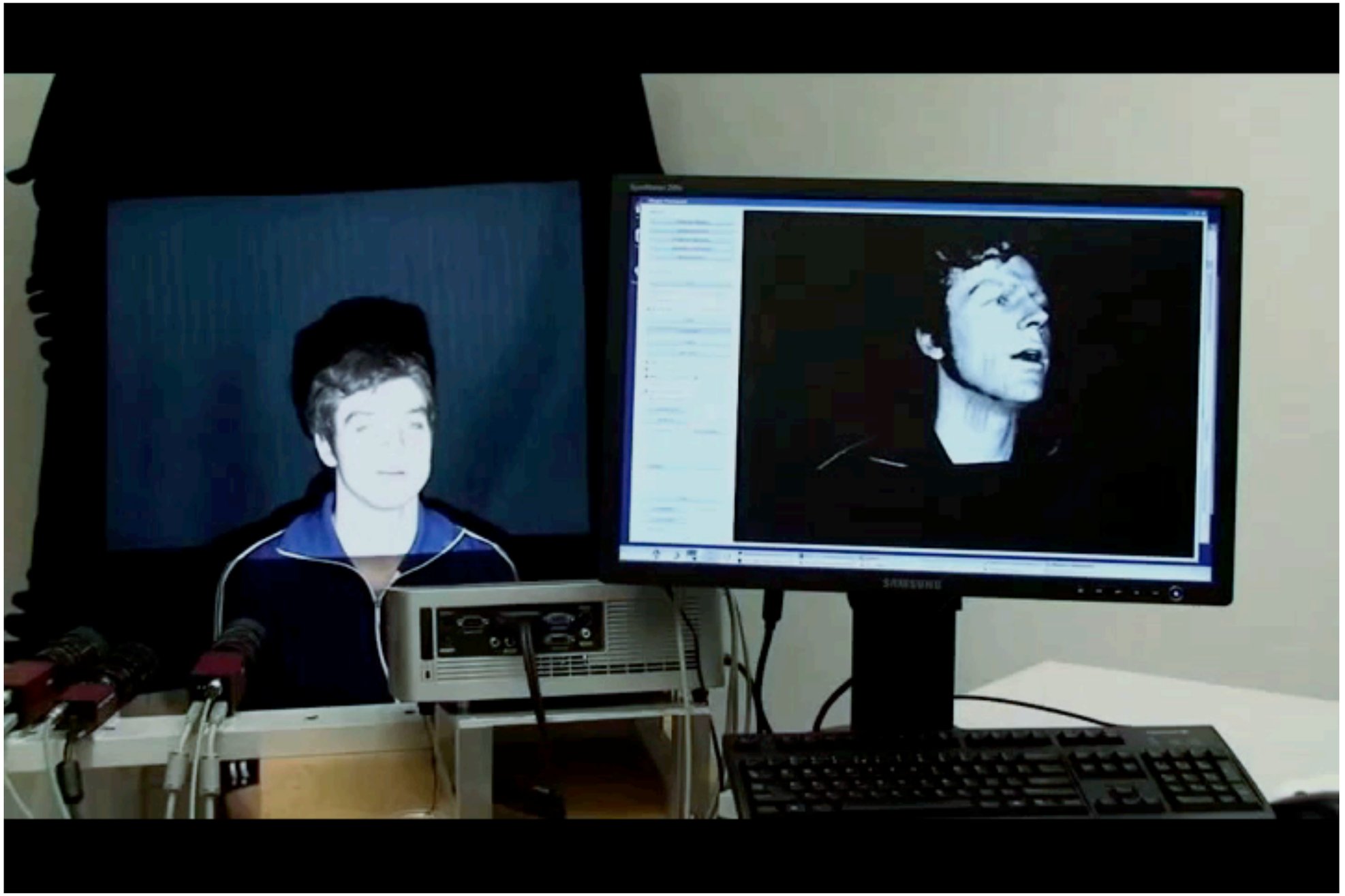
Jelly Effect



[Vlasic et al. '08]

[Vlasic et al. ’08]

Real-time Dense Acquisition

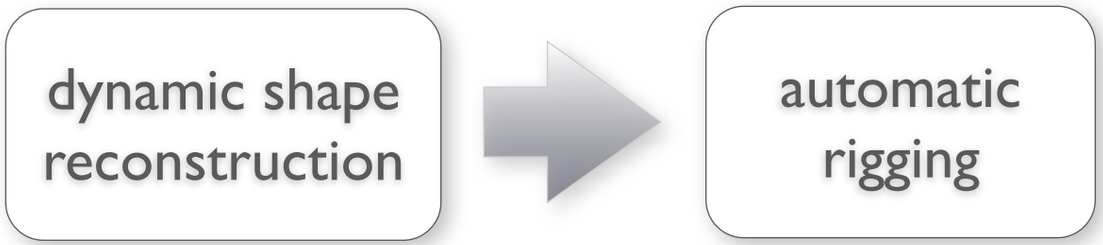


Structured Light Based on Phase-Shift Stereo [Weise et al. '07]

Animation Reconstruction

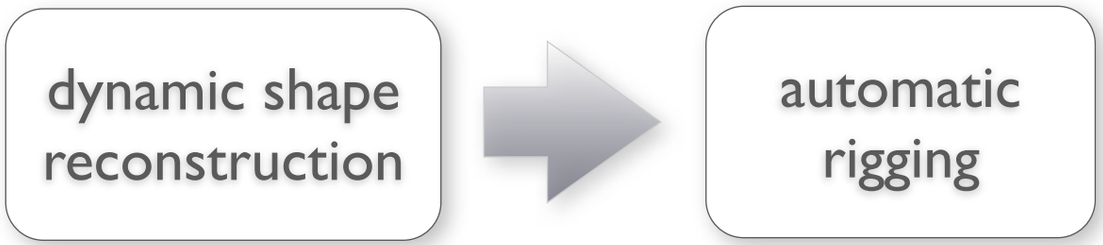
Animation Reconstruction

Animation Reconstruction

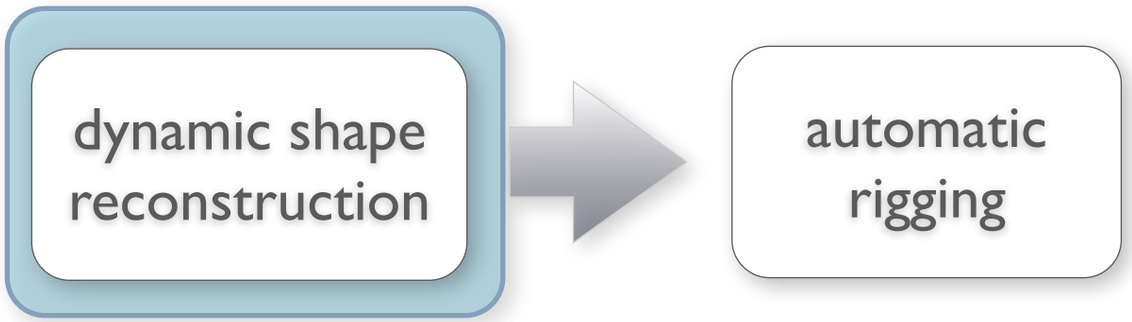


Animation Reconstruction

Animation Reconstruction



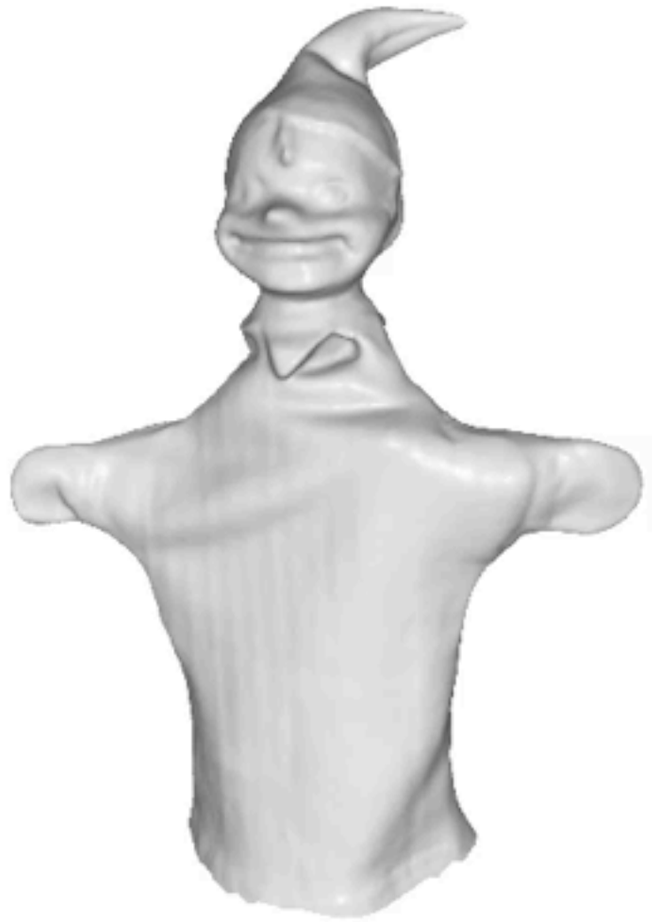
Animation Reconstruction



Objective

[Li et al. '09]

Input 3D Scan Sequence



Space-time Reconstruction

Challenges

Challenges

Challenges

Correspondence Issues

[Süssmuth et al. '08]

Challenges

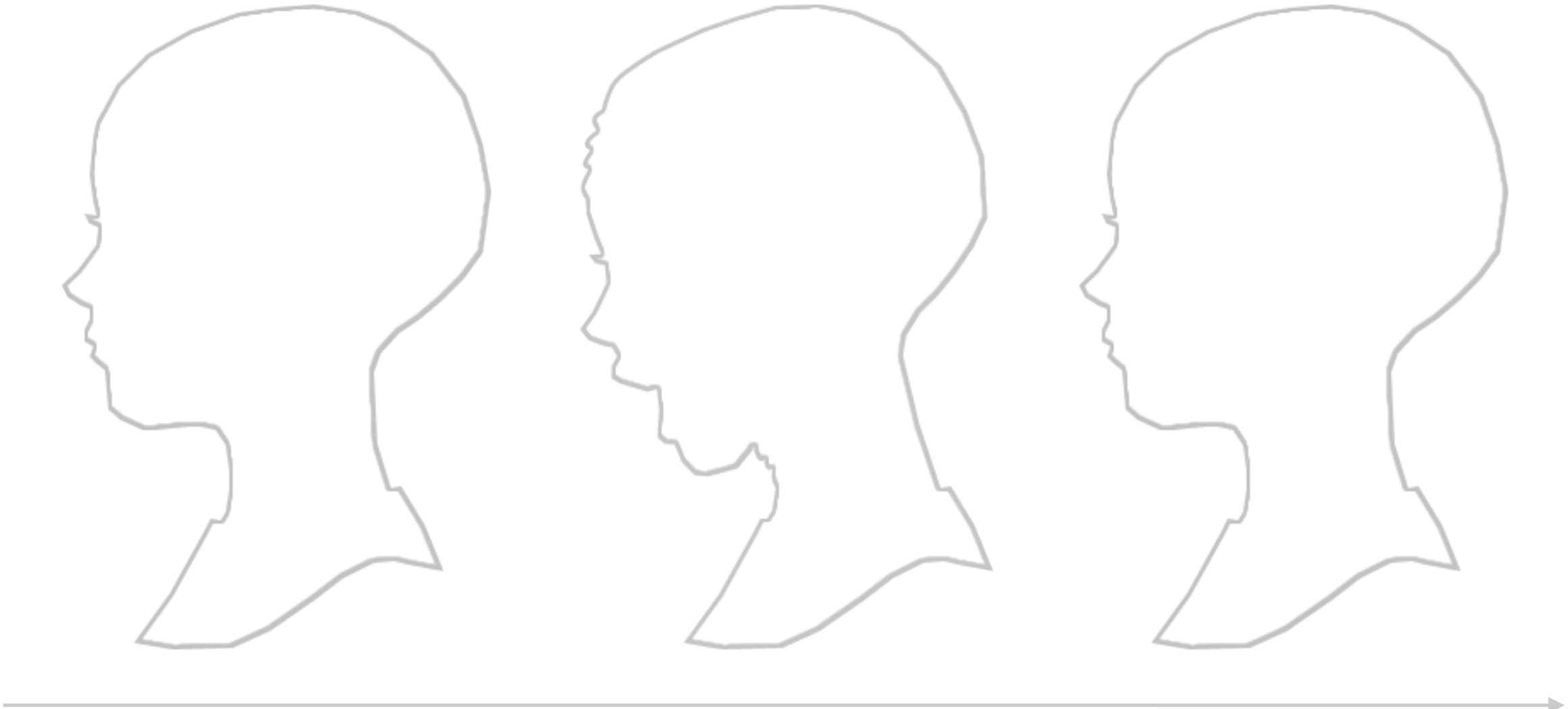
Correspondence Issues

[Süssmuth et al. '08]

Topology Issues

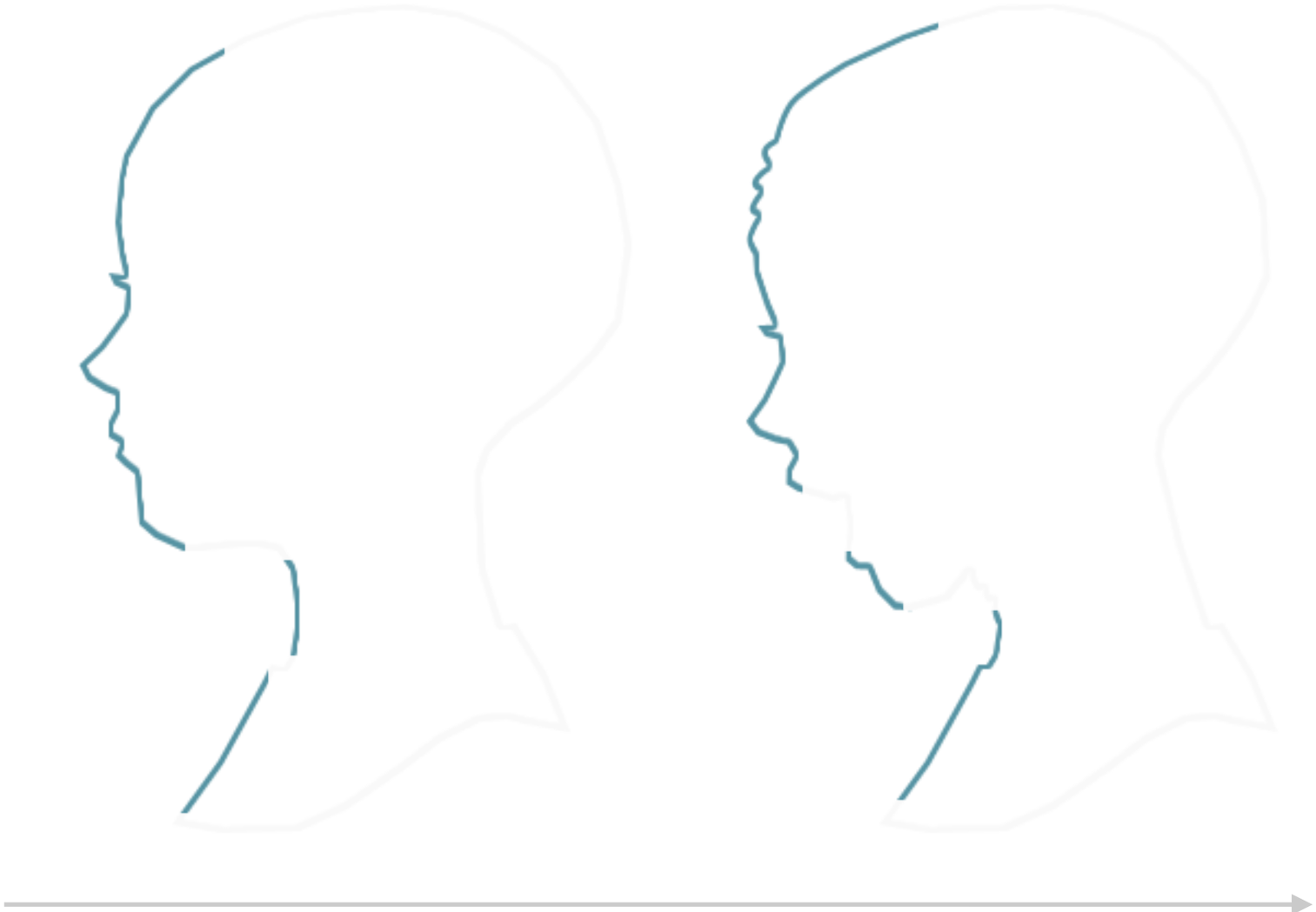
[Wand et al. '09]

