Automatic Face Reenactment

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GOAL

Target | **Source** | **Reenactment**

Two arbitrary facial performances

Replace faces and preserve target performance

CHALLENGES

➢ **Expressions** and **pose** may **differ**
➢ **Timing** and **speech** may **not match**
➢ **Reenactment** should look **smooth** and **plausible**

CONTRIBUTIONS

1. **Fully automatic**: No manual interaction is required
2. **No database with pre-defined expressions**: Our face matching is performed as a retrieval task using the existing source footage only
3. **No 3D face model**: Our image-based face transfer can handle moderate head motion, while preserving the source identity
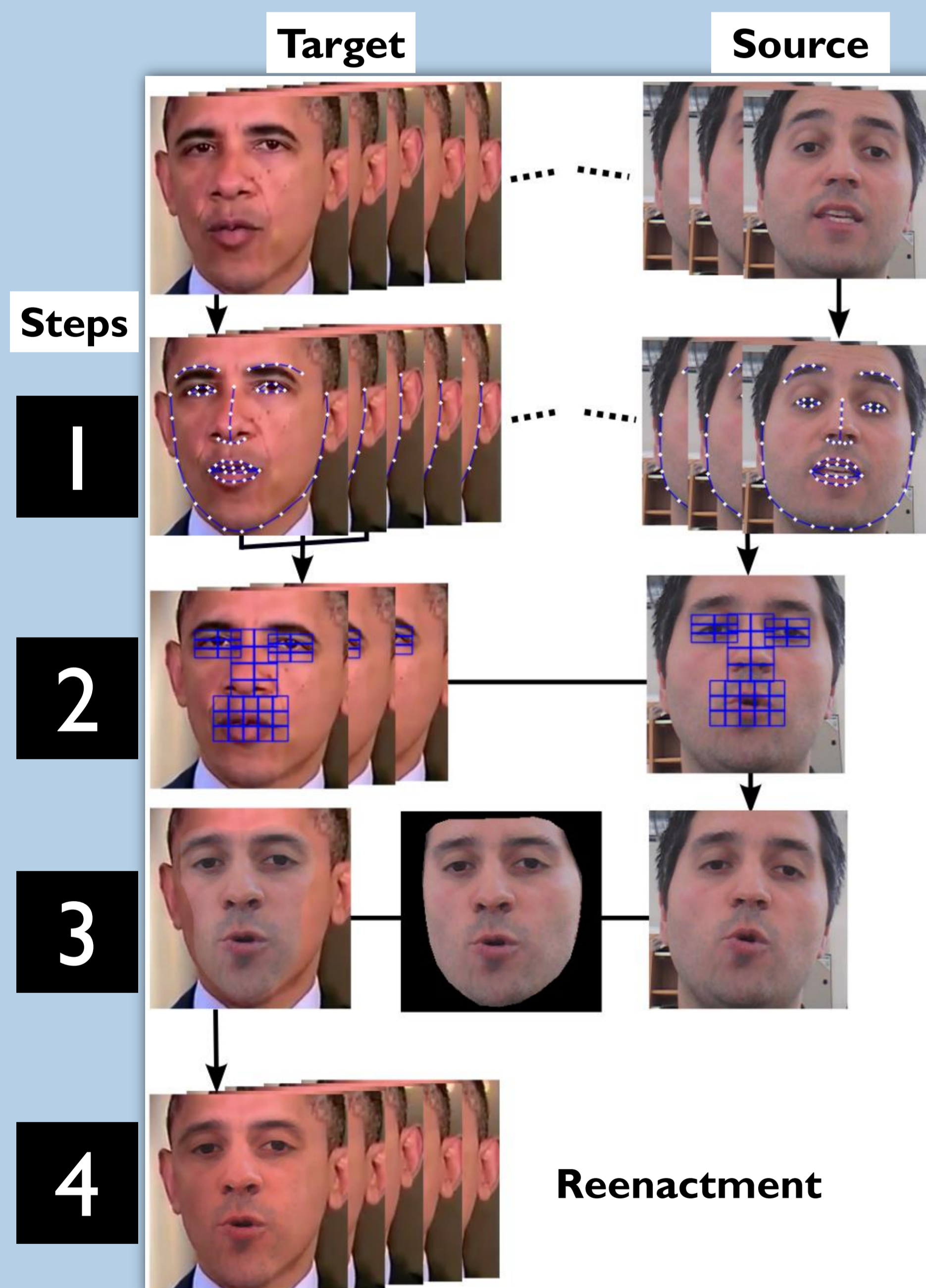
METHOD OVERVIEW