Deforming Physical Subject

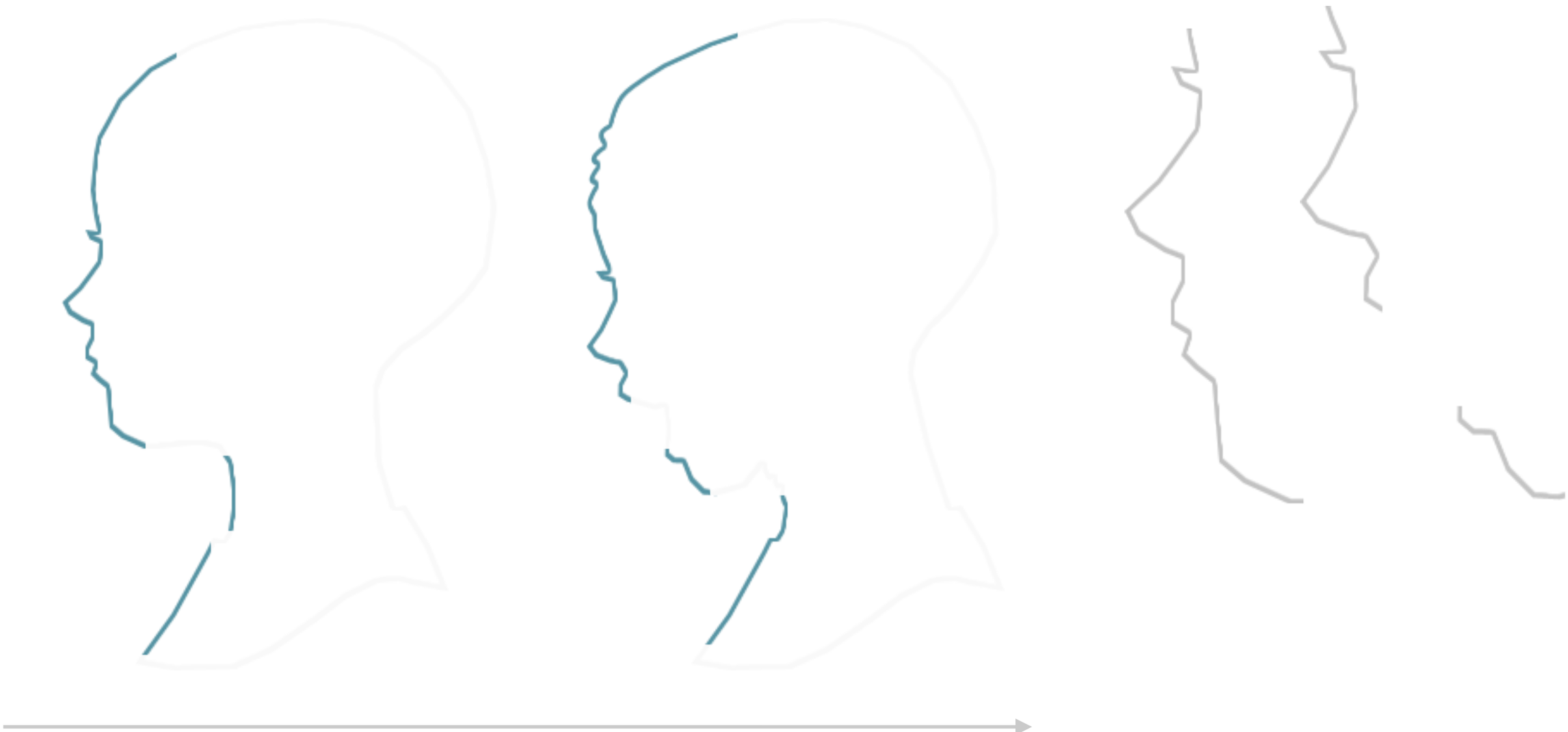


Partial Scans

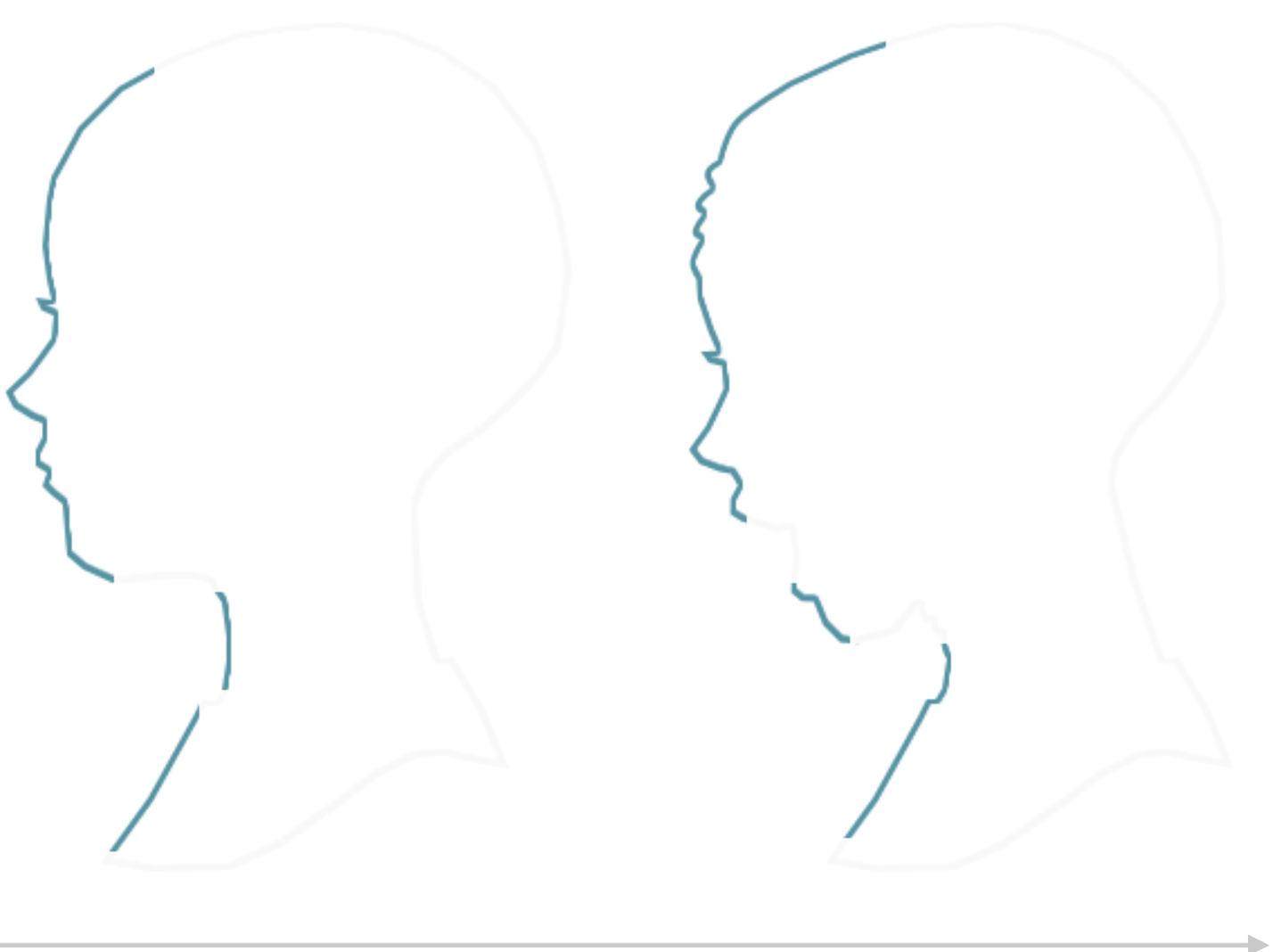
Partial and Non-Rigid Registration

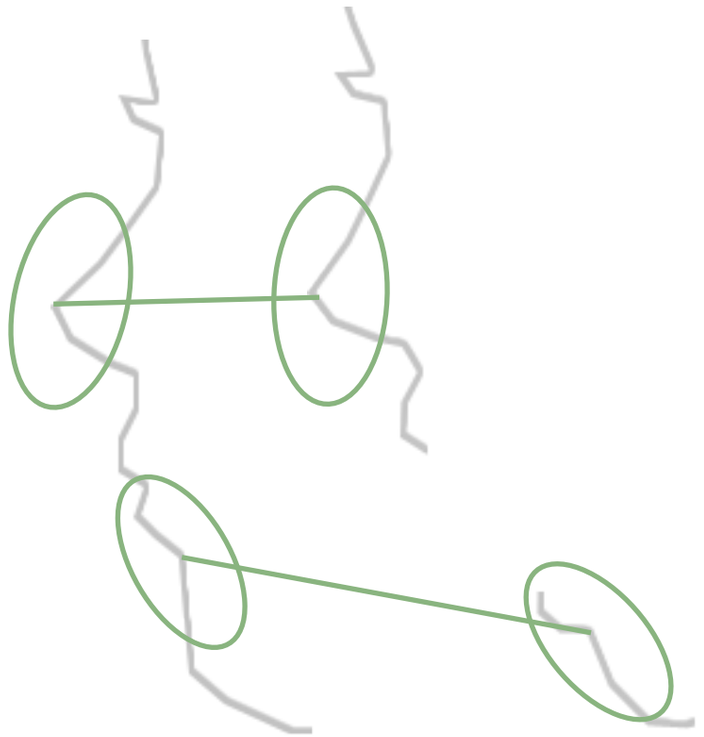


Partial and Non-Rigid Registration



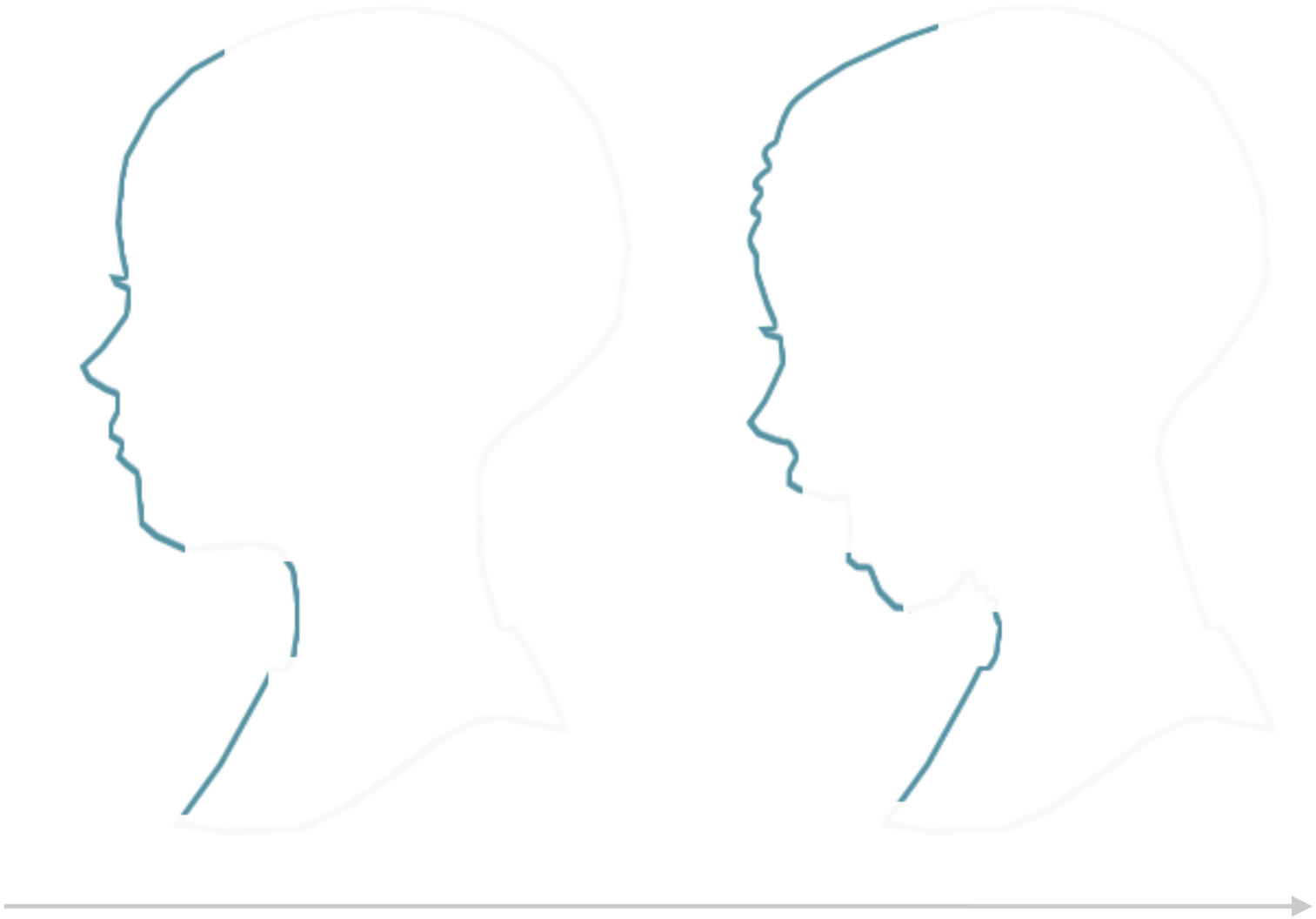
Partial and Non-Rigid Registration





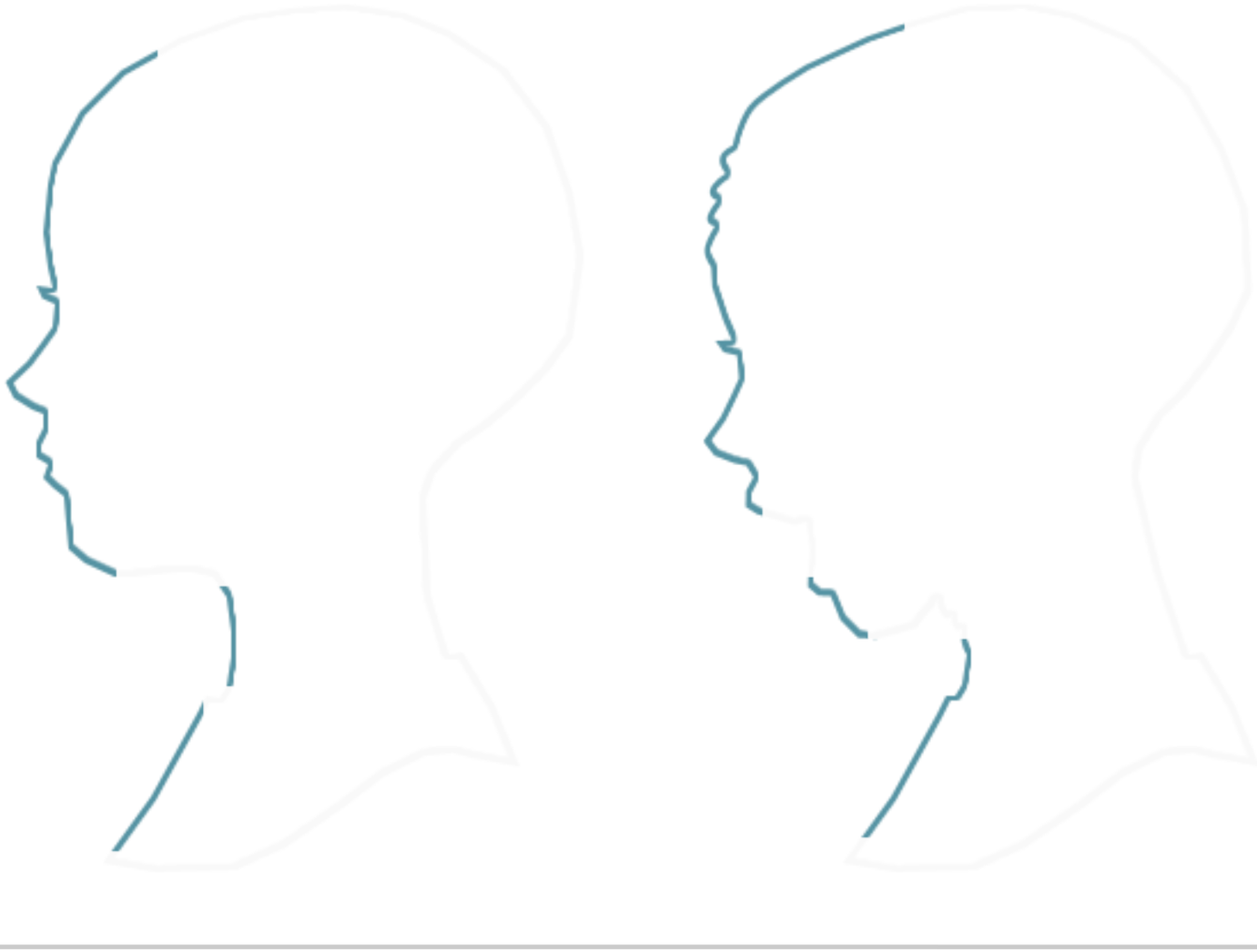
Large-Scale Motion

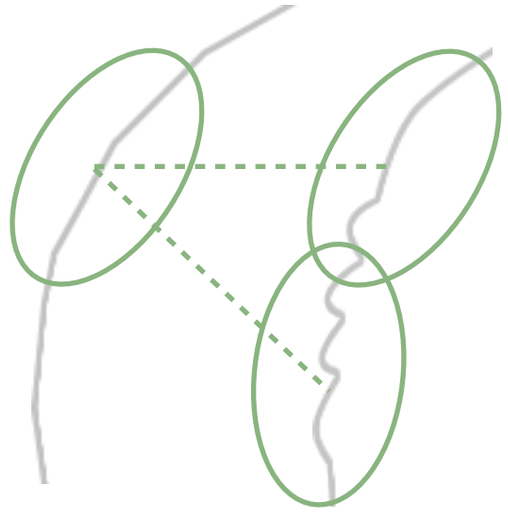
Partial and Non-Rigid Registration



Partial and Non-Rigid Registration

Partial and Non-Rigid Registration



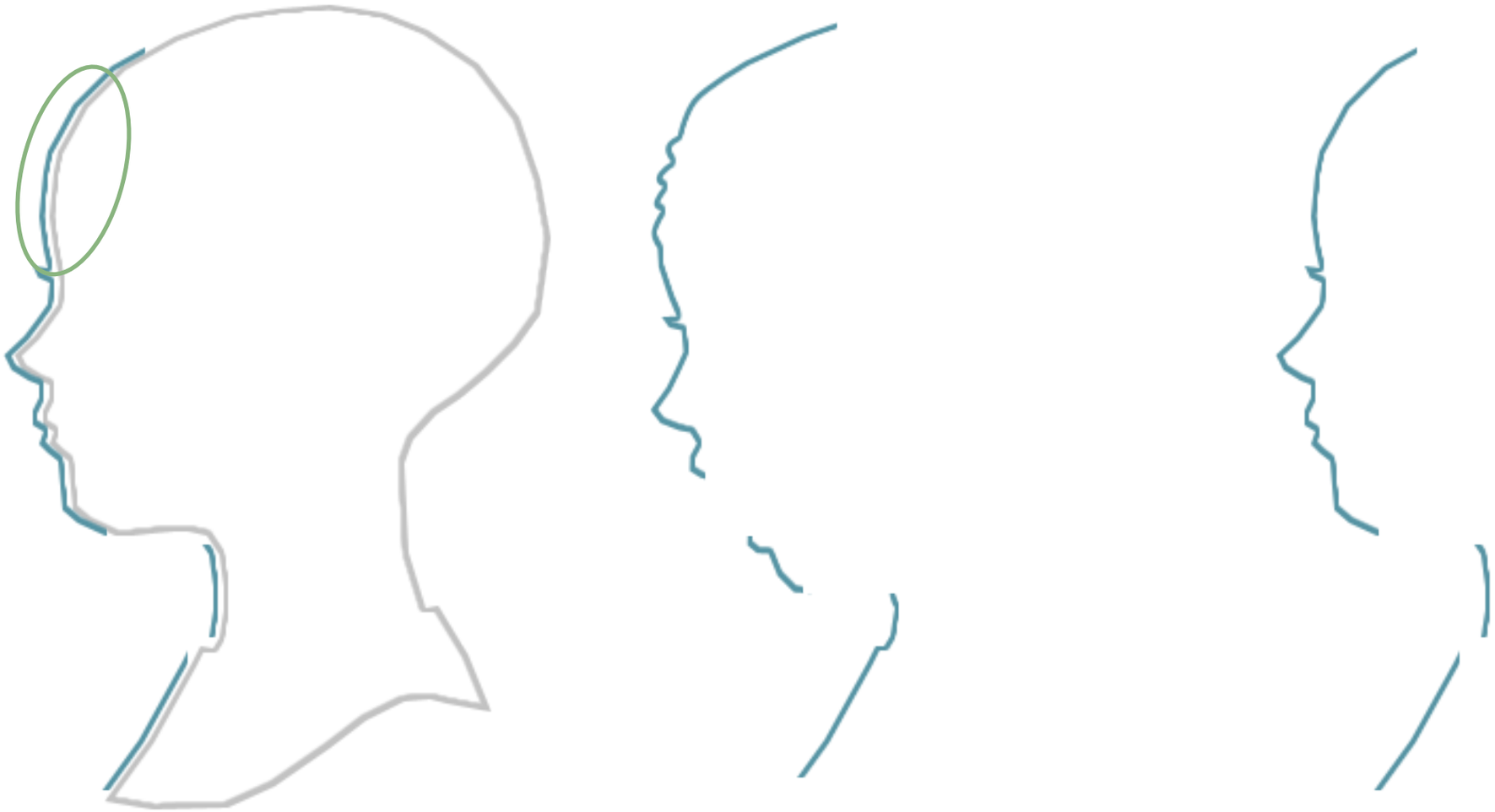


Small-Scale Dynamics

Bi-Resolution Approach

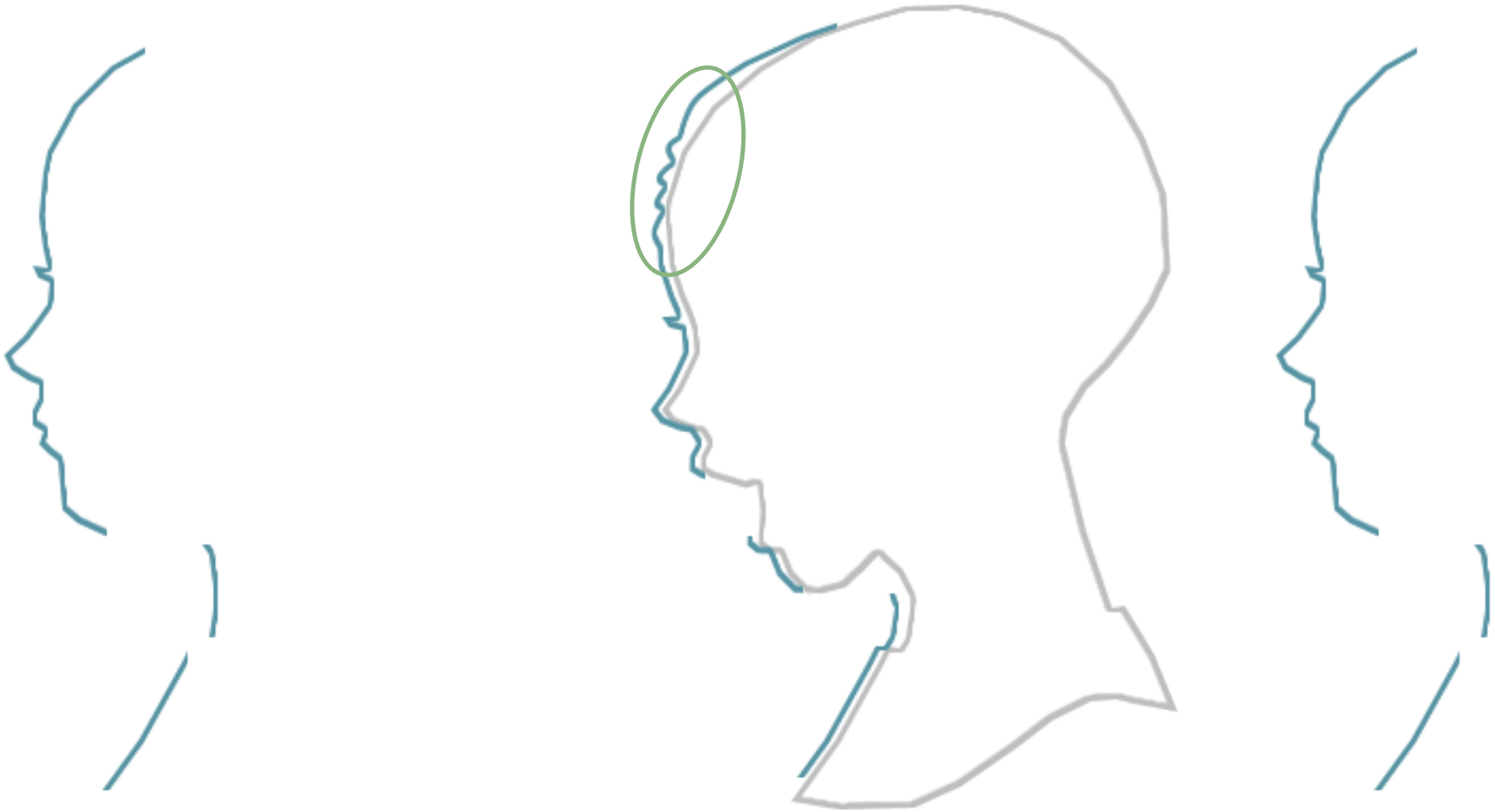
Warping a coarse template

Bi-Resolution Approach



Warping a coarse template

Bi-Resolution Approach

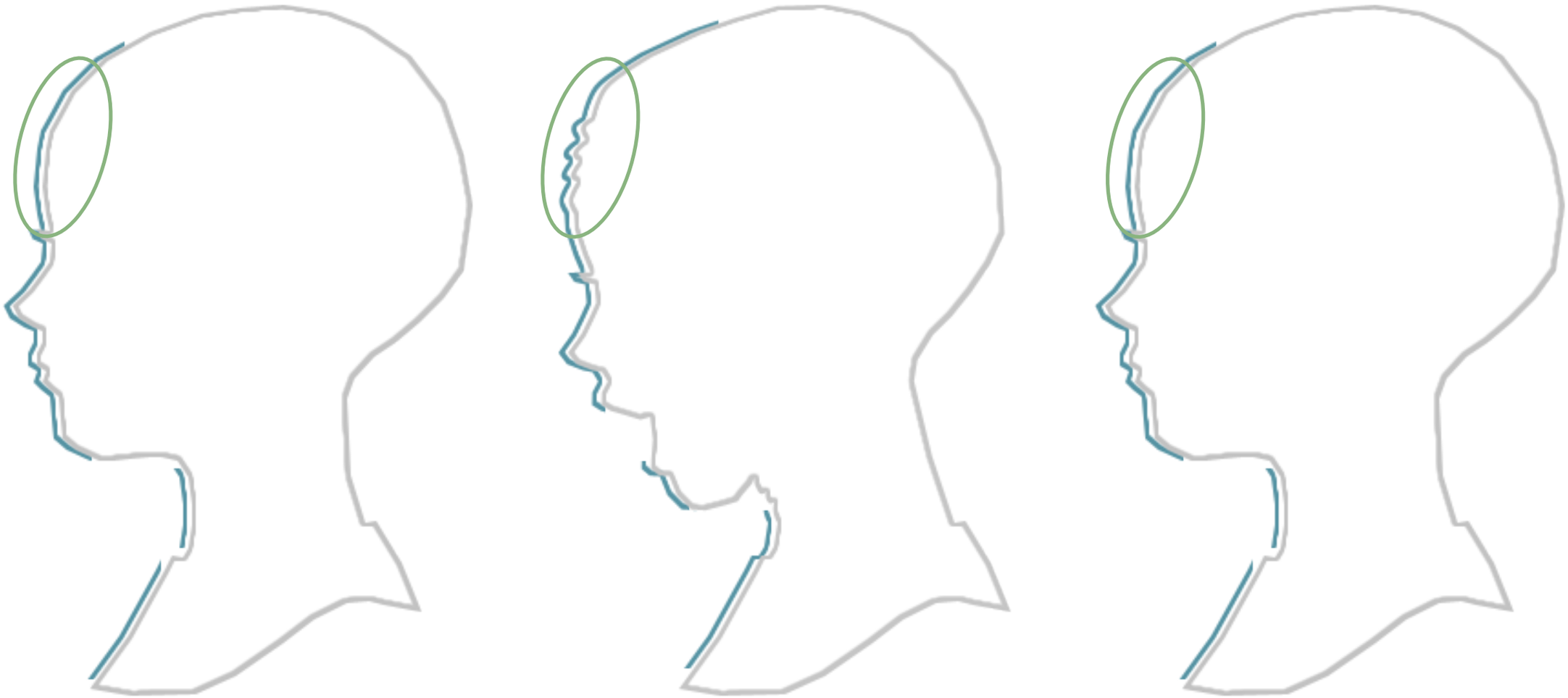


Warping a coarse template

Bi-Resolution Approach

Warping a coarse template

Bi-Resolution Approach



Synthesizing small scale details

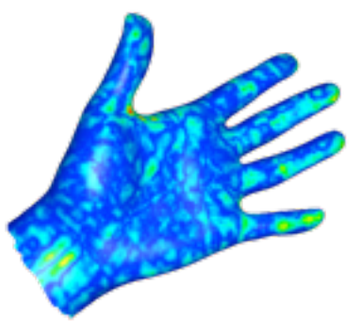
Reconstruction Framework

Reconstruction Framework

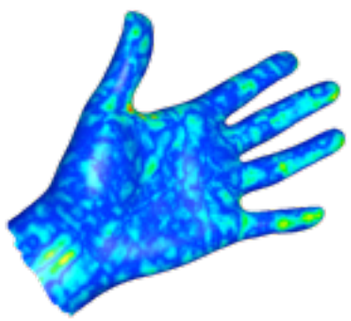
Reconstruction Framework

detail estimation

Reconstruction Framework

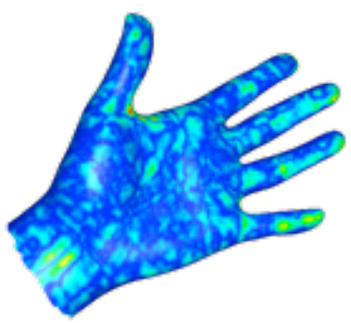


Reconstruction Framework

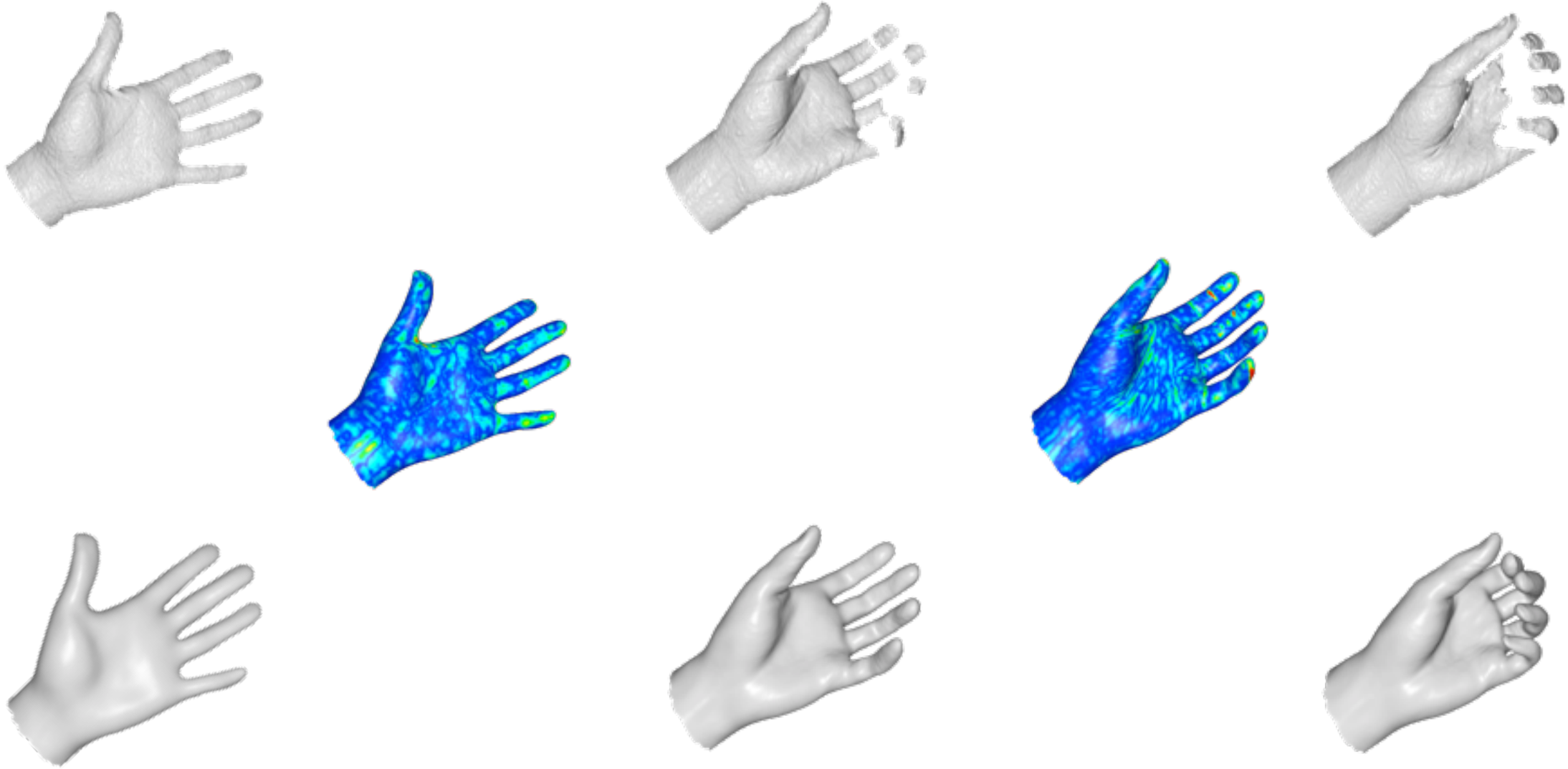


non-rigid registration

Reconstruction Framework

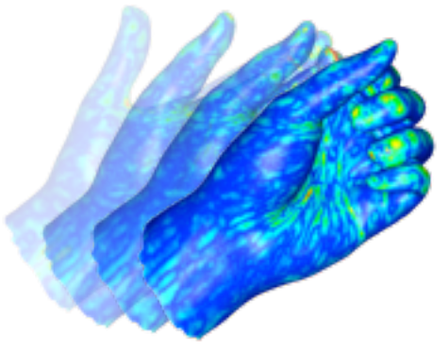


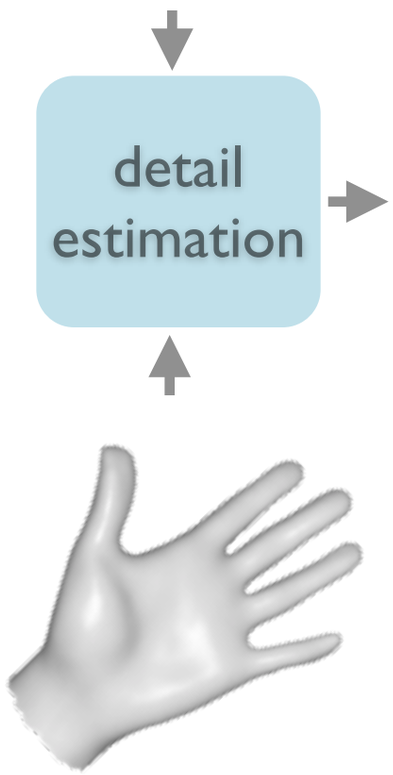
Reconstruction Framework



Reconstruction Framework

Reconstruction Framework



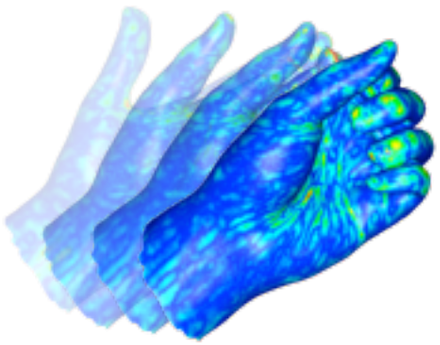


detail estimation

non-rigid registration

Large-Scale Motion

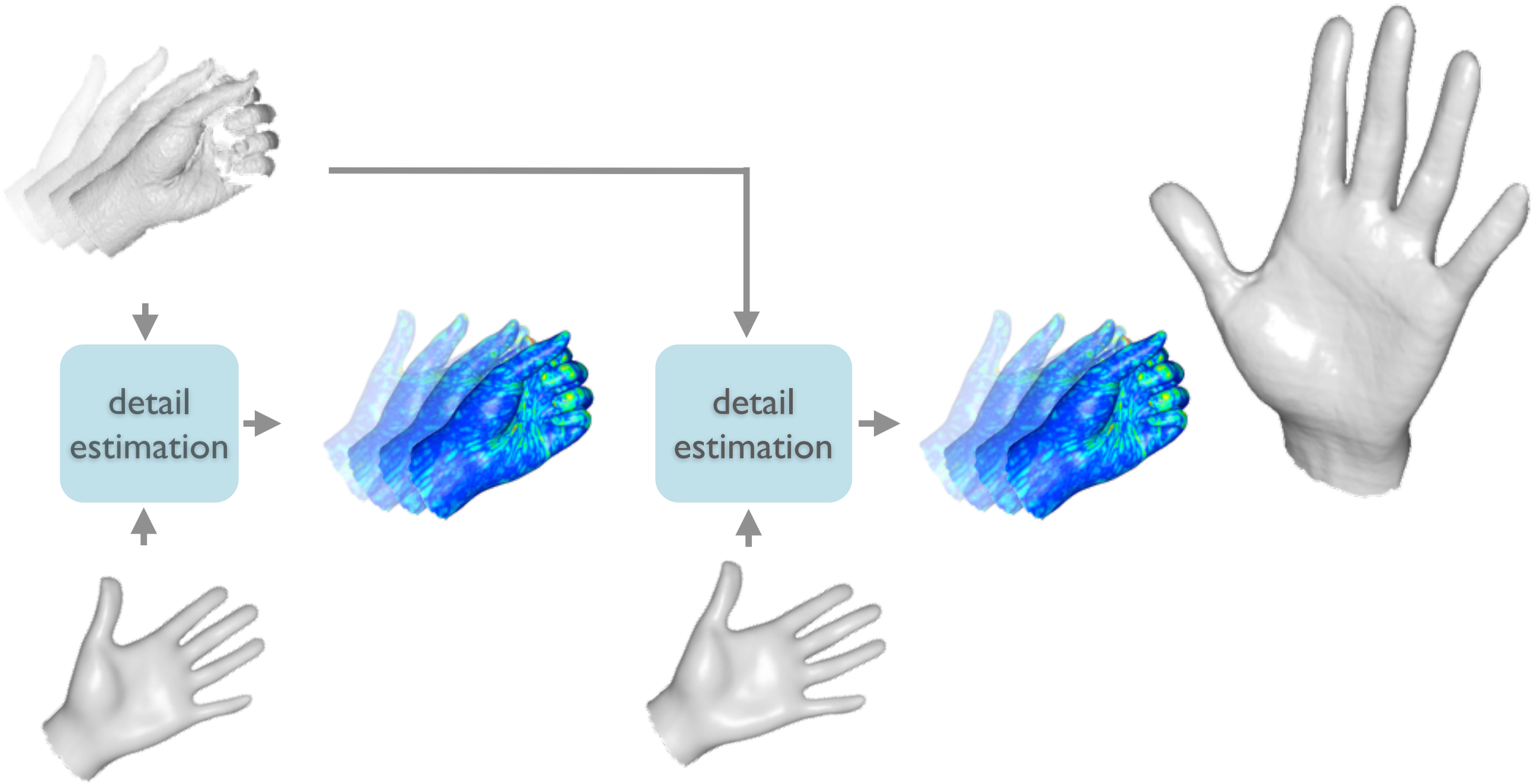
Reconstruction Framework



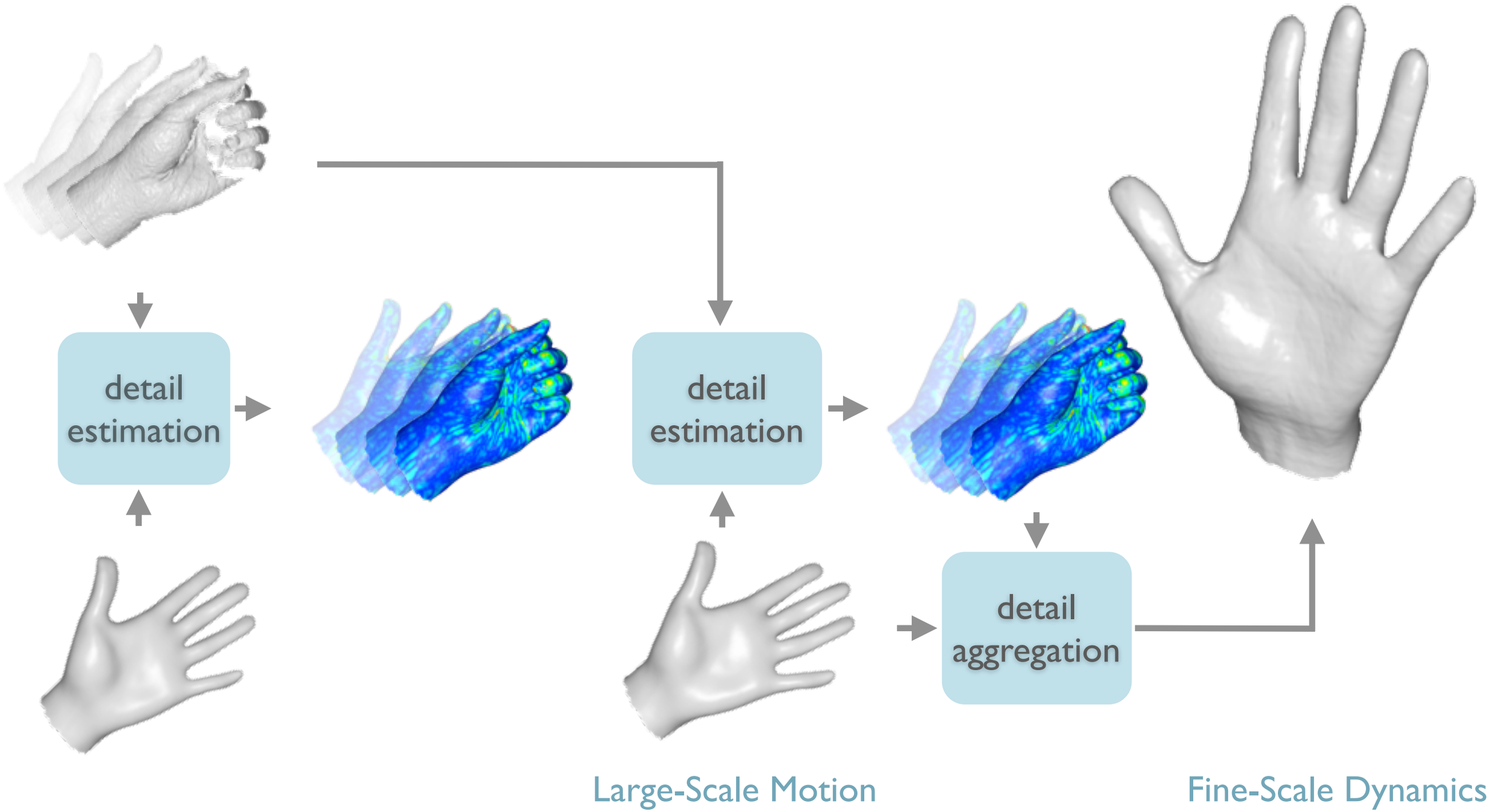
detail estimation

Large-Scale Motion

Reconstruction Framework



Reconstruction Framework



Sequential Non-Rigid Registration

input data

data provided by Stanford and MPI Saarbrücken