Target | **Source**

Steps

1
2
3
4

Reenactment

1 — Face Tracking

Non-Rigid Face Tracking

- Main facial features are tracked and landmark trajectories are stabilized
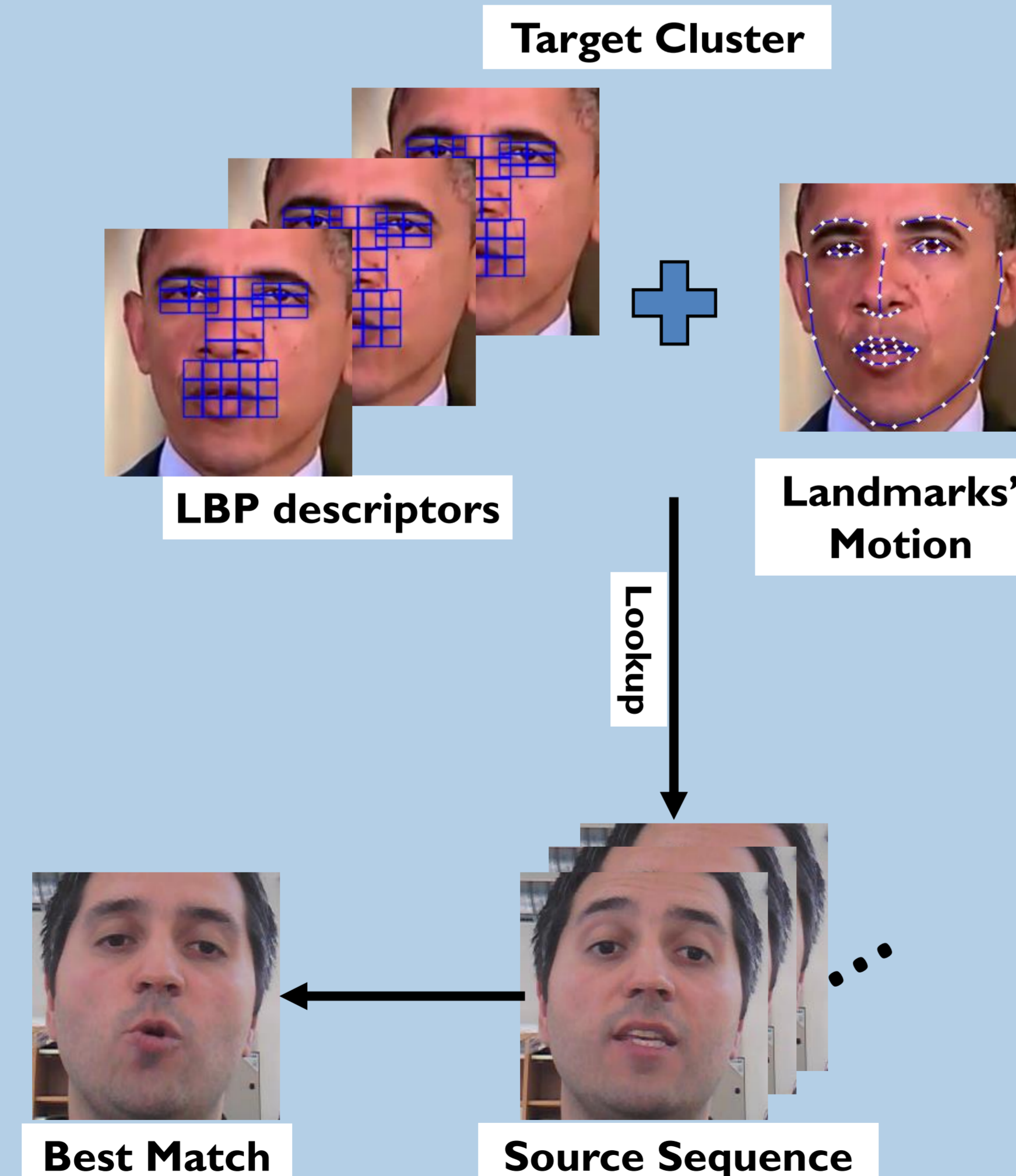
2 — Face Matching

Frame Selection

- Lookup using nearest neighbor search in source sequence
- Face descriptors: Local binary patterns (from main facial features) and motion of landmarks

Target Cluster

LBP descriptors + **Landmarks' Motion**

Lookup

Best Match ← **Source Sequence**

Temporal Stabilization

- Clustering: Segment target video and match each temporal cluster to a representative source frame
- Motion of landmarks in the whole temporal cluster controls abrupt expression changes