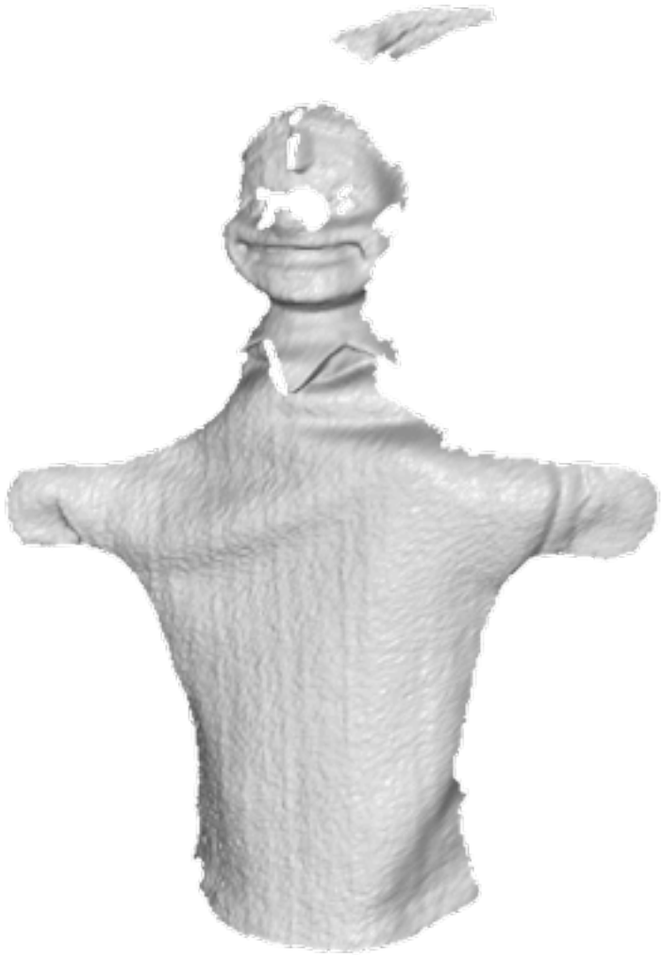
Sequential Non-Rigid Registration

input data

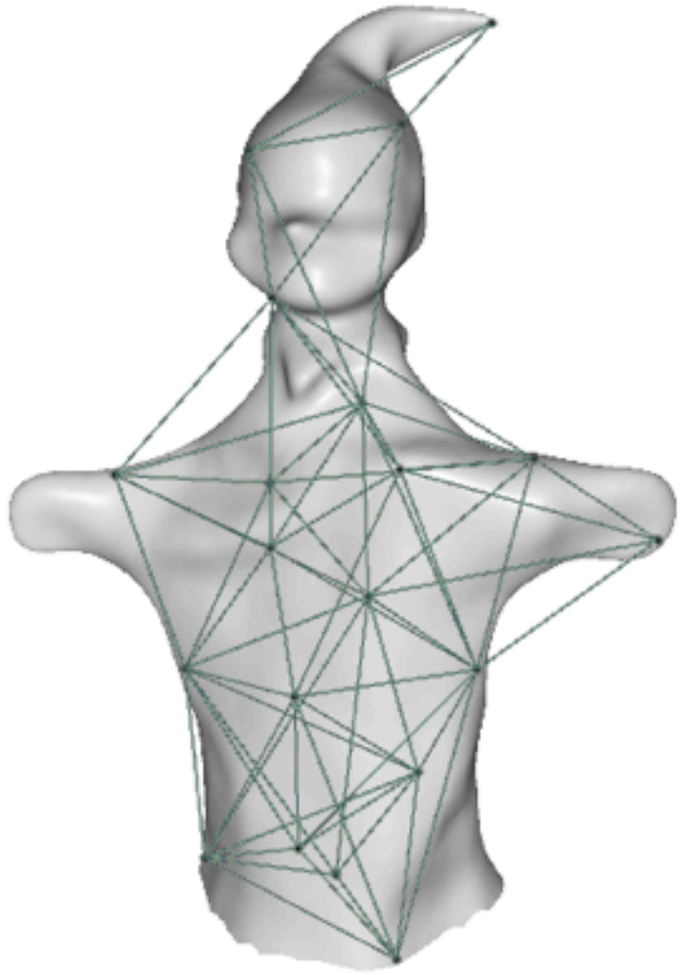
template fitting

data provided by Stanford and MPI Saarbrücken

Adaptive Deformation Model



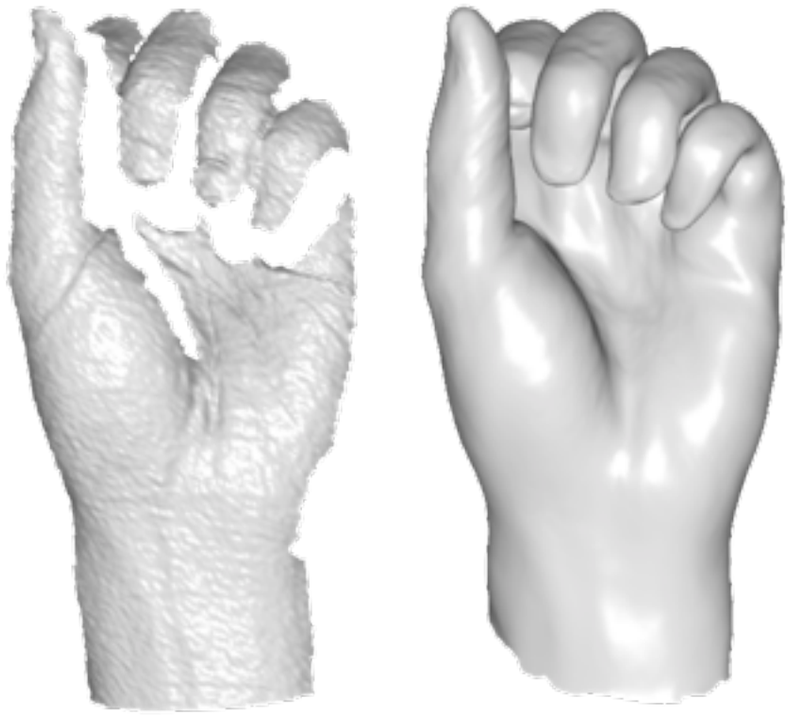
Input Scans



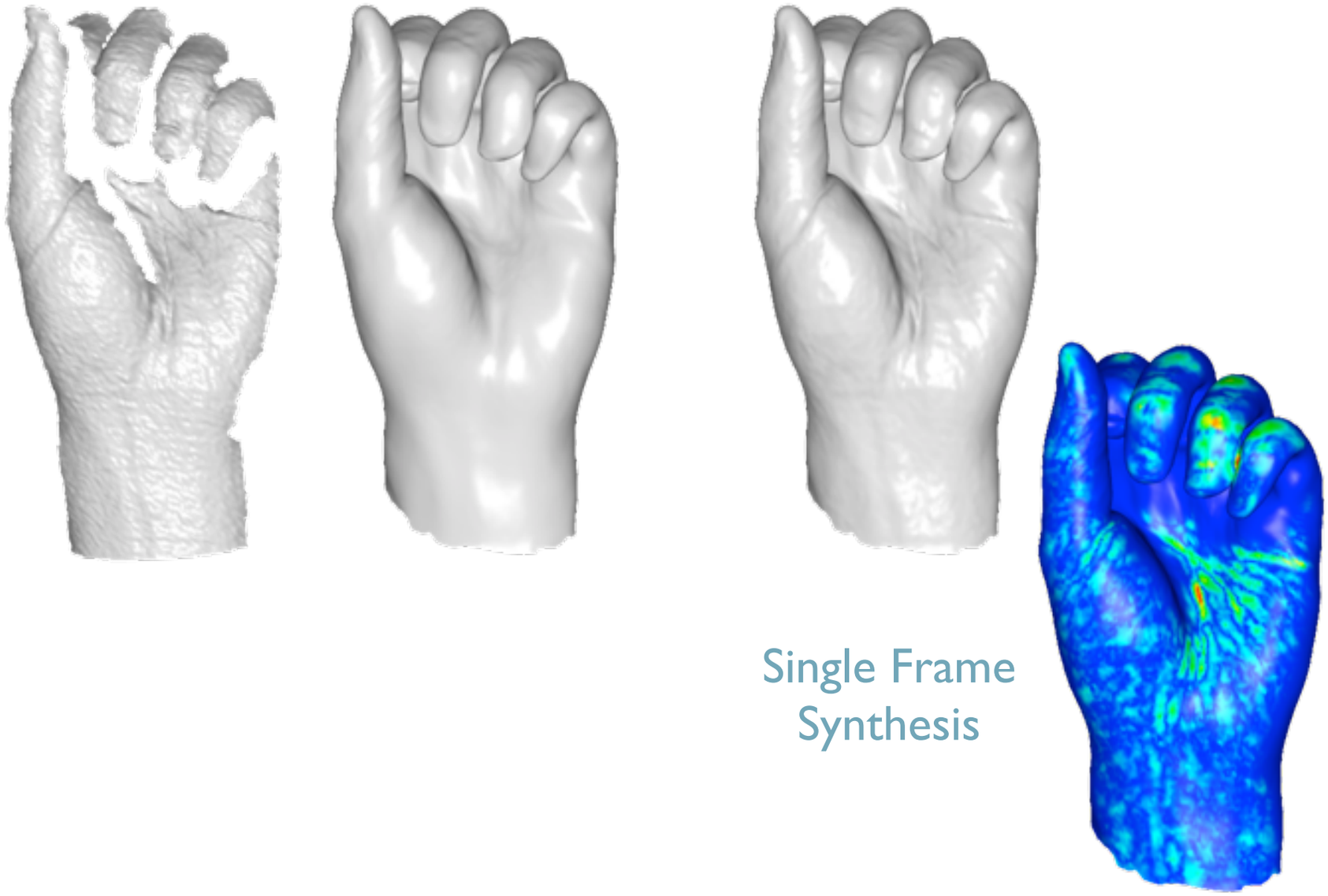
Warped Template with Graph

Detail Aggregation

Detail Aggregation

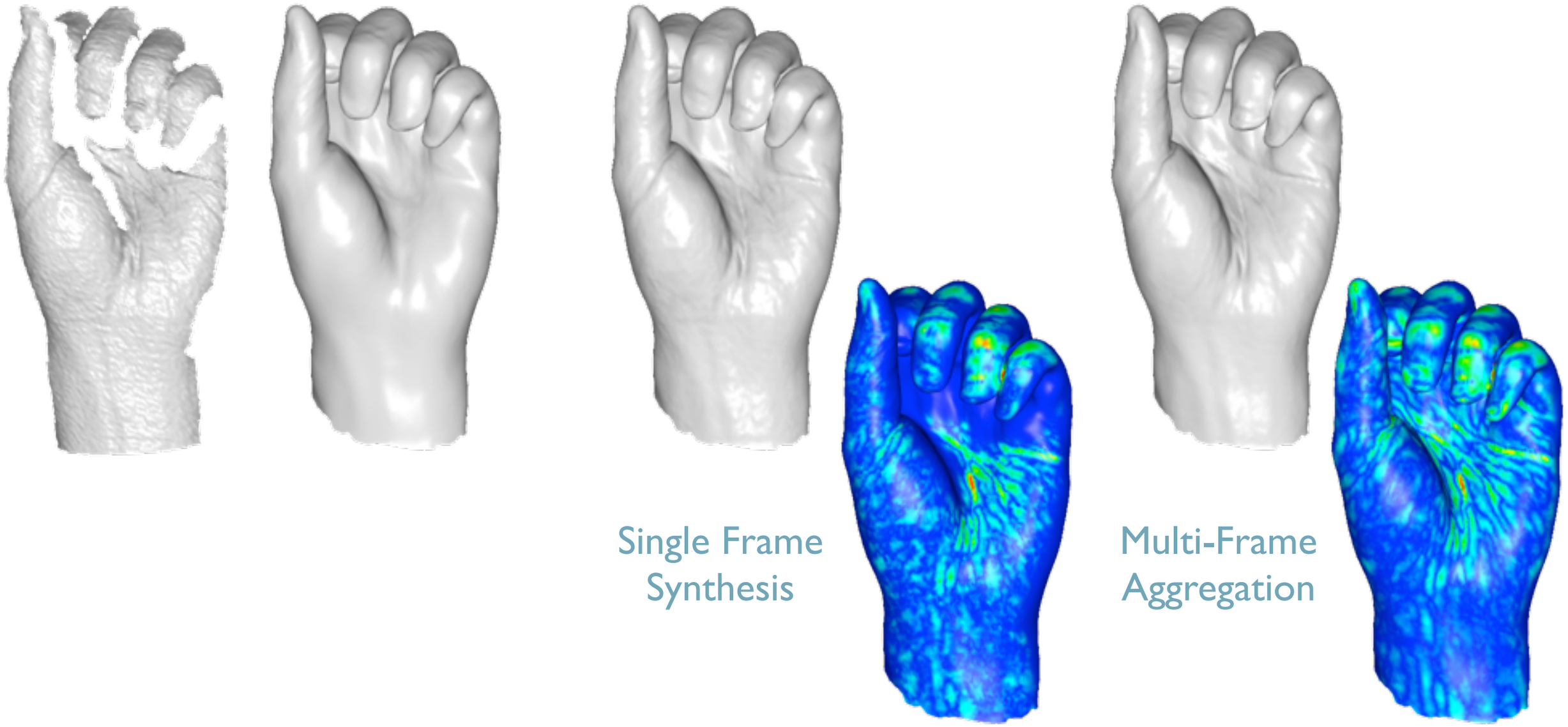


Detail Aggregation



Single Frame Synthesis

Detail Aggregation

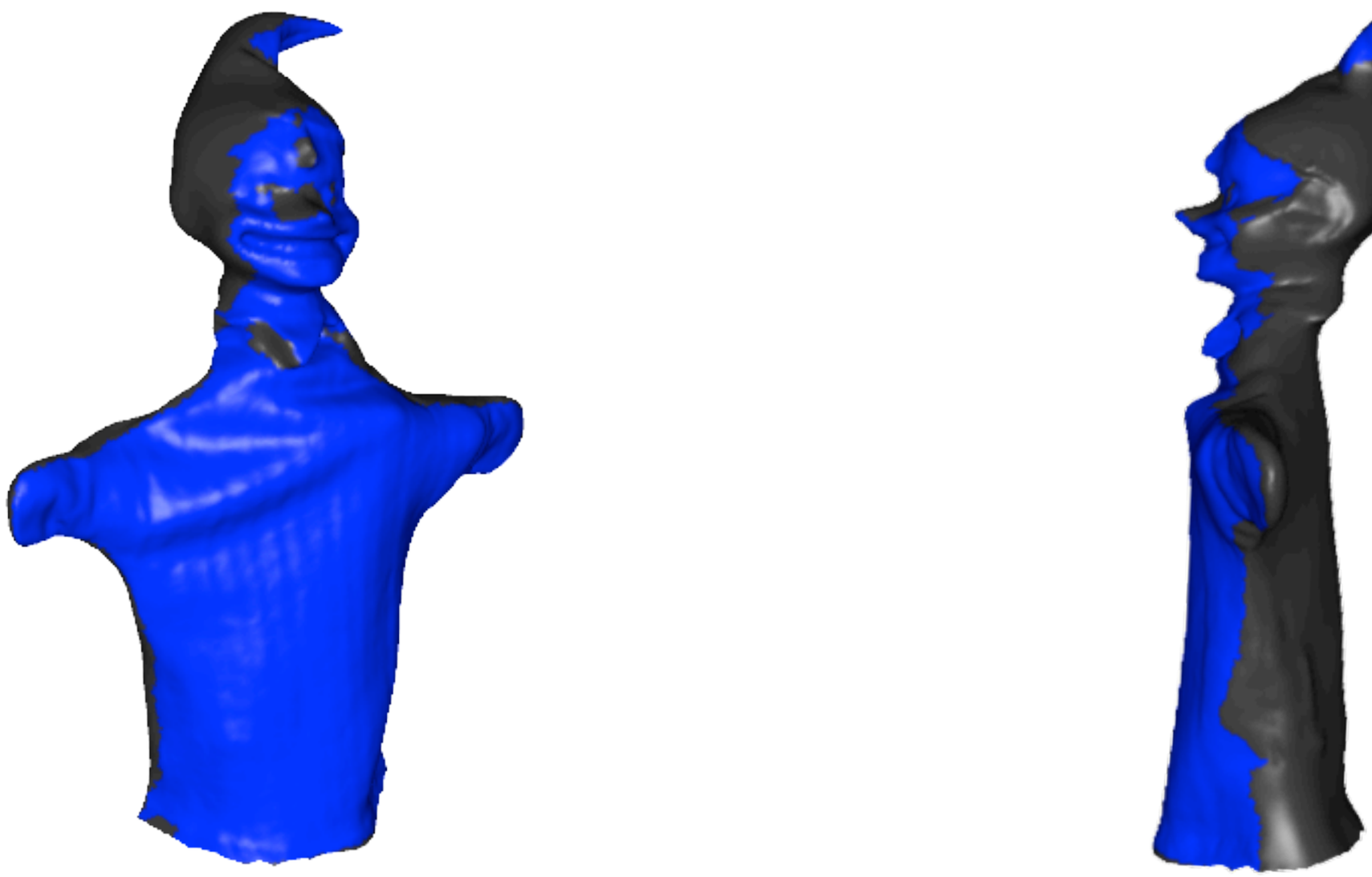


Single Frame Synthesis

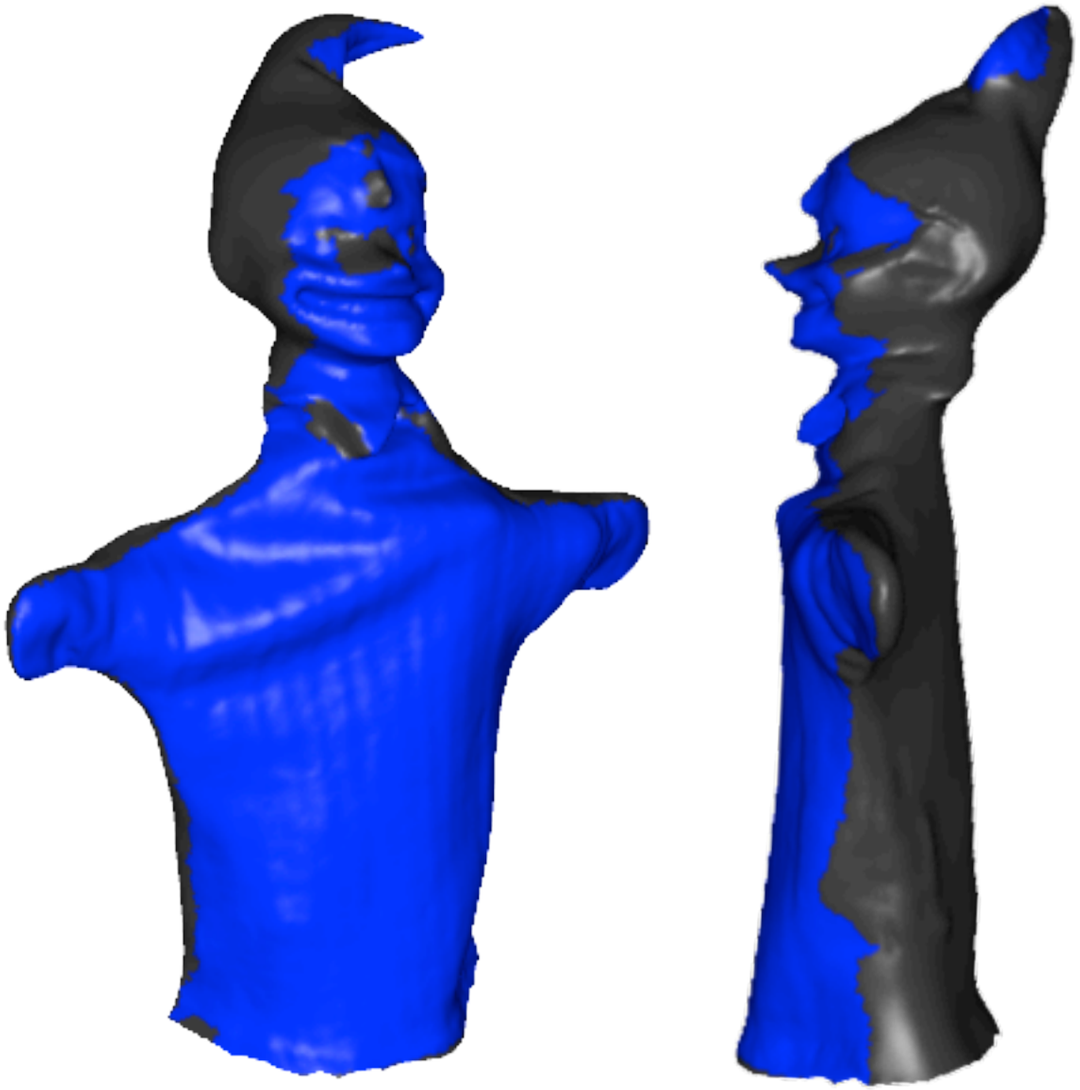
Multi-Frame Aggregation

Forward-Backward Pass

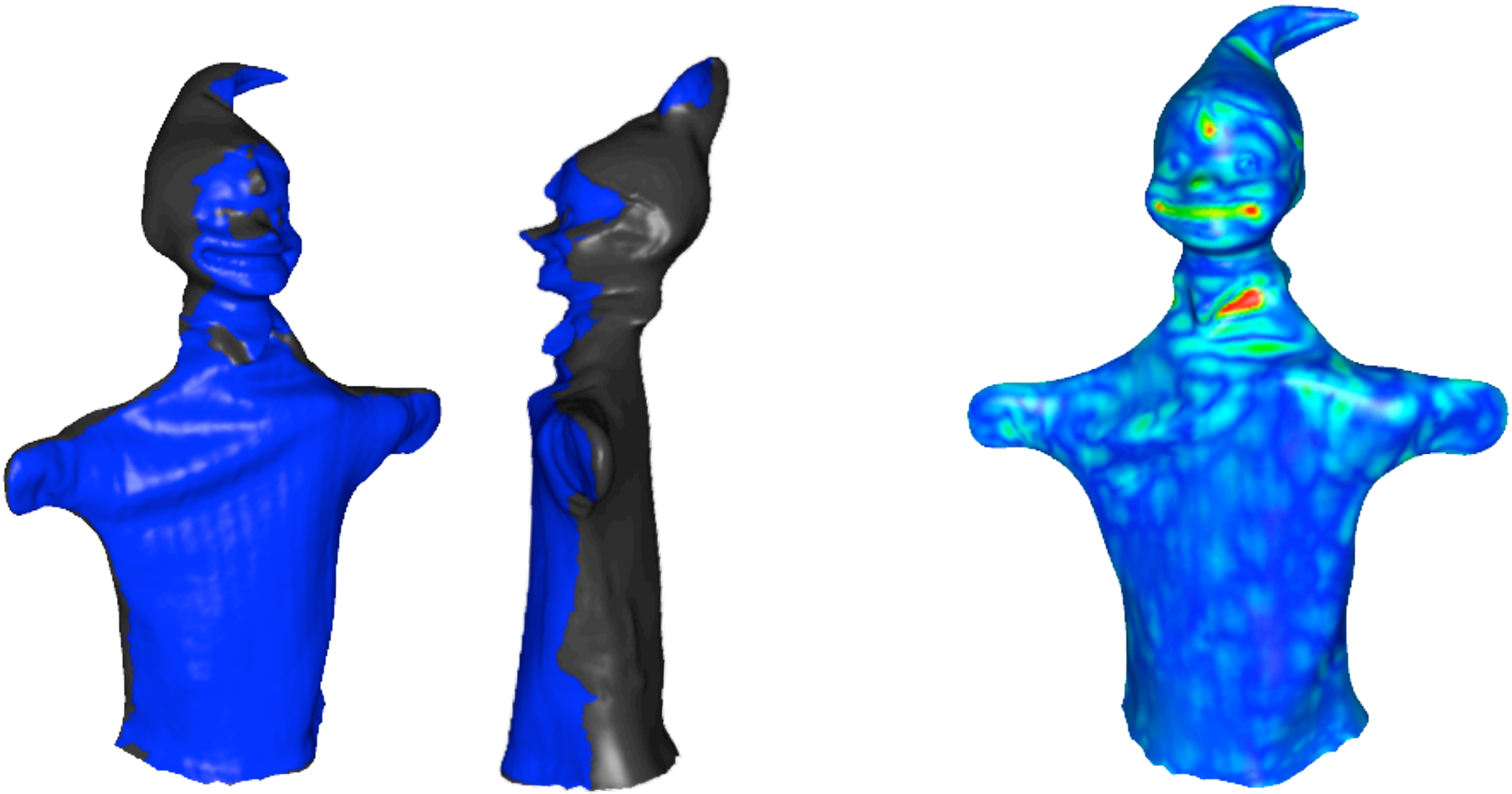
Forward-Backward Pass



Forward-Backward Pass

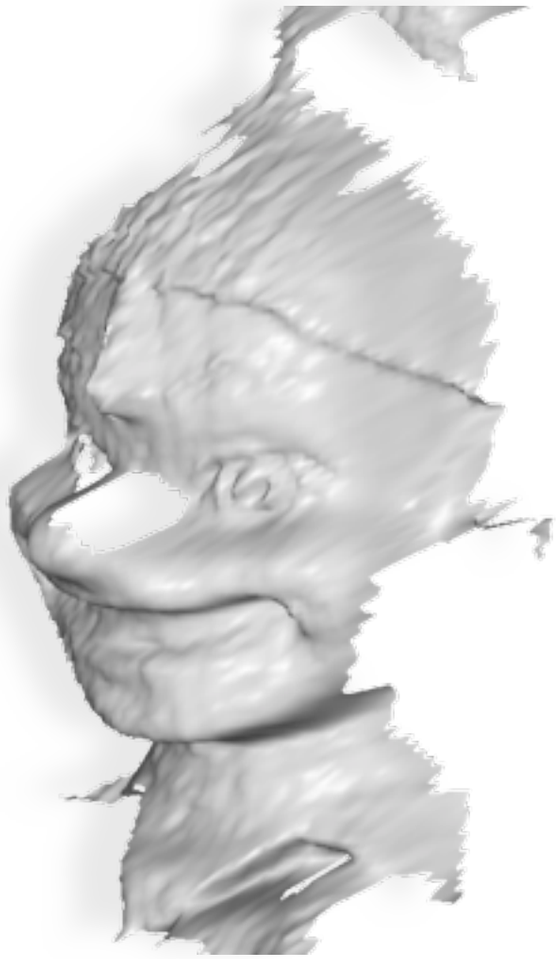


Forward-Backward Pass



Super Resolution

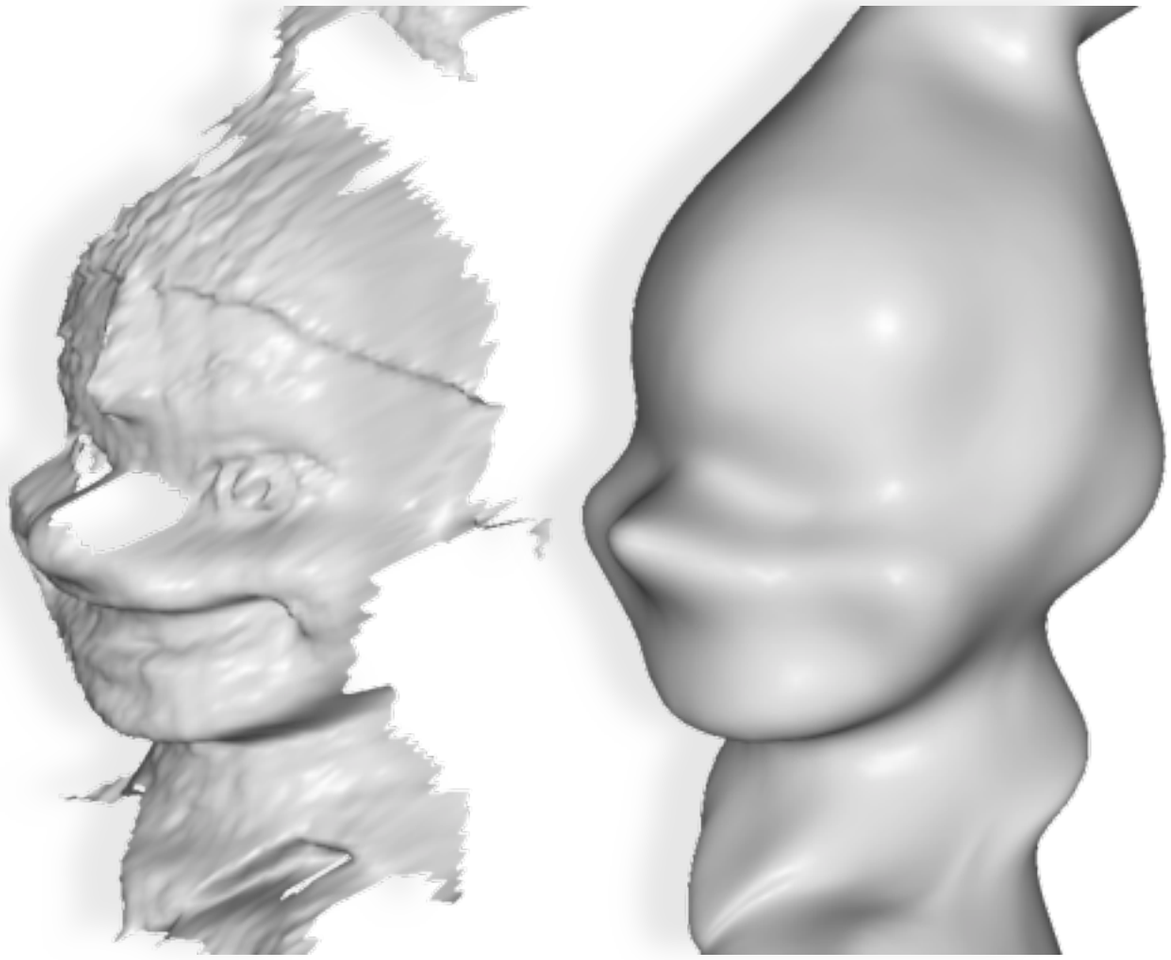
Input Scan



Super Resolution

Input Scan

Warped Template

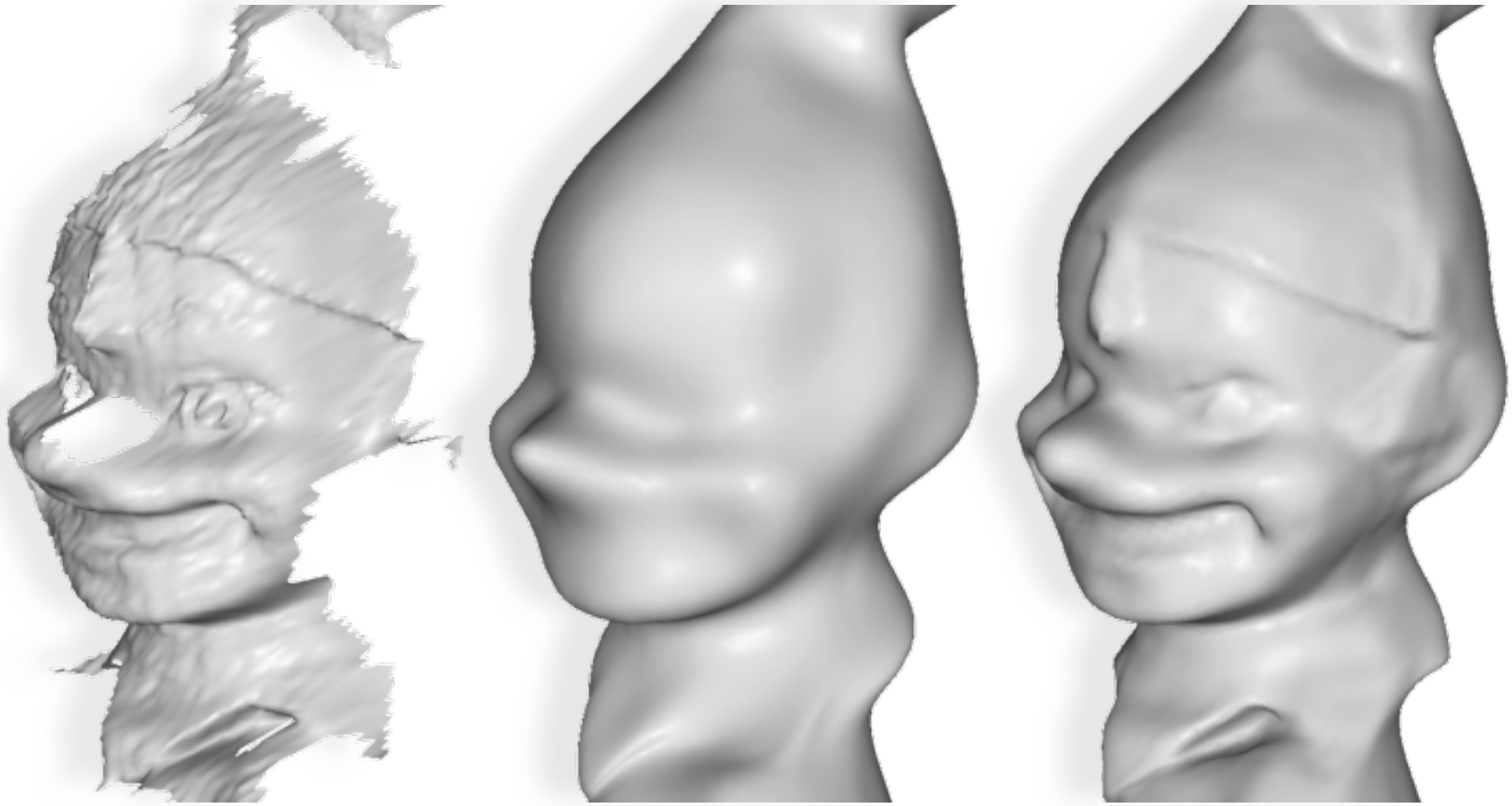


Super Resolution

Input Scan

Warped Template

Reconstruction



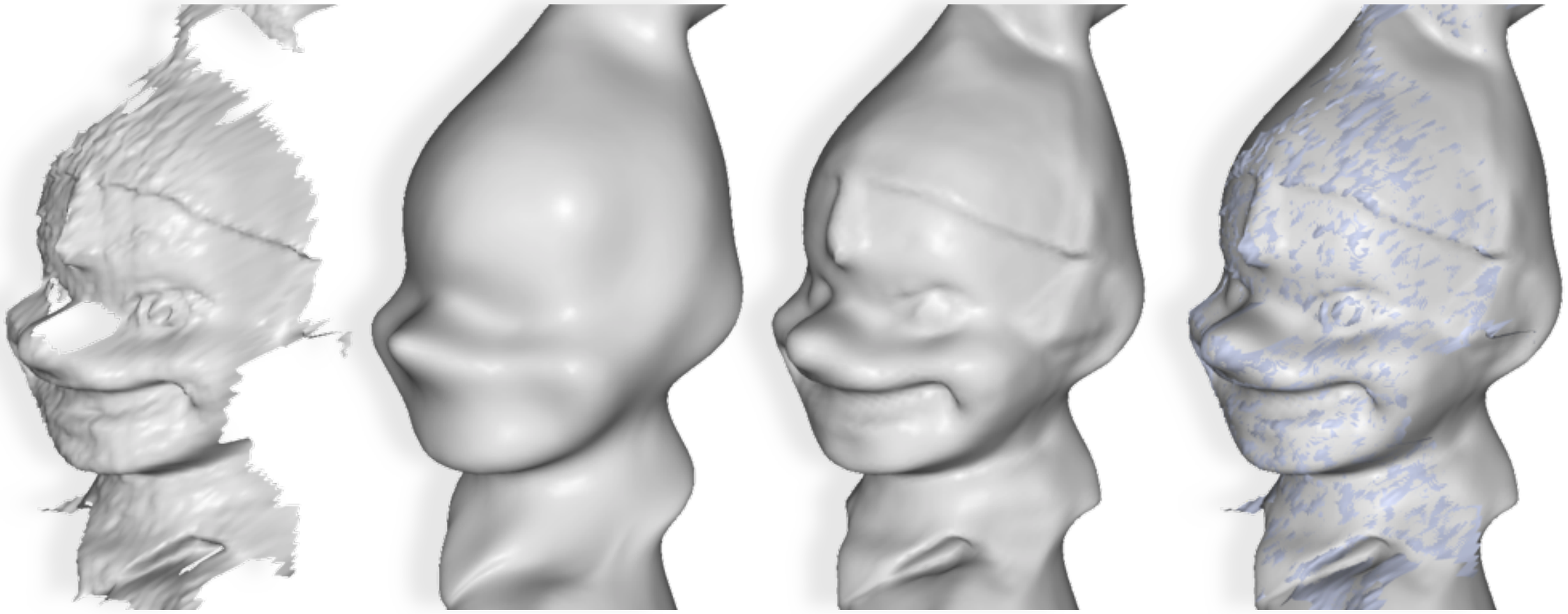
Super Resolution

Input Scan

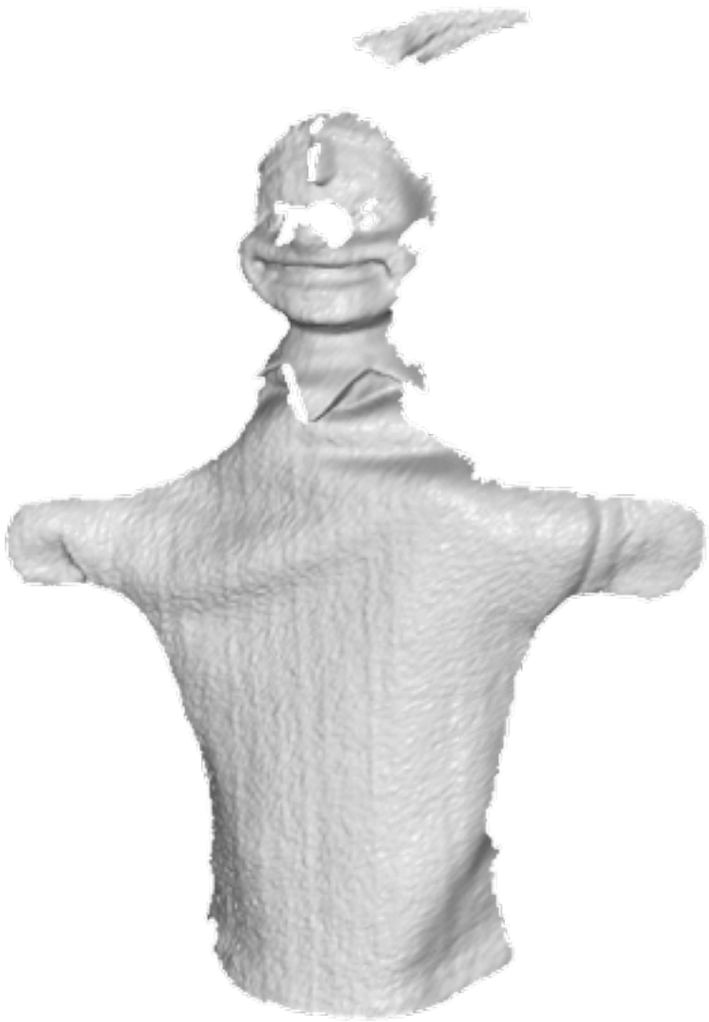
Warped Template

Reconstruction

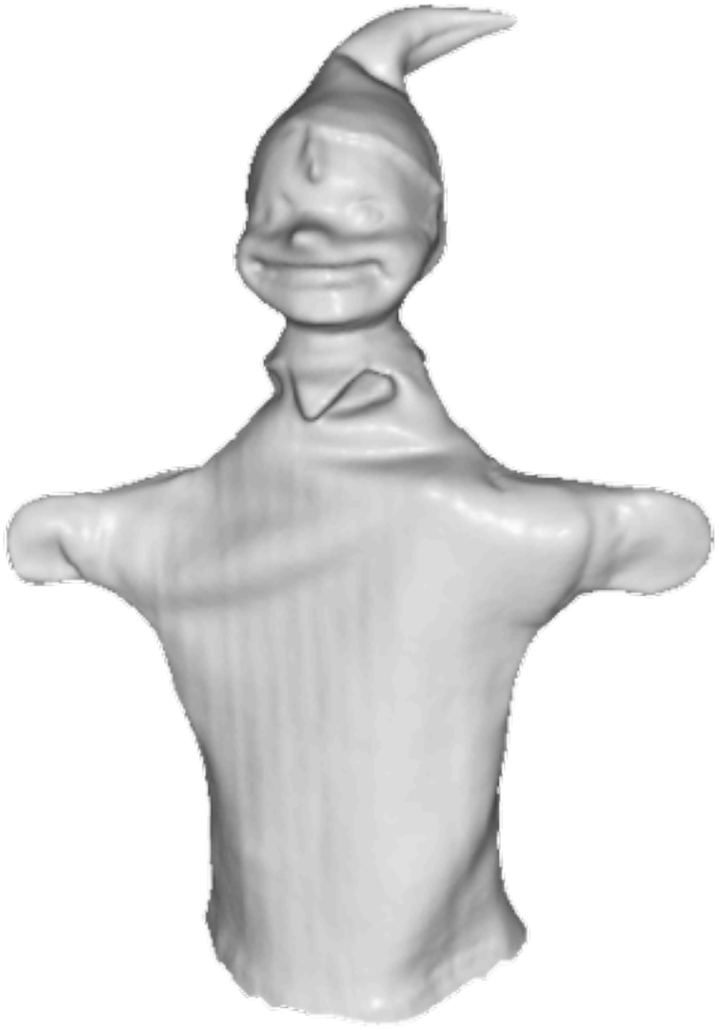
Overlaid Scan



Final Reconstruction – 100 Frames



Input Scans



Reconstruction

Textured Reconstruction

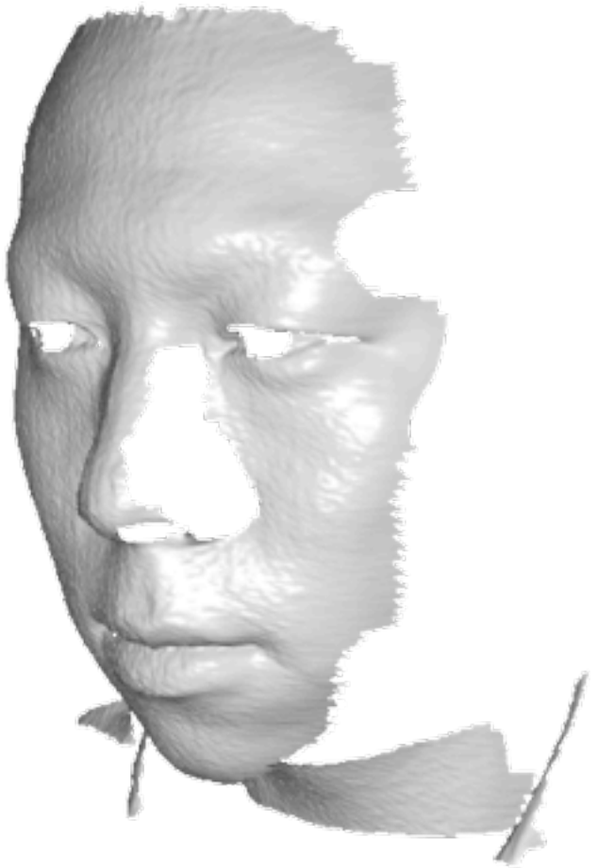
Crumpling Paper Bag – 85 Frames

Input Scans

Reconstruction

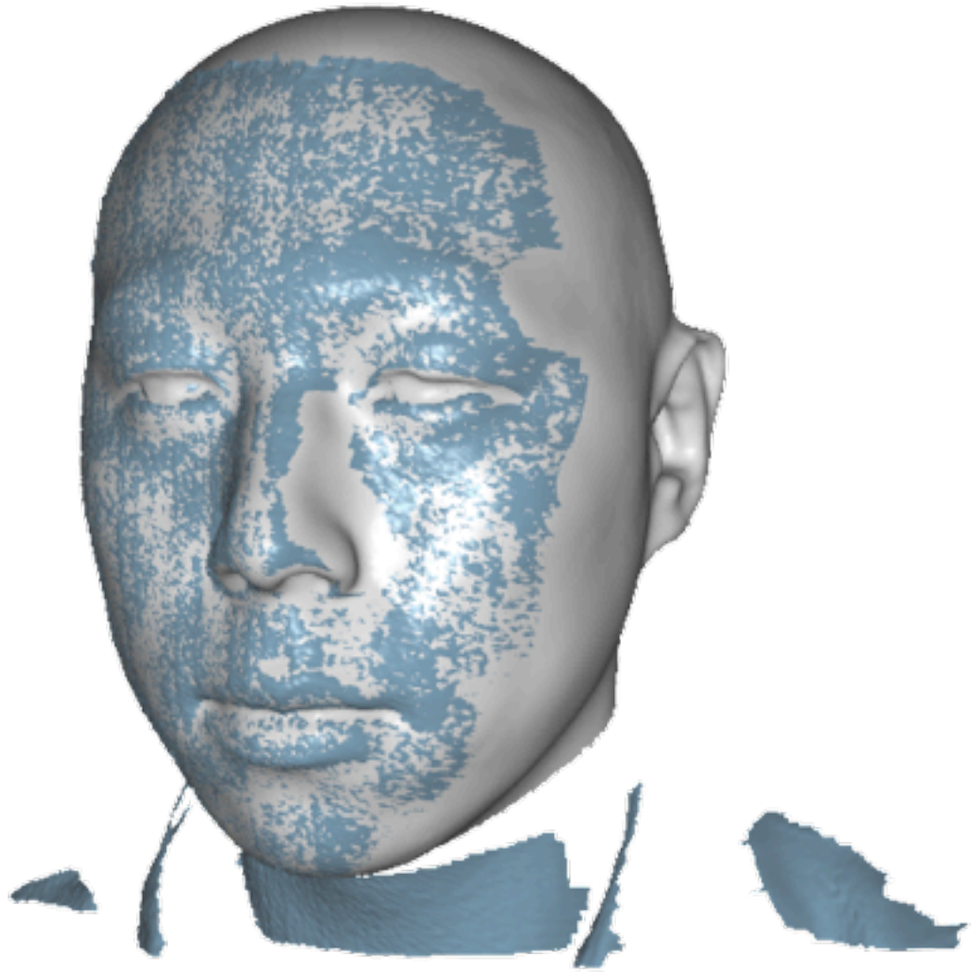
Textured Reconstruction

Facial Expressions – 200 Frames



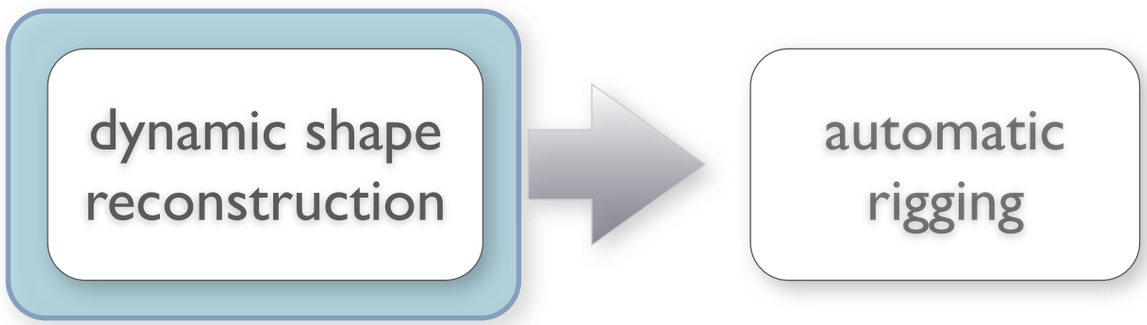
Input Scans

Reconstruction

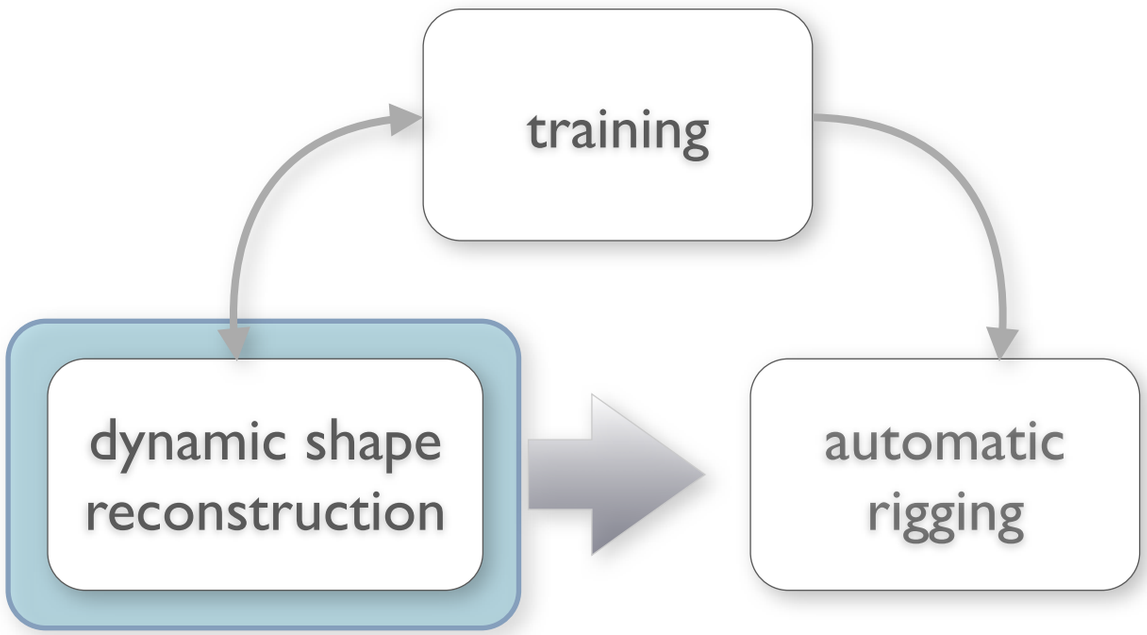


Overlaid Scans

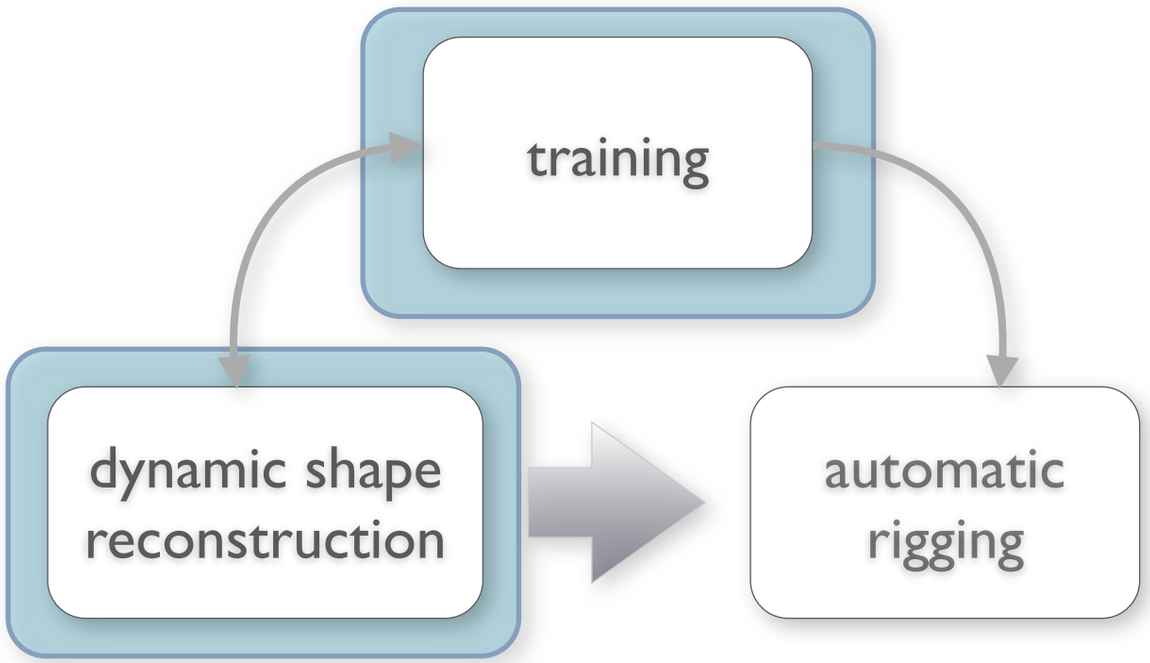
Limitations: Drift



Limitations: Drift



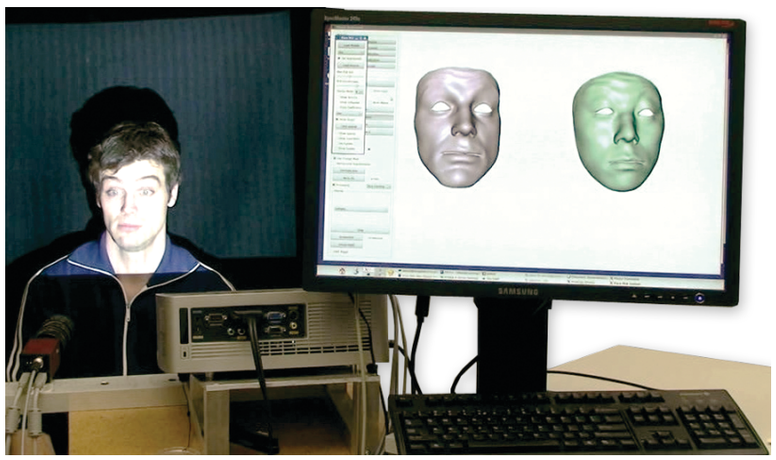
Limitations: Drift



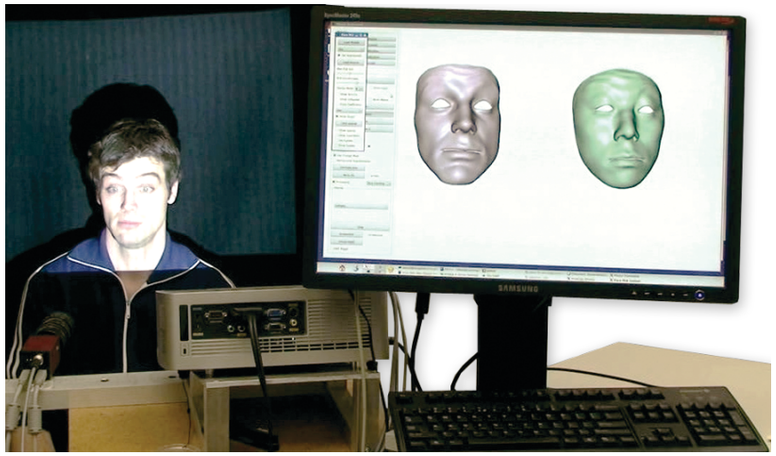
Facial Animation

[Weise et al. '09]