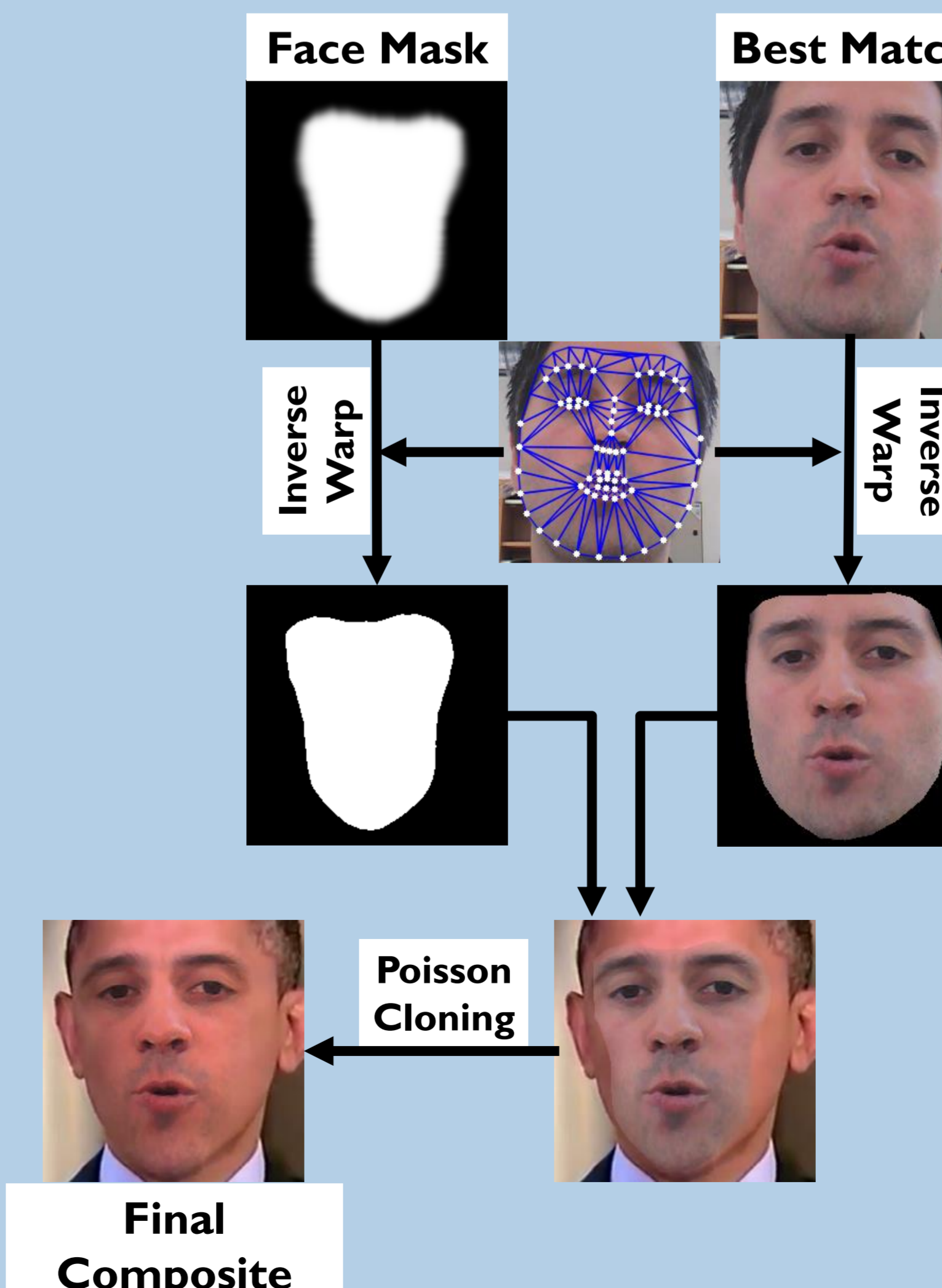## 3 — Face Transfer

Shape Transfer

- Selected source landmarks are aligned to those of the target by minimizing a warping energy:

$$E(X_R) = \omega_{nr}E_{nr} + \omega_r E_r, \qquad \omega_{nr}+\omega_r = 1$$

X_R are the aligned landmarks, and E_r, E_{nr} denote the affine and the non-rigid term

Appearance Transfer and Compositing

- Source texture is transferred by inverse warping
- Main facial features are seamlessly implanted on the target subject

Face Mask | **Best Match**

Inverse Warp | **Inverse Warp**

Poisson Cloning

Final Composite

4 — Reenactment: Selected Results

YouTube Video

Jack Nicholson in "A few good men". ***Top:*** Target sequence. ***Middle:*** Retrieved source frame (best match). ***Bottom:*** Final composite.

HD Footage

Performance made by different subjects. ***Top:*** Target sequence. ***Middle:*** Retrieved source frame (best match). ***Bottom:*** Final composite.

Project website
http://gvv.mpi-inf.mpg.de/projects/FaceReenactment/