System Overview



System Overview



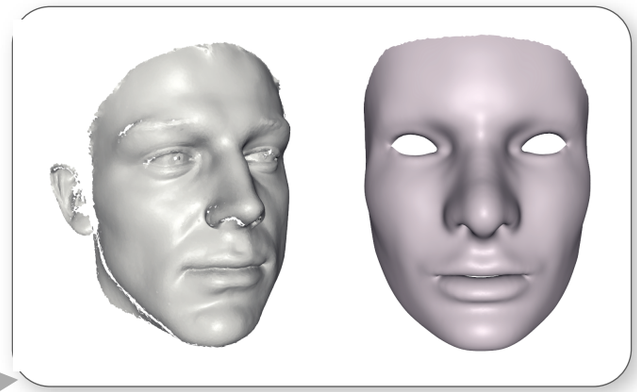
scans textures

System Overview

scans

textures

template construction

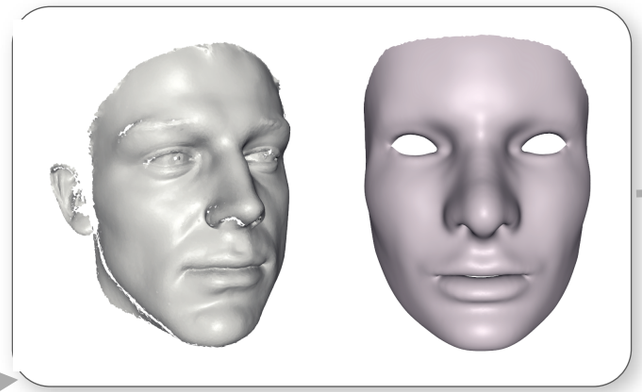


System Overview

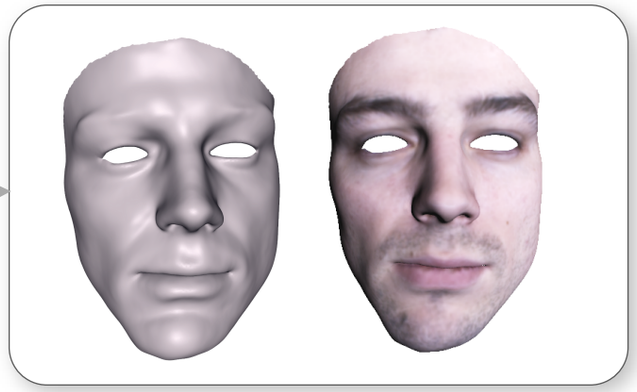
scans

textures

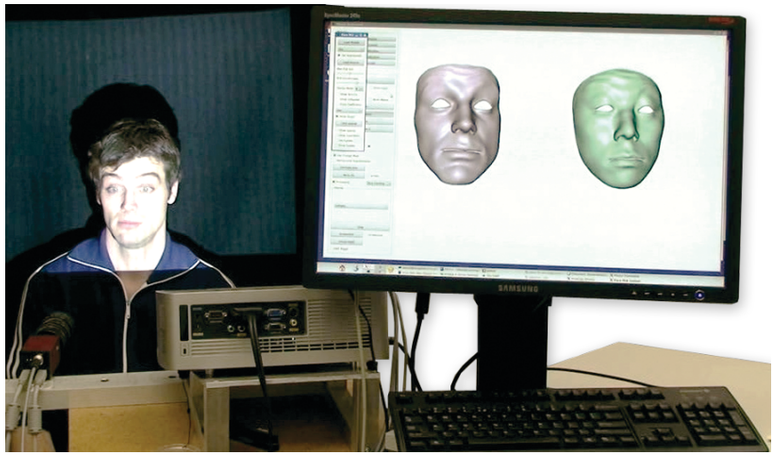
template construction



texture mapping



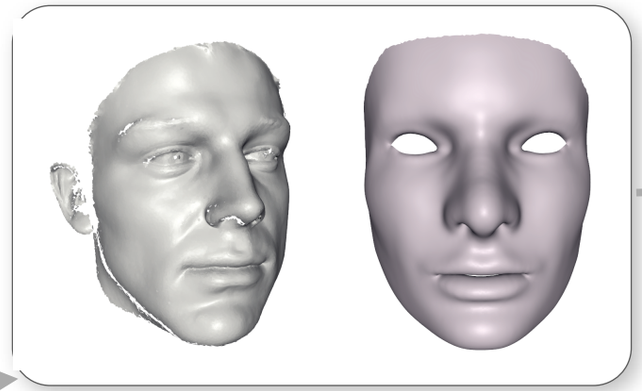
System Overview



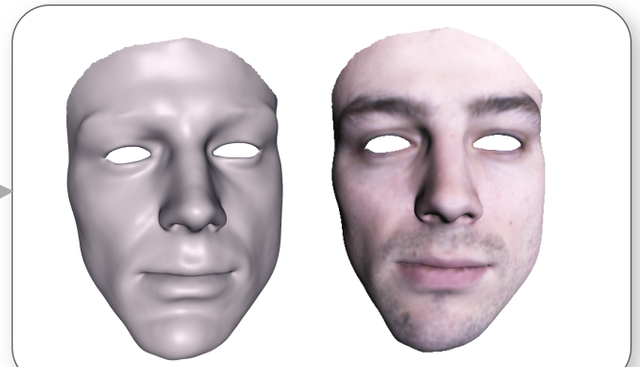
scans

textures

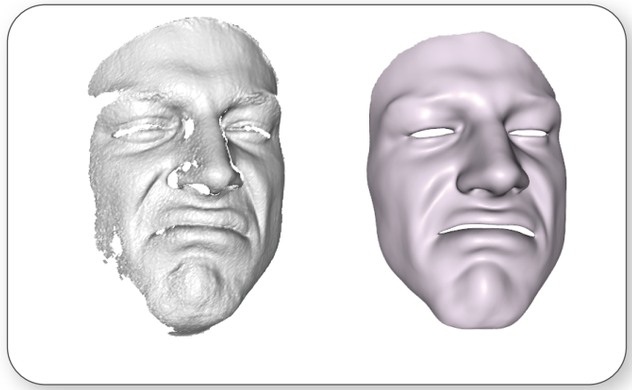
template construction



texture mapping



offline tracking

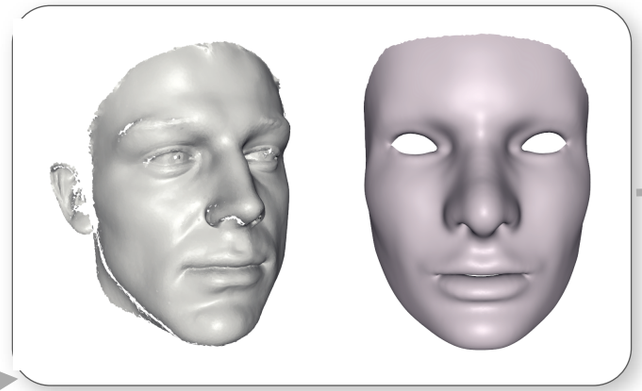


System Overview

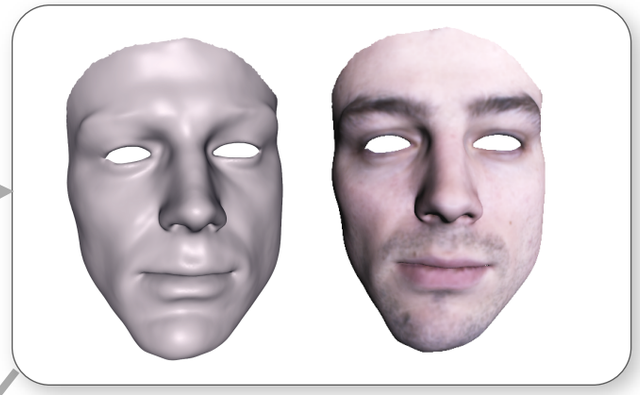
scans

textures

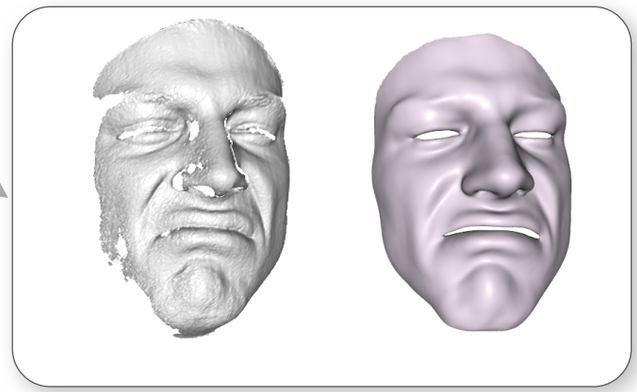
template construction



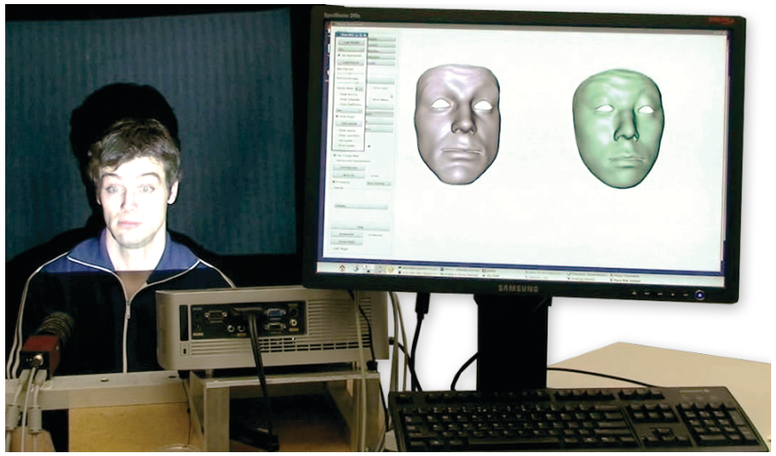
texture mapping



offline tracking



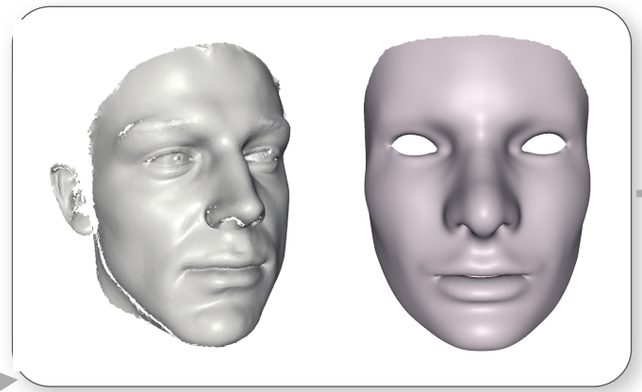
System Overview



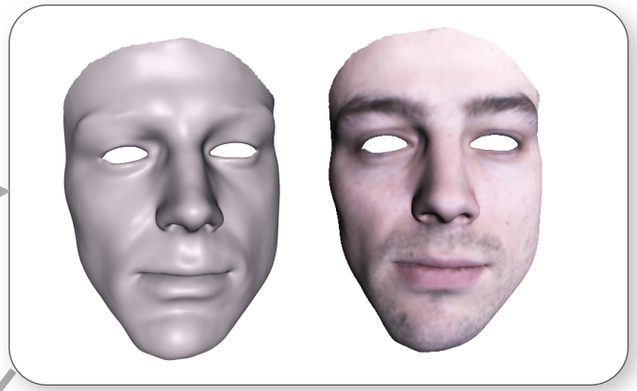
scans

textures

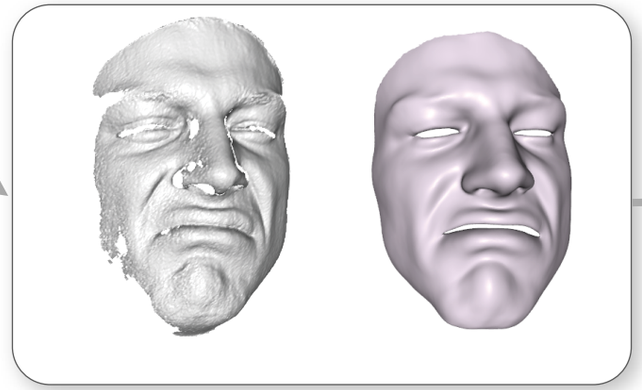
template construction



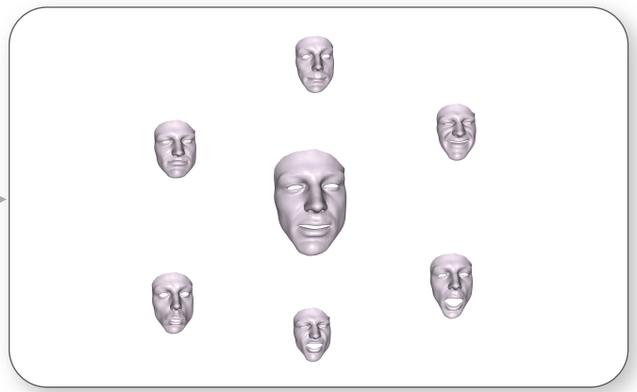
texture mapping



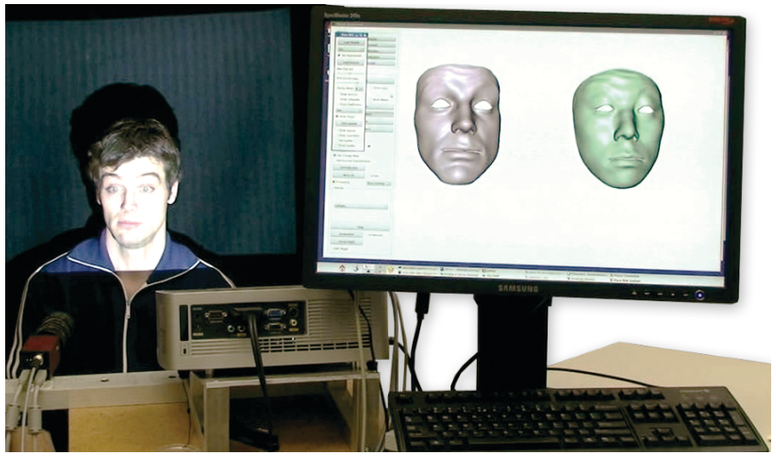
offline tracking



dimension reduction



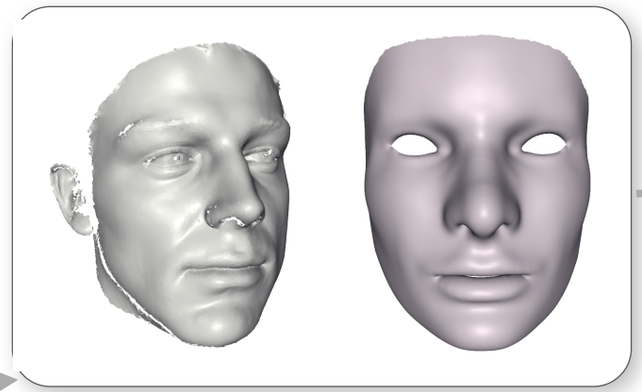
System Overview



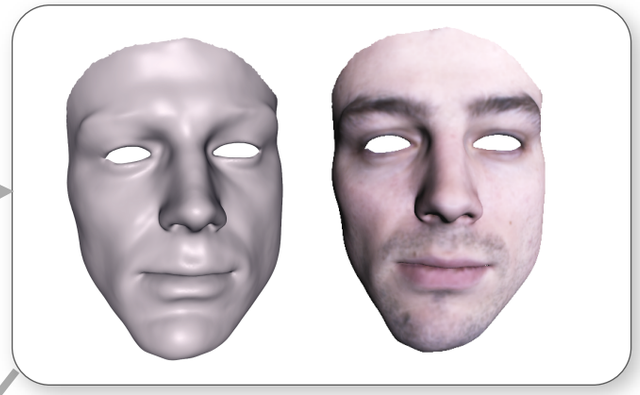
scans

textures

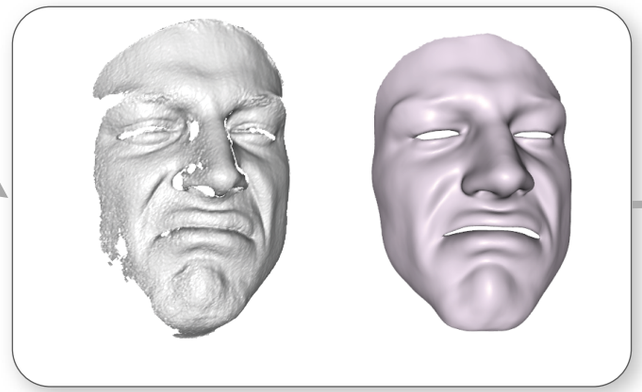
template construction



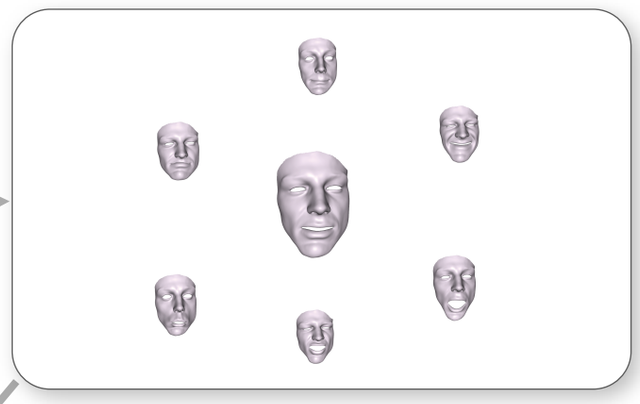
texture mapping



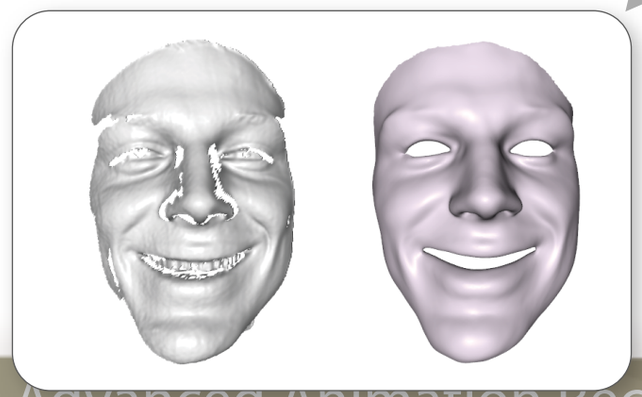
offline tracking



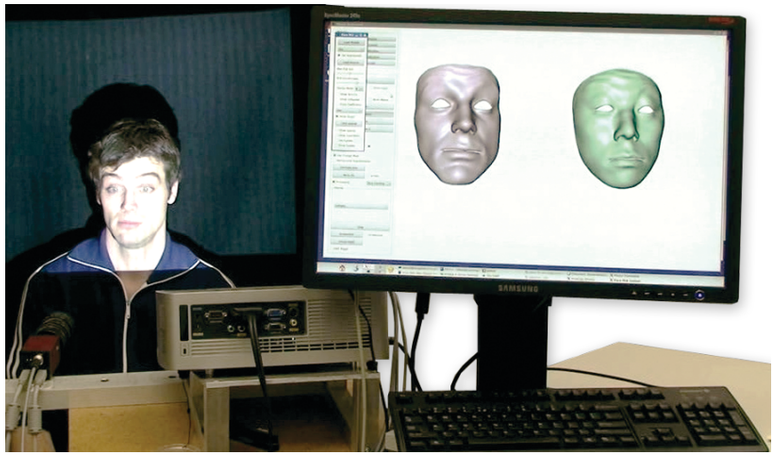
dimension reduction



online tracking



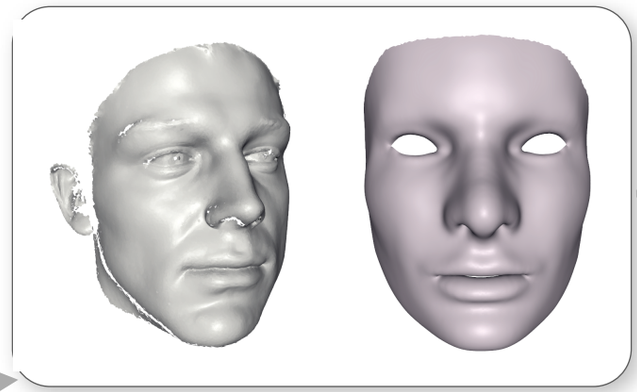
System Overview



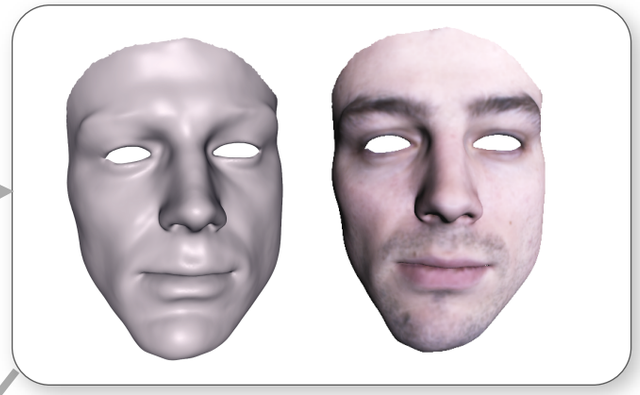
scans

textures

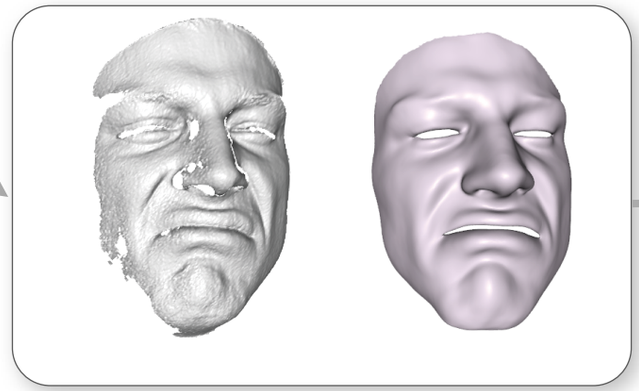
template construction



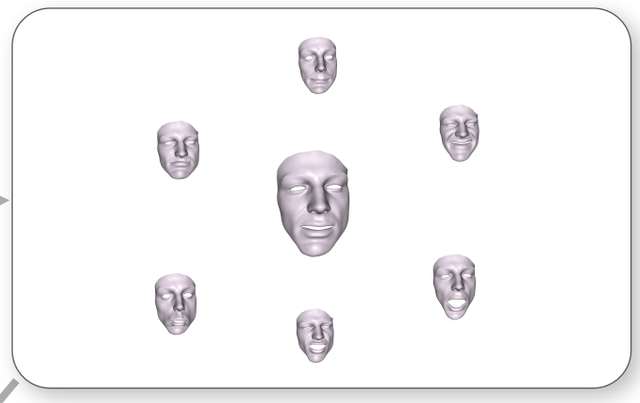
texture mapping



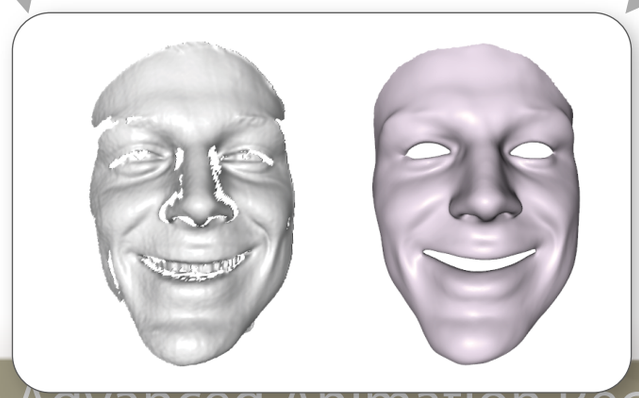
offline tracking



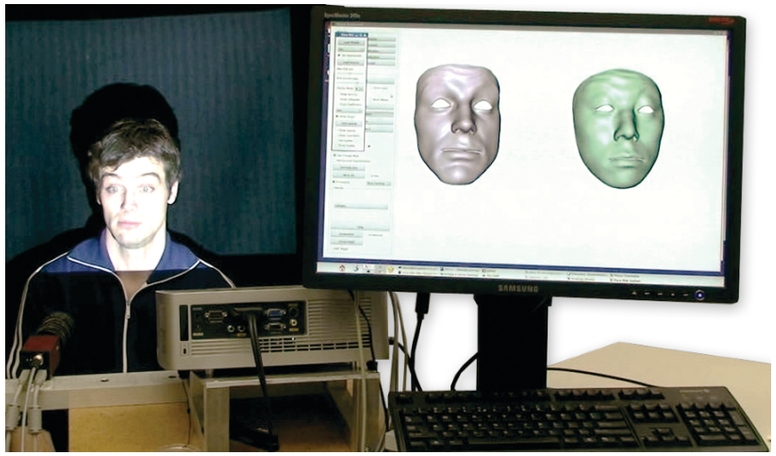
dimension reduction



online tracking



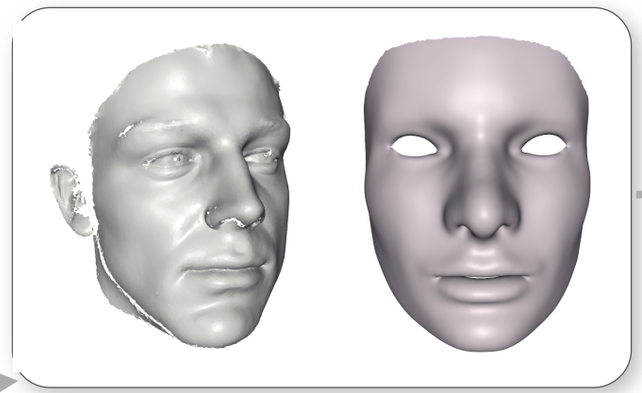
System Overview



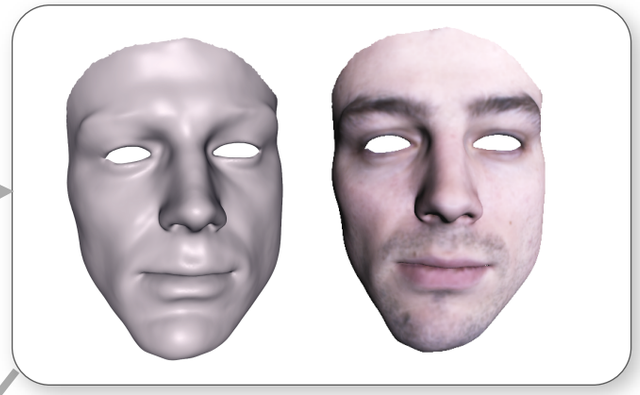
scans

textures

template construction

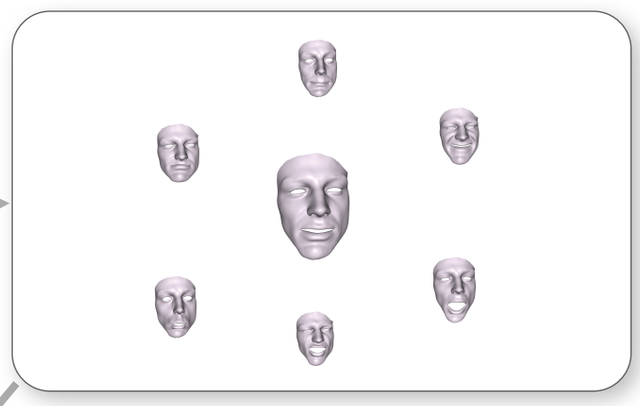


texture mapping



offline tracking

dimension reduction



online tracking

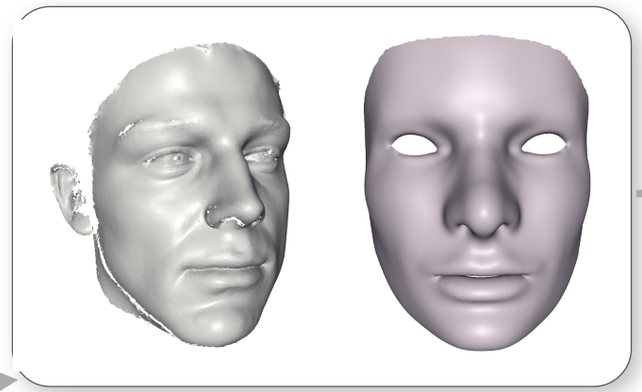
retargeting

System Overview

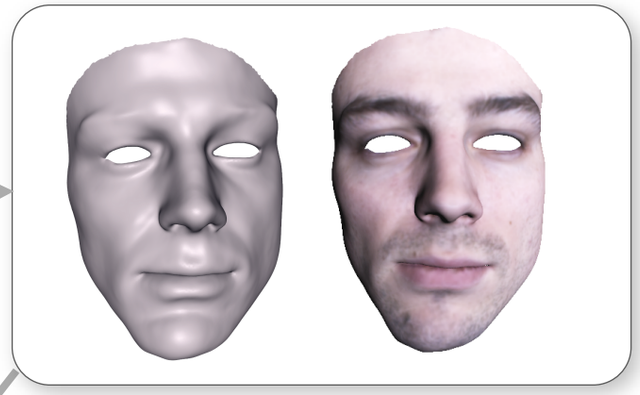
scans

textures

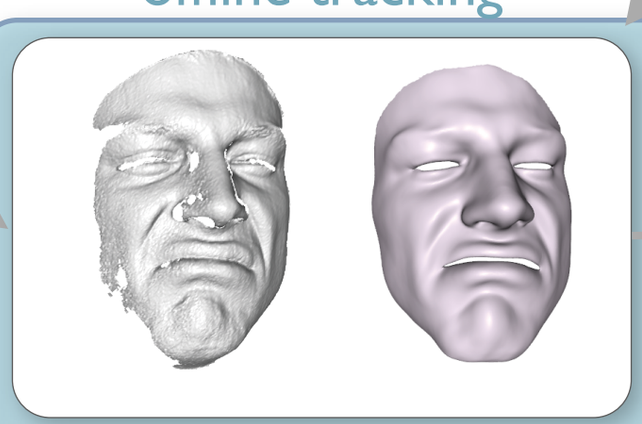
template construction



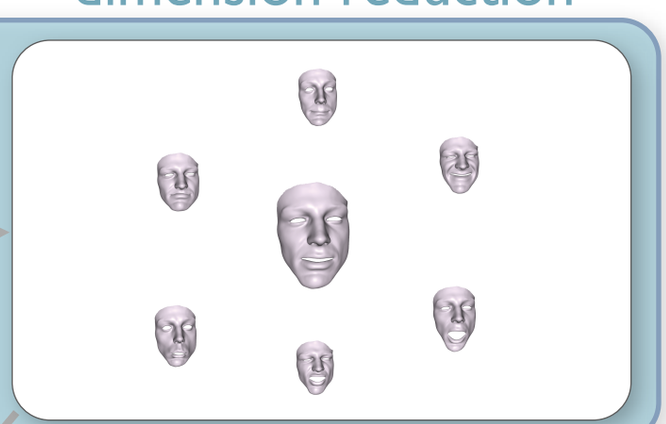
texture mapping



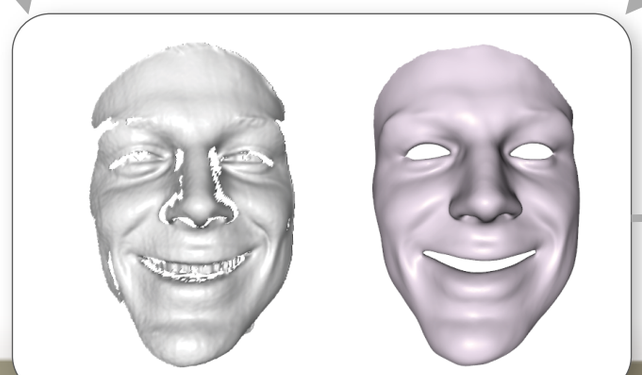
offline tracking



dimension reduction



online tracking



retargeting

Dimension Reduction

Dimension Reduction

Dimension Reduction

Principal Component Analysis

Dimension Reduction

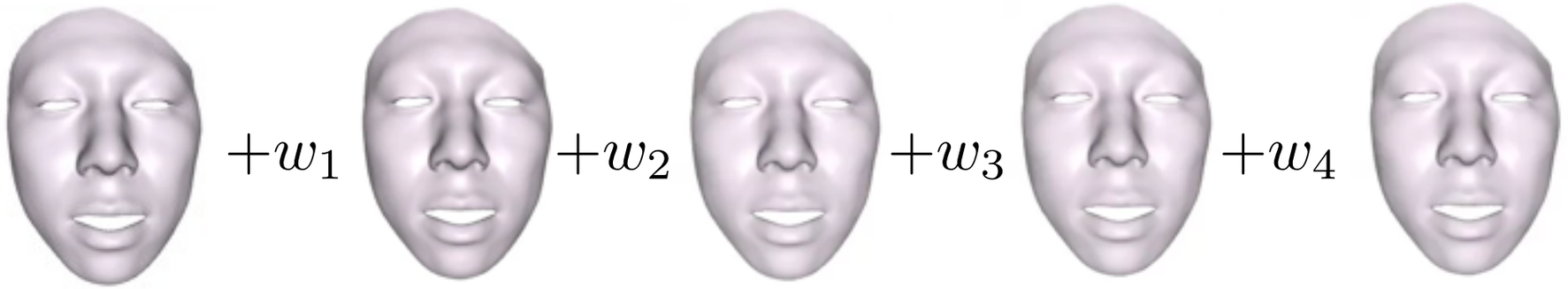
Principal Component Analysis

Dimension Reduction

Principal Component Analysis

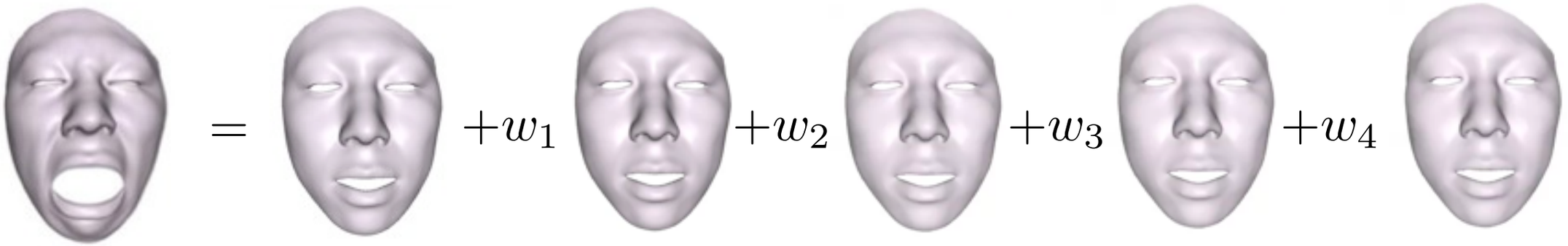
Dimension Reduction

Principal Component Analysis



Dimension Reduction

Principal Component Analysis



Limitations: Varying Topology

Temporally Coherent Shape Completion [Li et al. '11]

partial data reconstruction partial data reconstruction

Temporally Coherent Shape Completion [Li et al. '11]

partial data | reconstruction | partial data | reconstruction

Temporally Coherent Shape Completion [Li et al. '11]

partial data | reconstruction | partial data | reconstruction

Light Stage 6 Capture

Lightstage 6 (USC-ICT)

[Vlasic et al. '09]

Light Stage 6 Capture

Lightstage 6 (USC-ICT)

8 Normal Maps / Frame

[Vlasic et al. '09]

Reconstruction

per view reconstruction

Reconstruction

per view reconstruction

non-rigid registration

Reconstruction

per view reconstruction

non-rigid registration

poisson reconstruction

Reconstruction

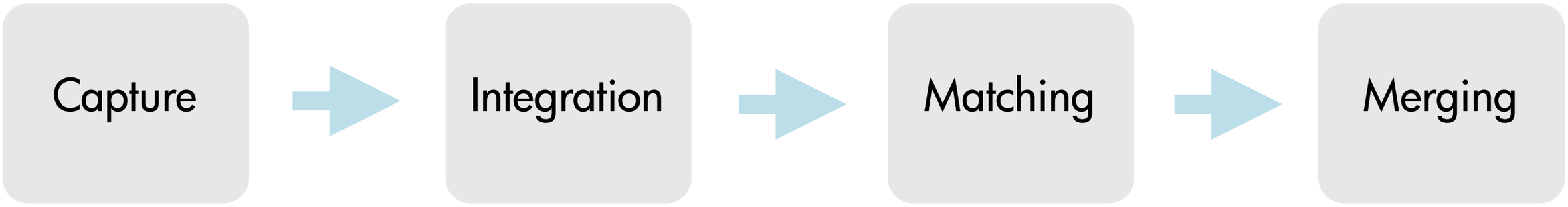
Capture

Reconstruction

Capture → Integration

Reconstruction

Reconstruction



Reconstruction

Capture → Integration → Matching → Merging

input scans

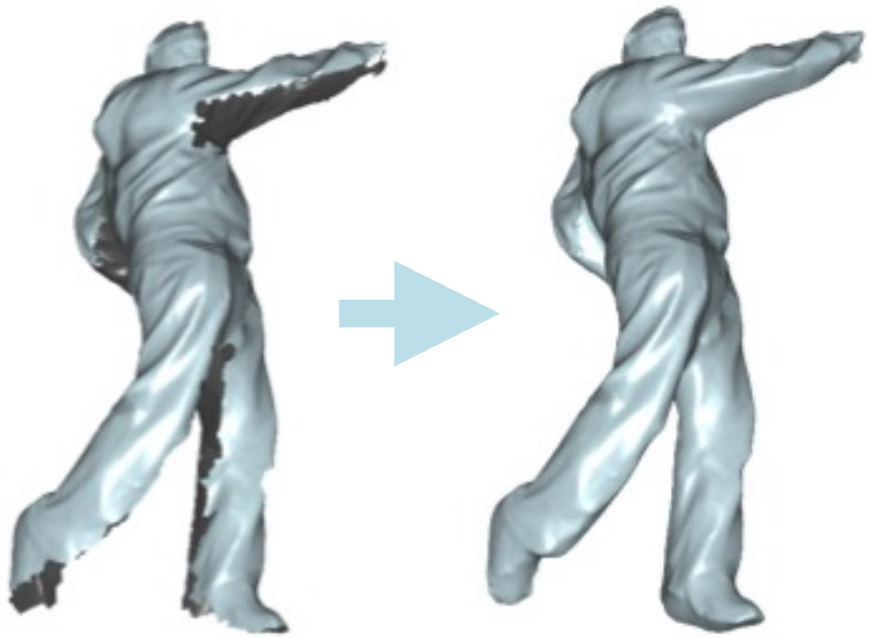
Naive Shape Completion

hole filled

Dynamic Shape Completion

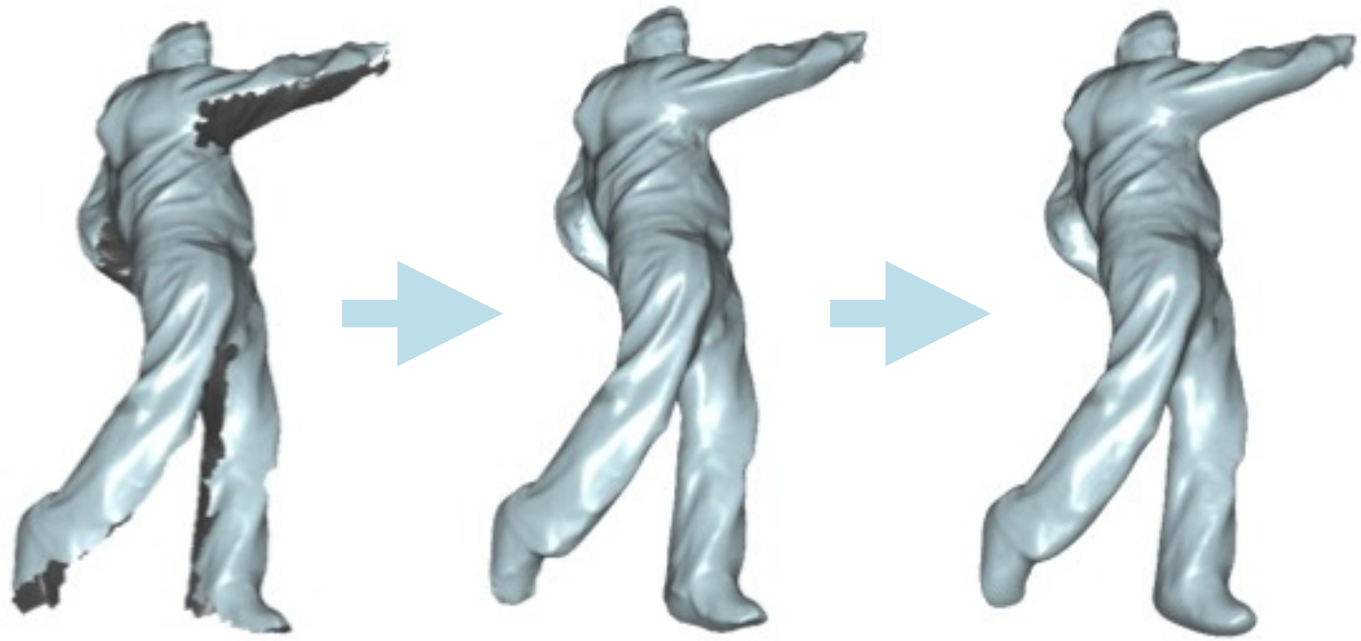
input scan

Dynamic Shape Completion



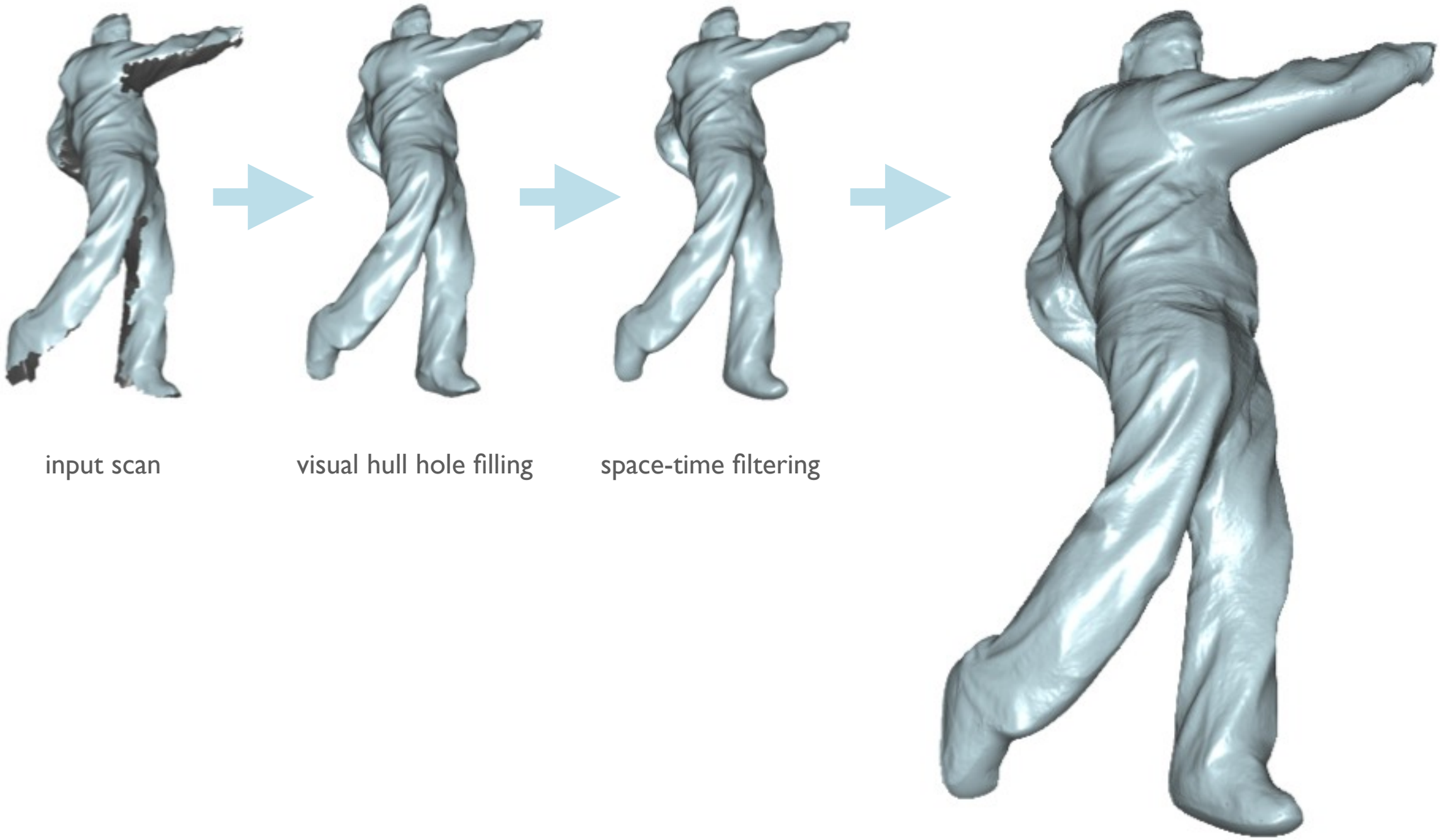
input scan visual hull hole filling

Dynamic Shape Completion



input scan visual hull hole filling space-time filtering

Dynamic Shape Completion



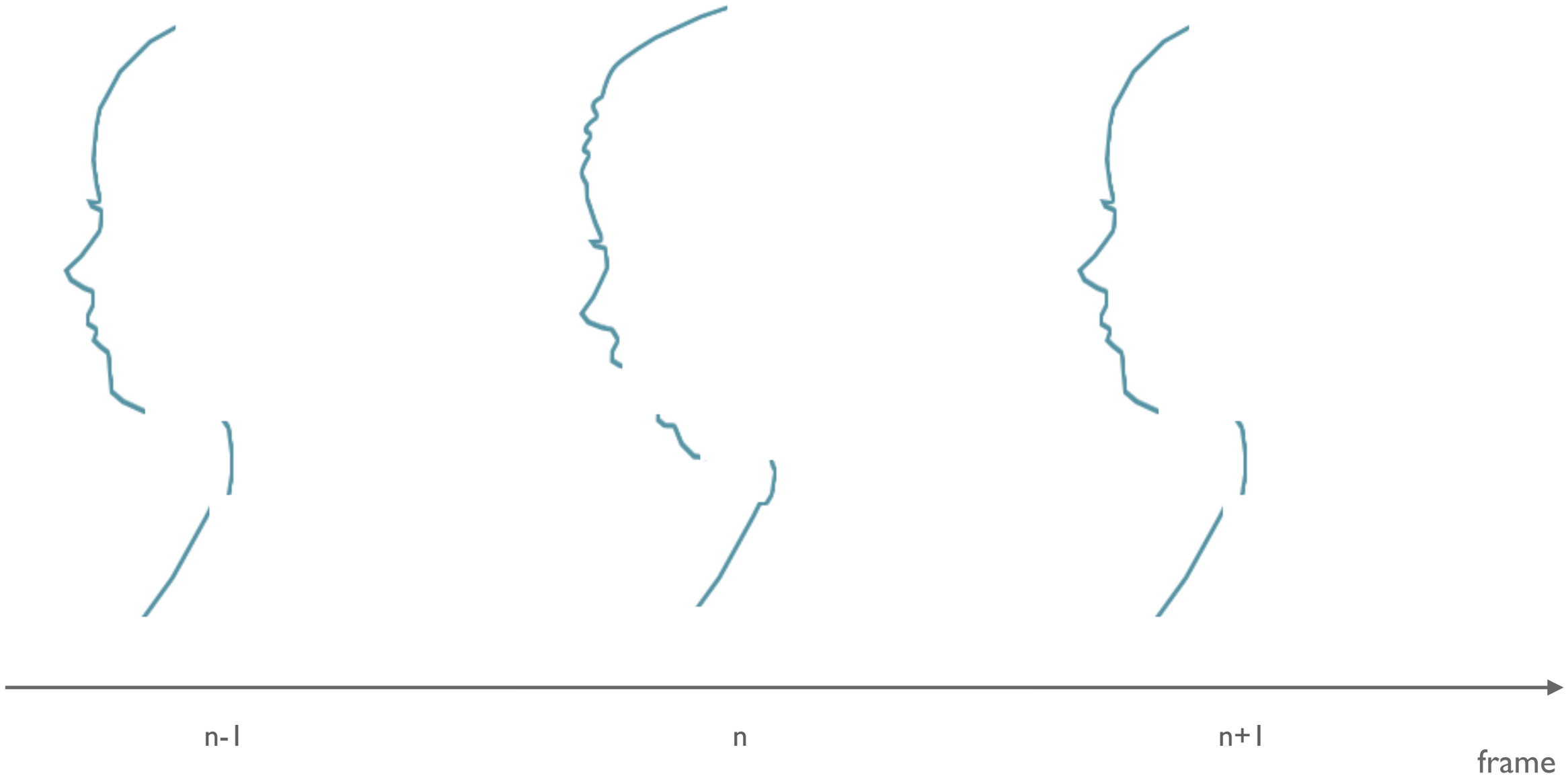
input scan

visual hull hole filling

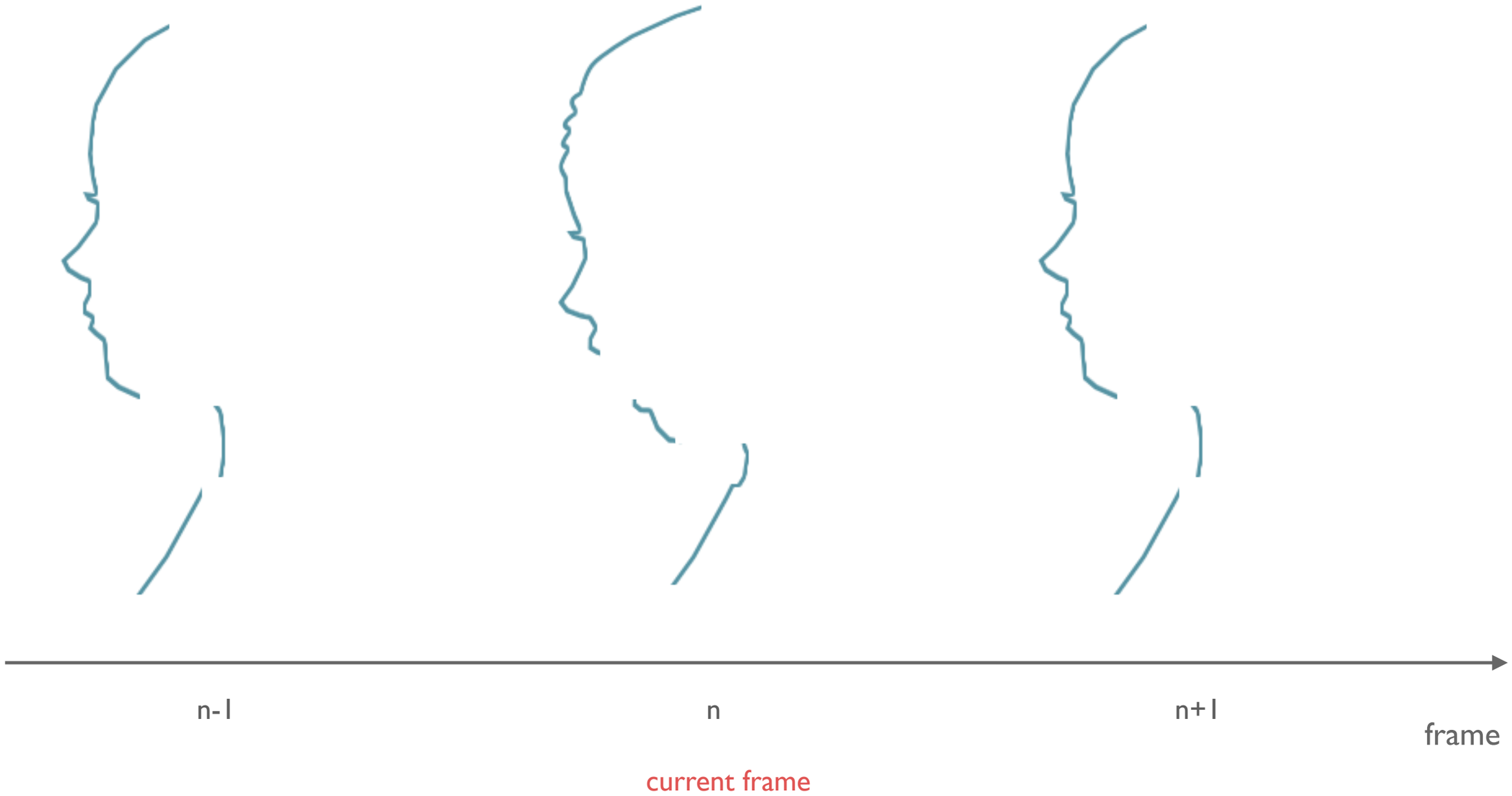
space-time filtering

detail re-synthesis

Temporal Filtering



Temporal Filtering



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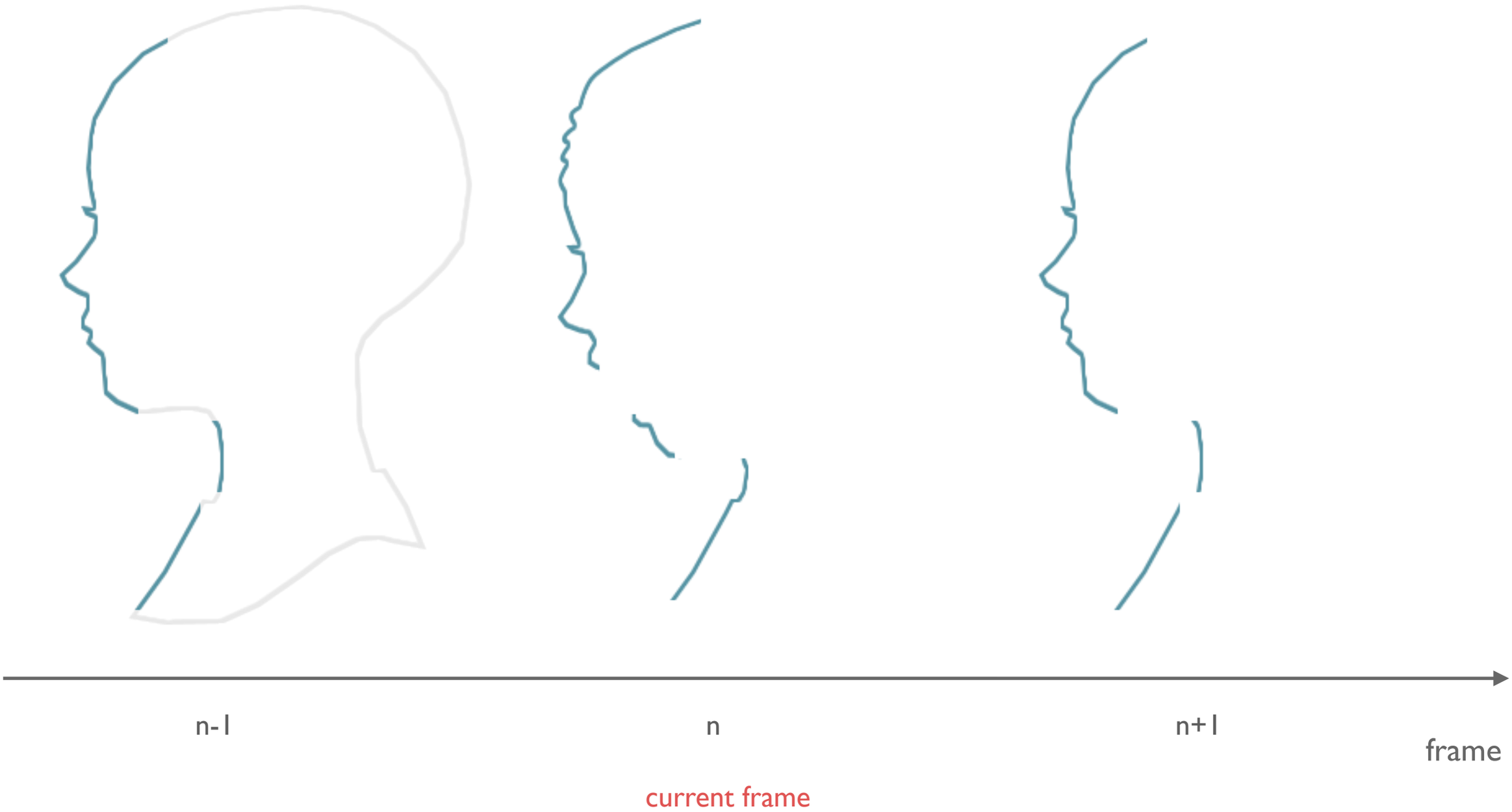
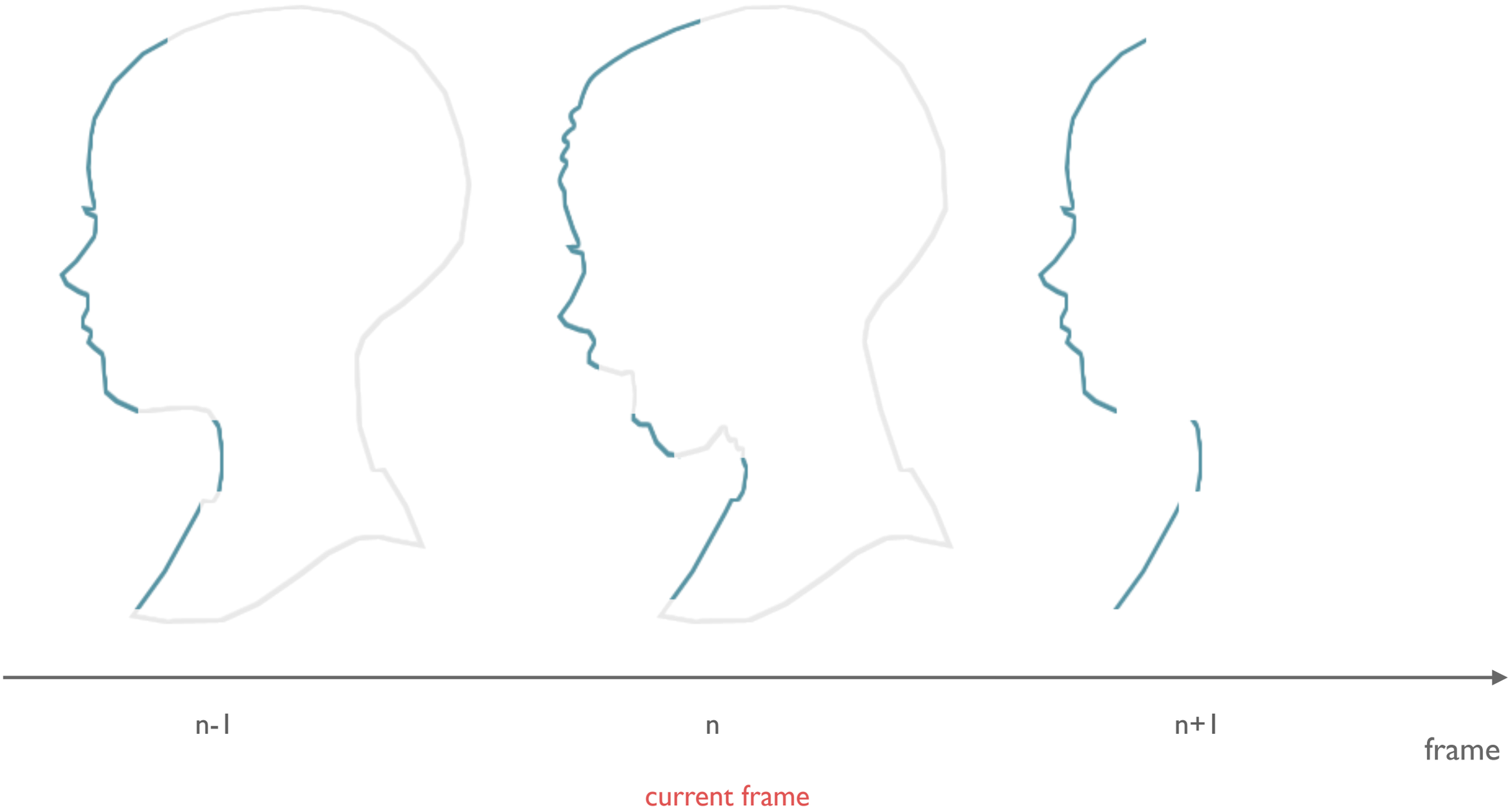


Temporal Filtering



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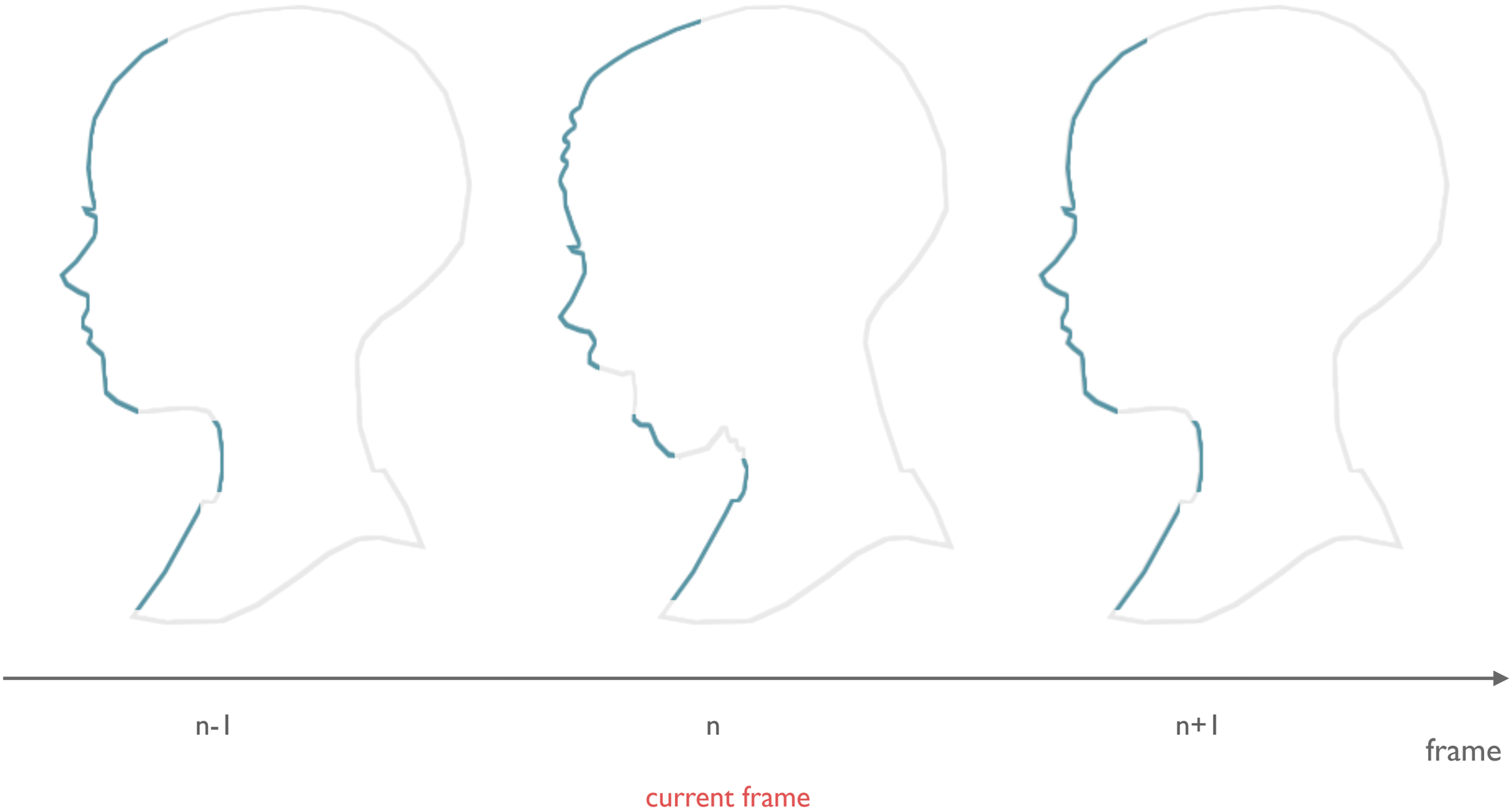

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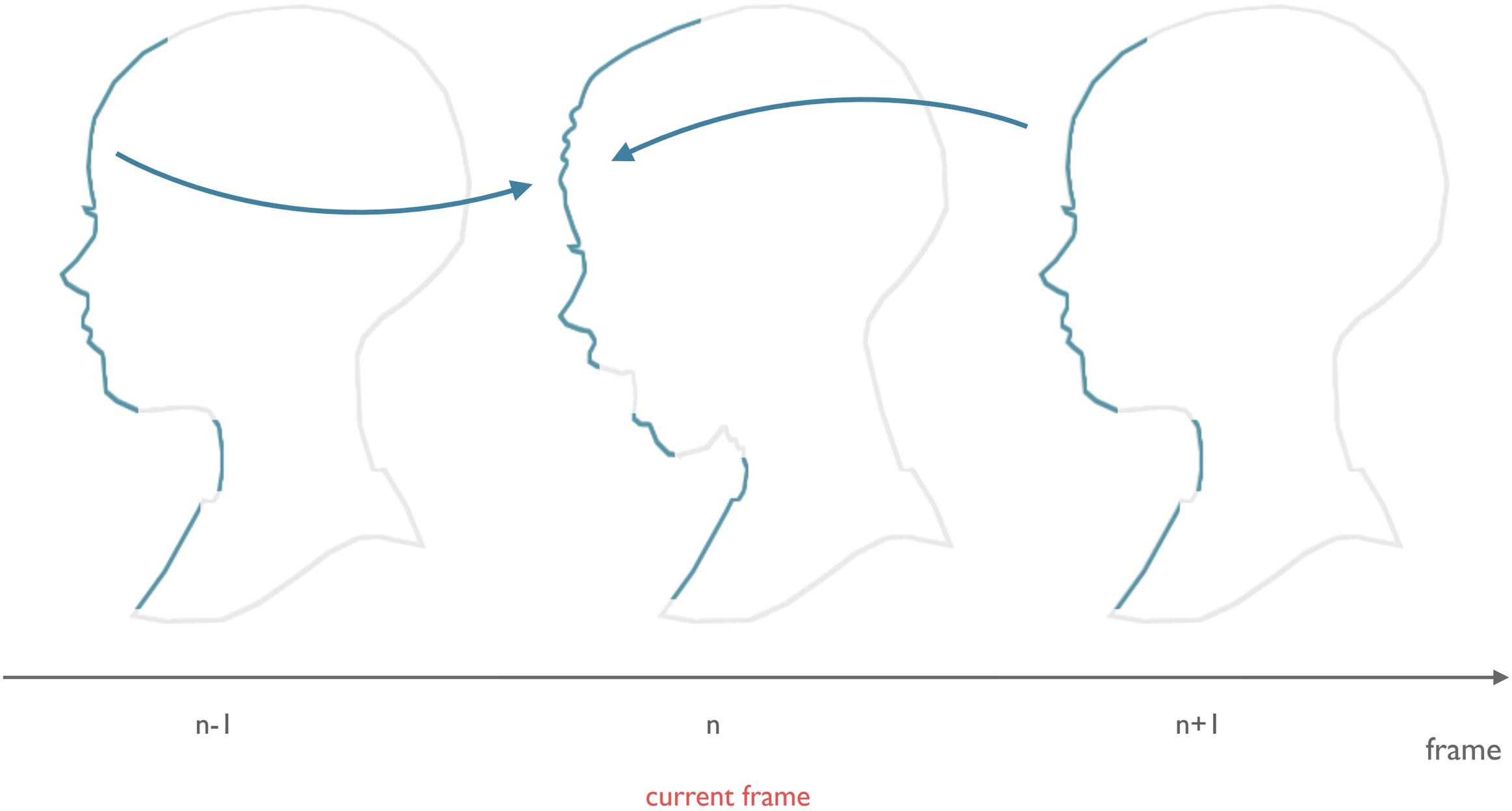

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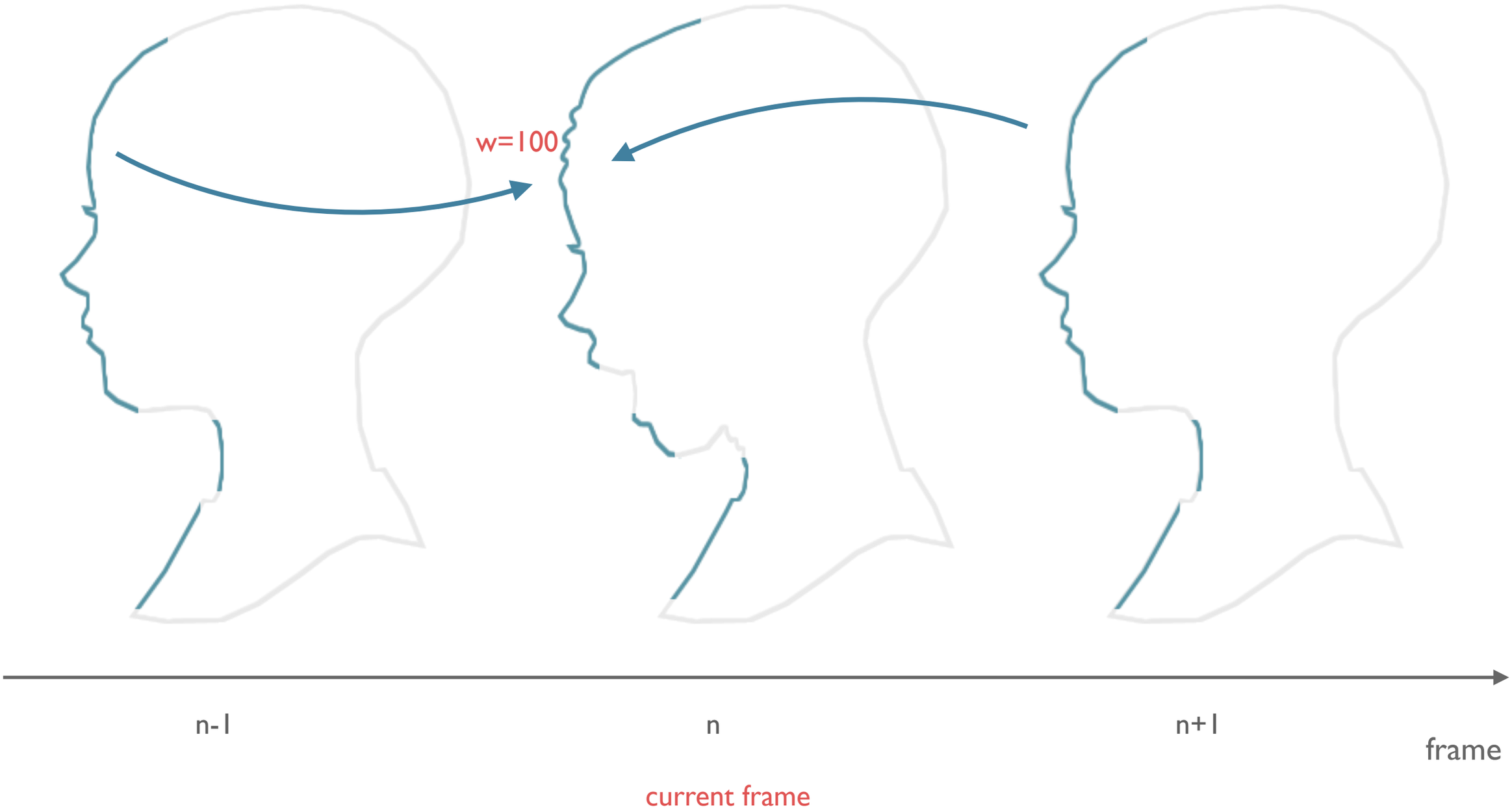

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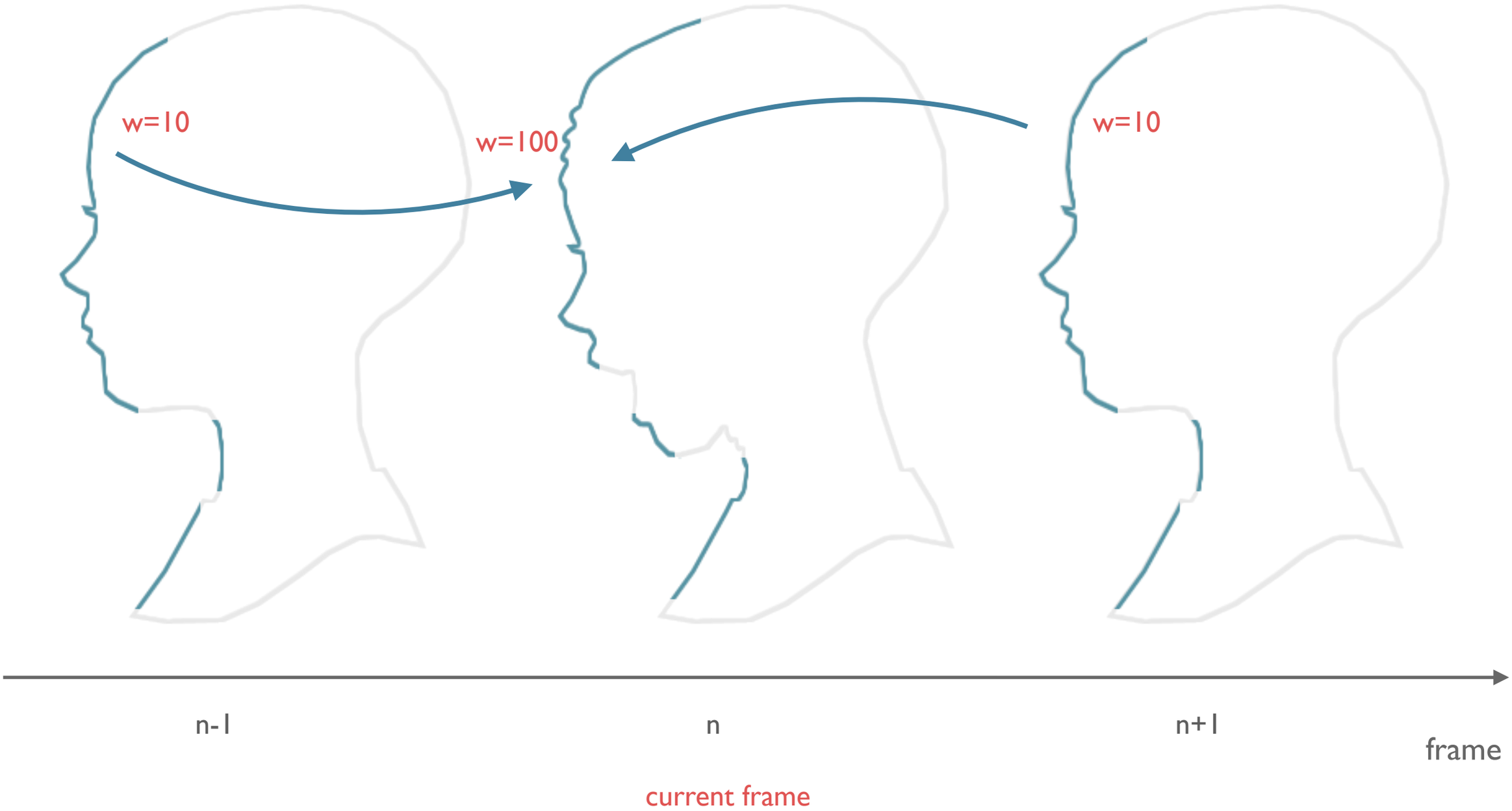

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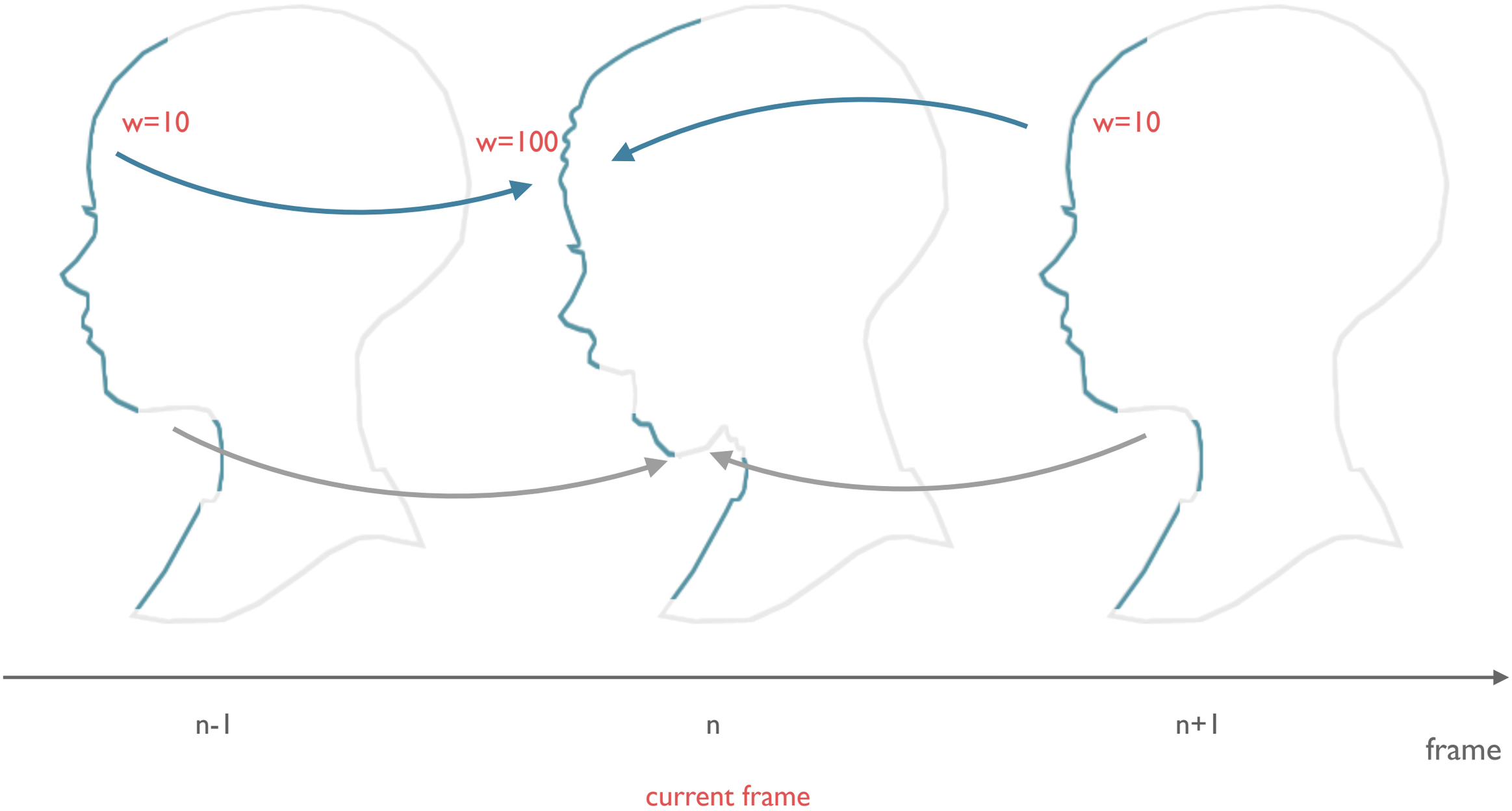

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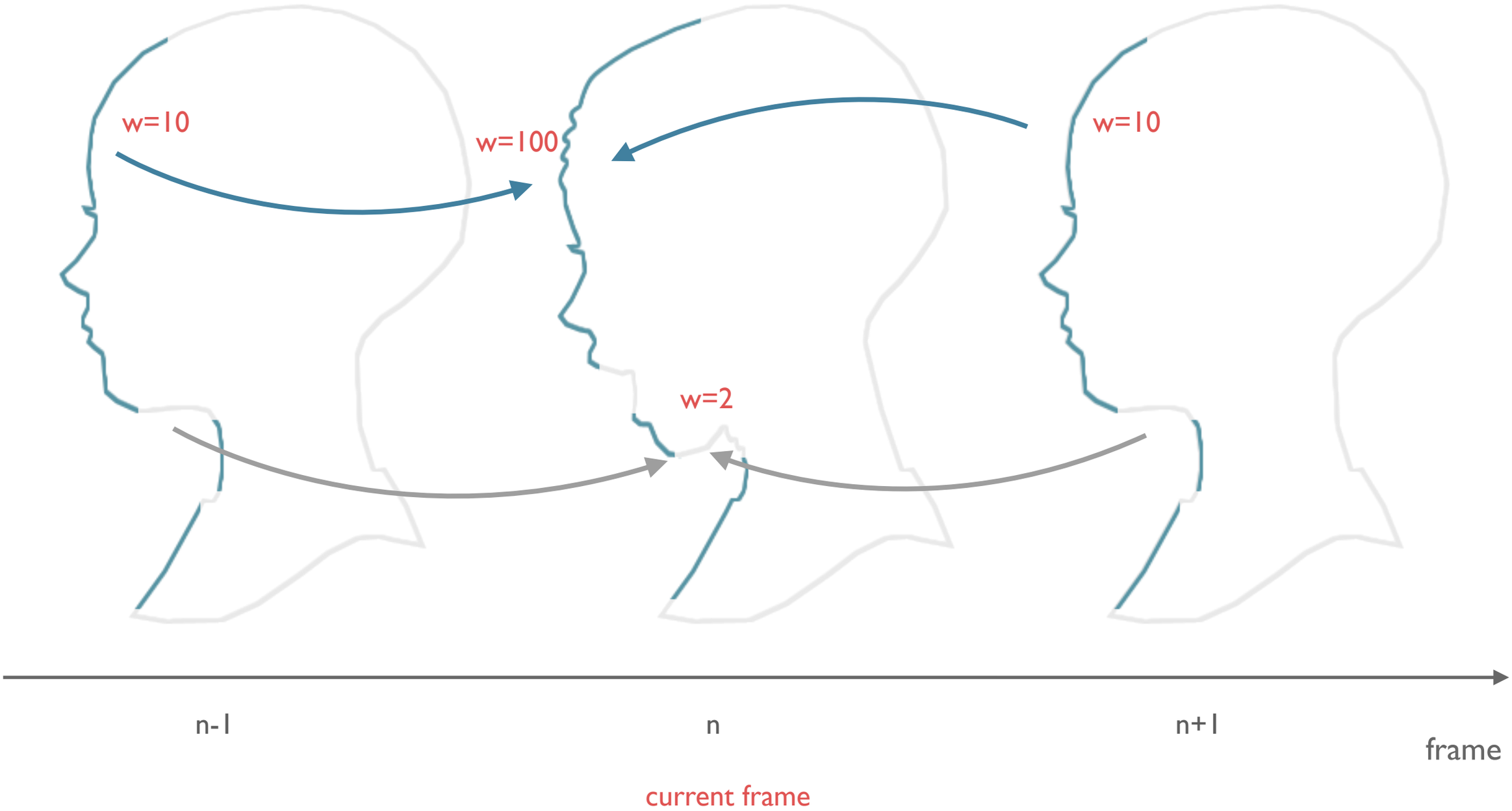
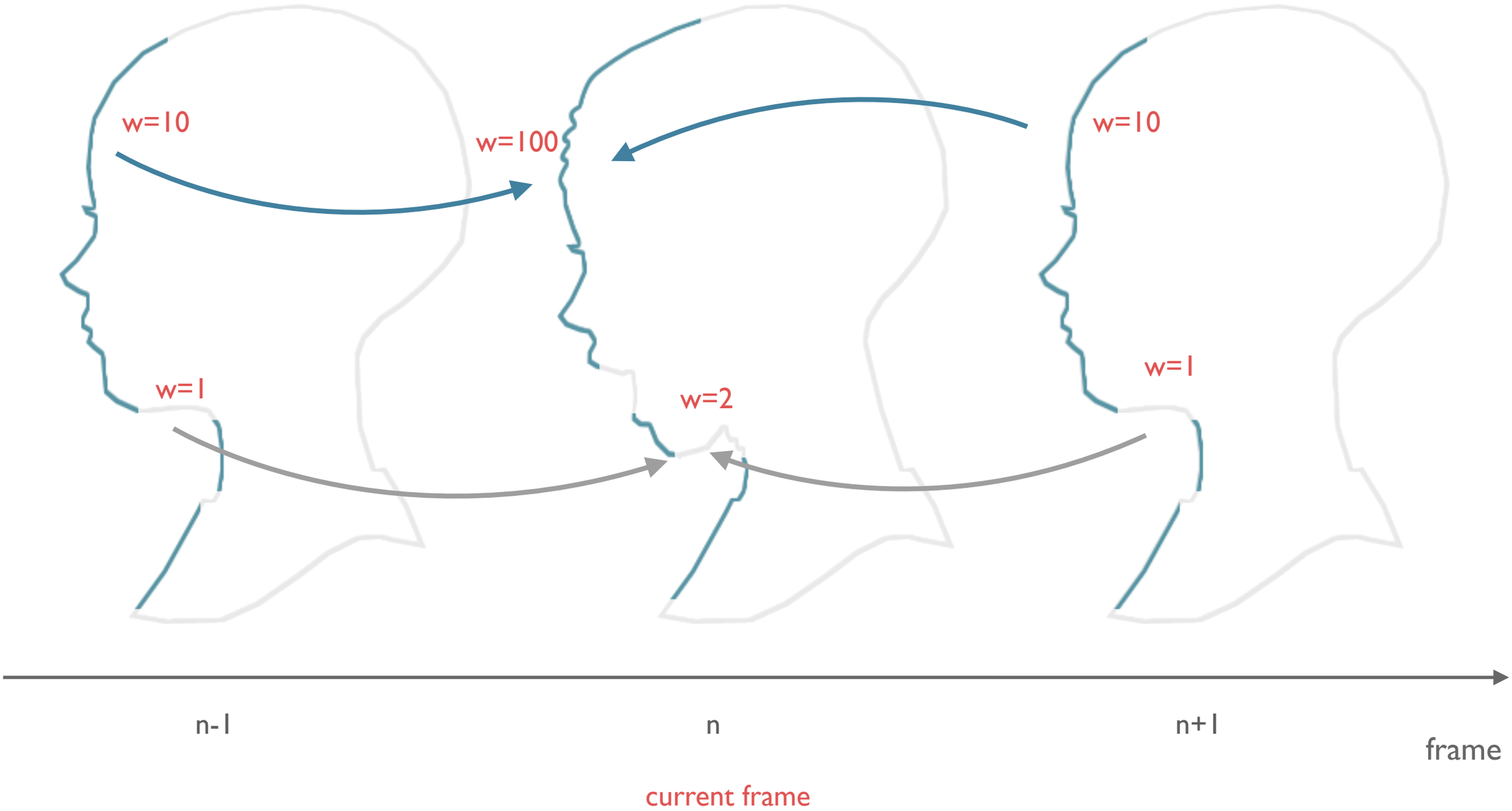
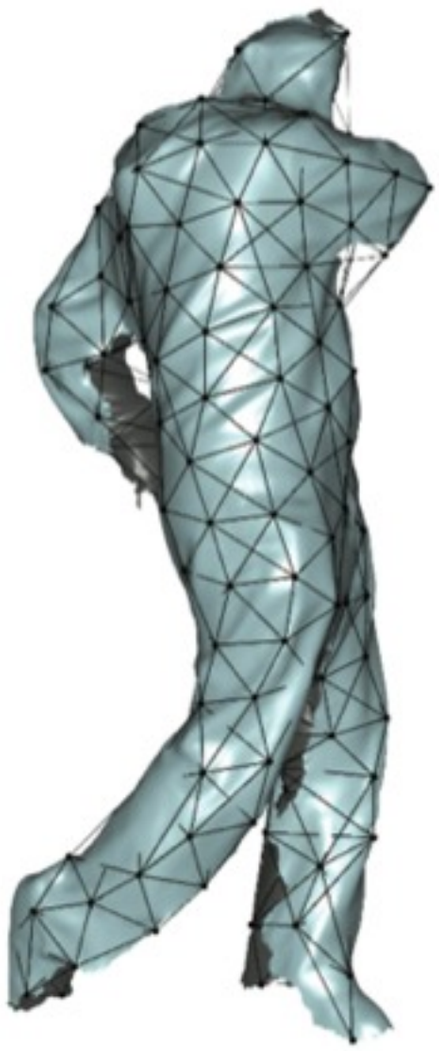


Temporal Filtering



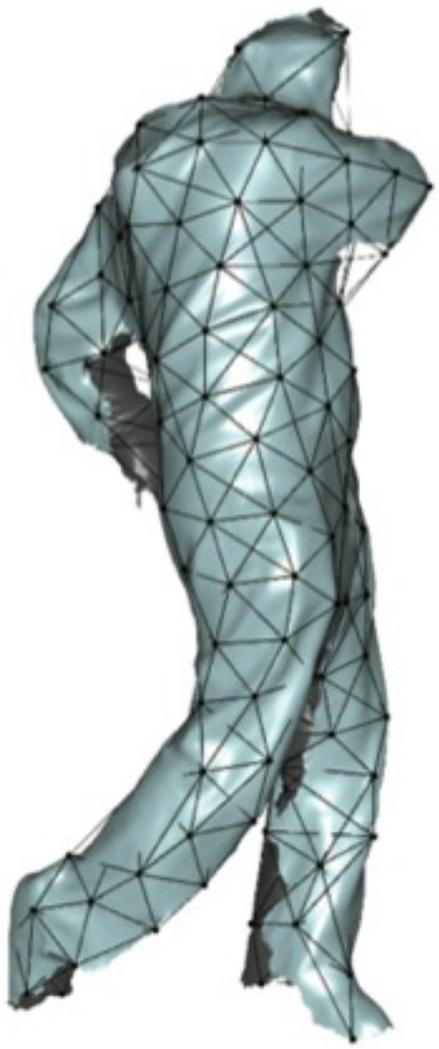
Short Range Correspondences

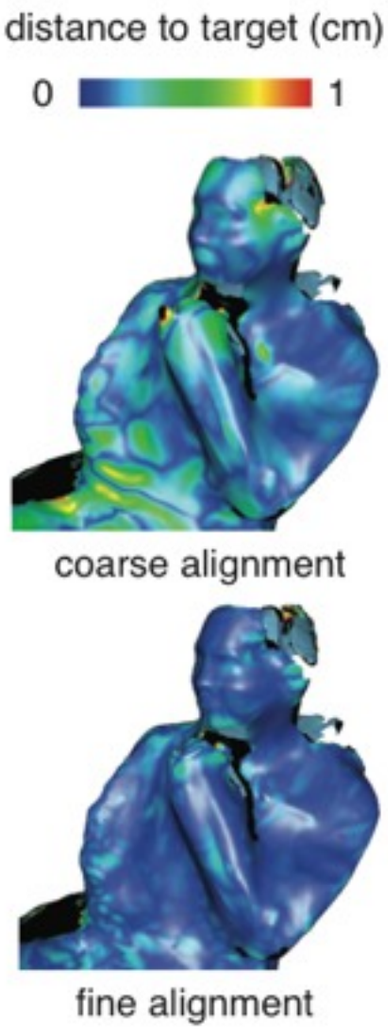
Short Range Correspondences



coarse-scale alignment
+ graph prediction
+ surf/optical flow

Short Range Correspondences

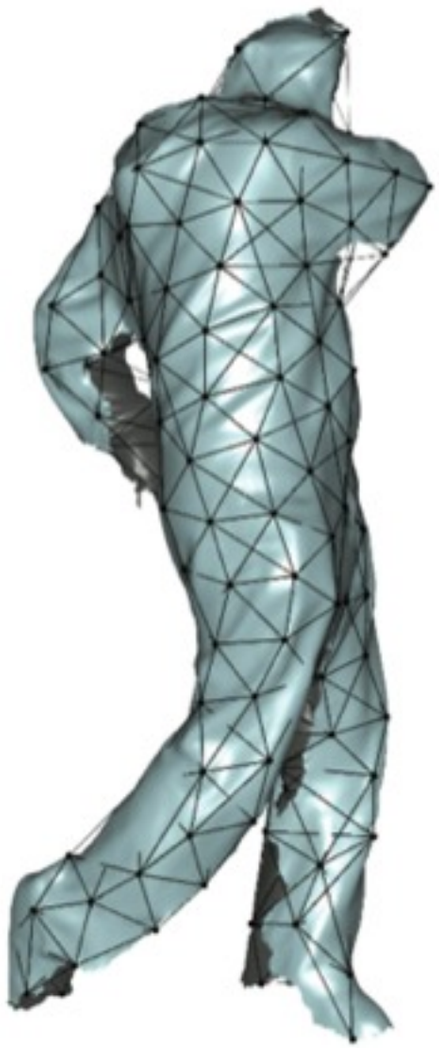


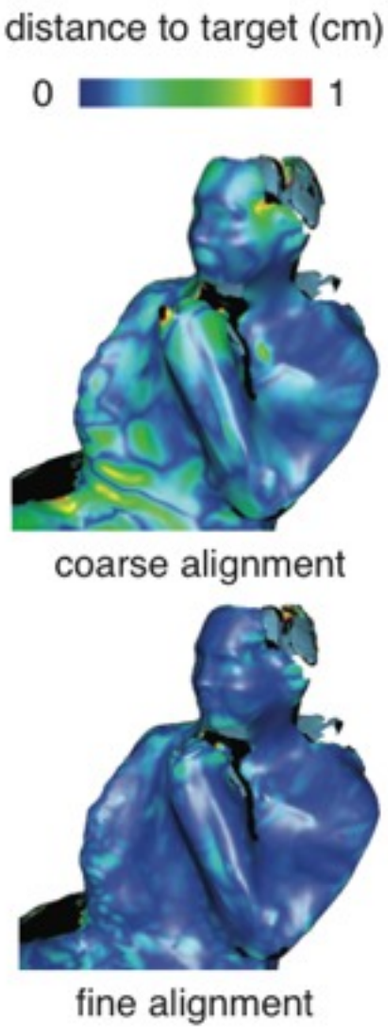


coarse-scale alignment
+ graph prediction
+ surf/optical flow

fine-scale registration

Short Range Correspondences





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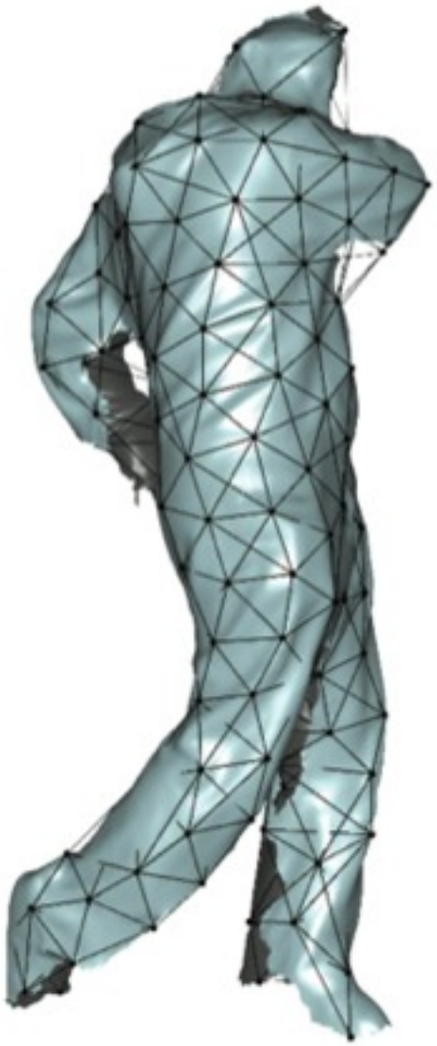
Short Range Correspondences



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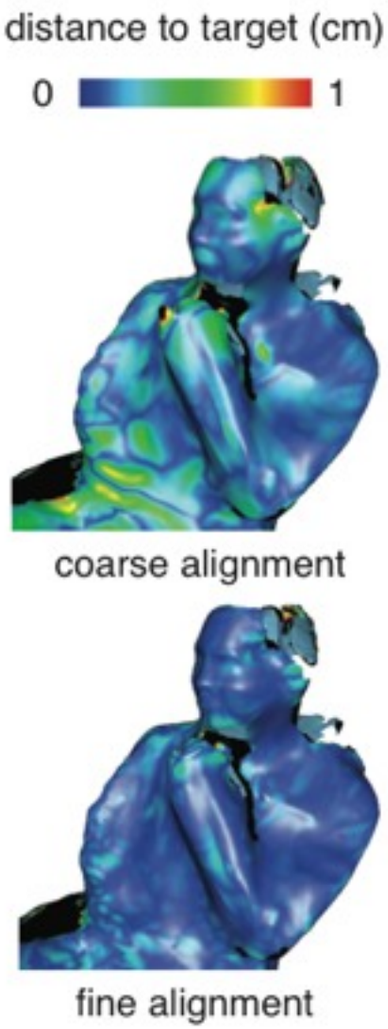
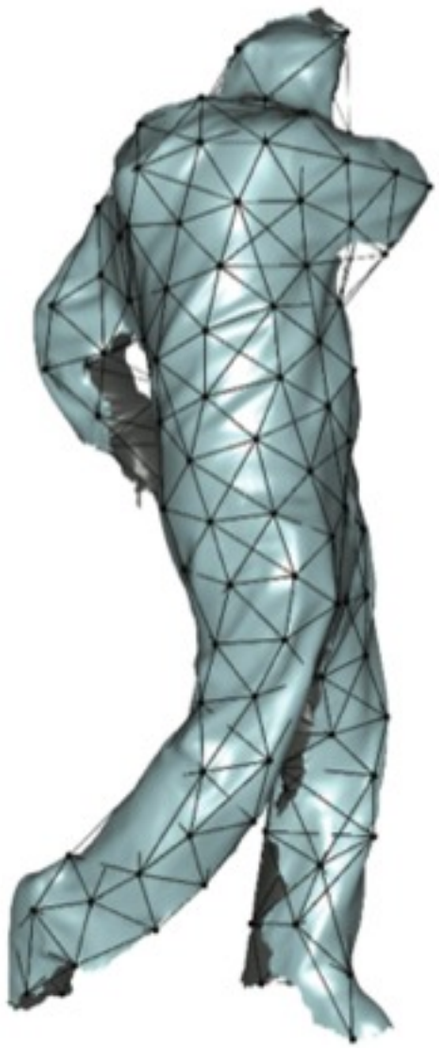


fine-scale registration

Coarse Registration

Fine Registration

Short Range Correspondences



coarse-scale alignment
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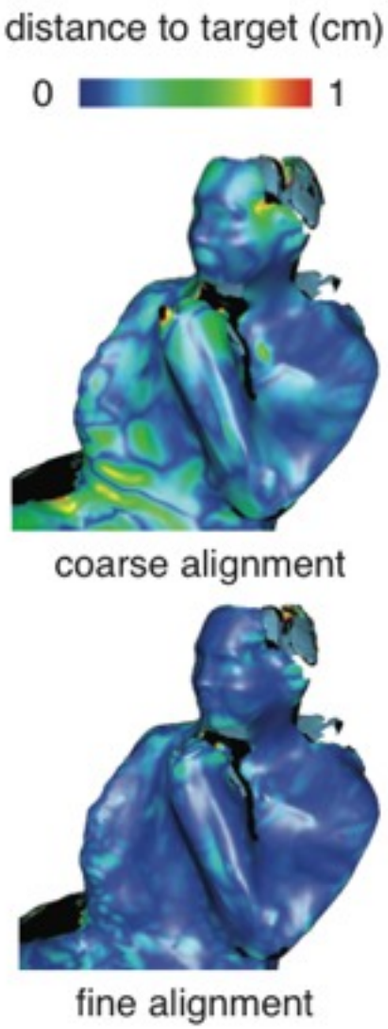


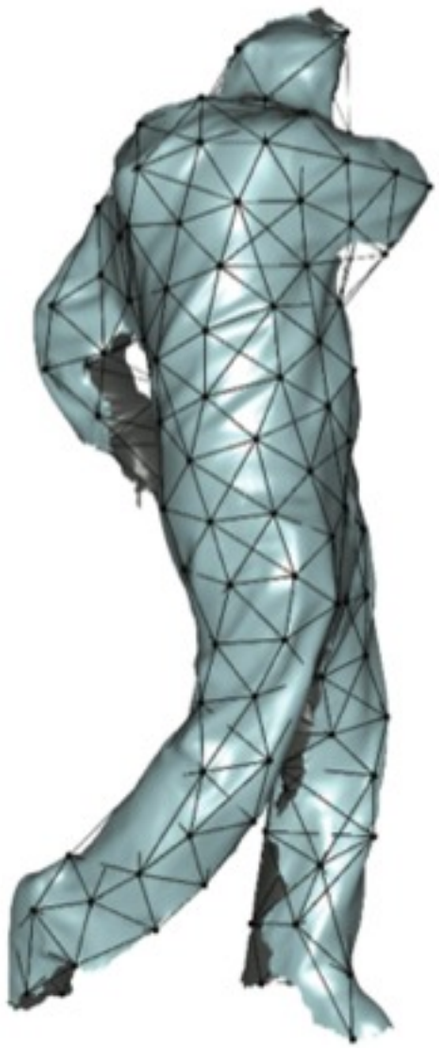
fine-scale registration

Coarse Registration

Fine Registration

Merging

Short Range Correspondences



coarse-scale alignment
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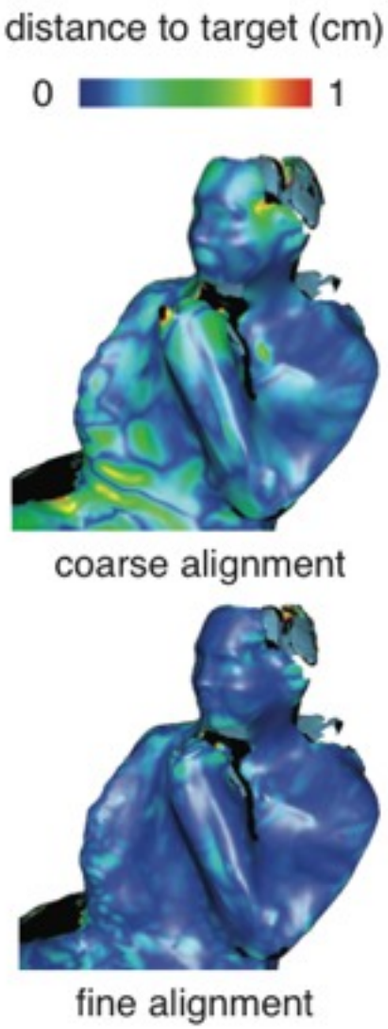

fine-scale registration

Coarse Registration

Fine Registration

Merging

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