A Novel Technique for Sketch to Photo Synthesis

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Goal of this work?

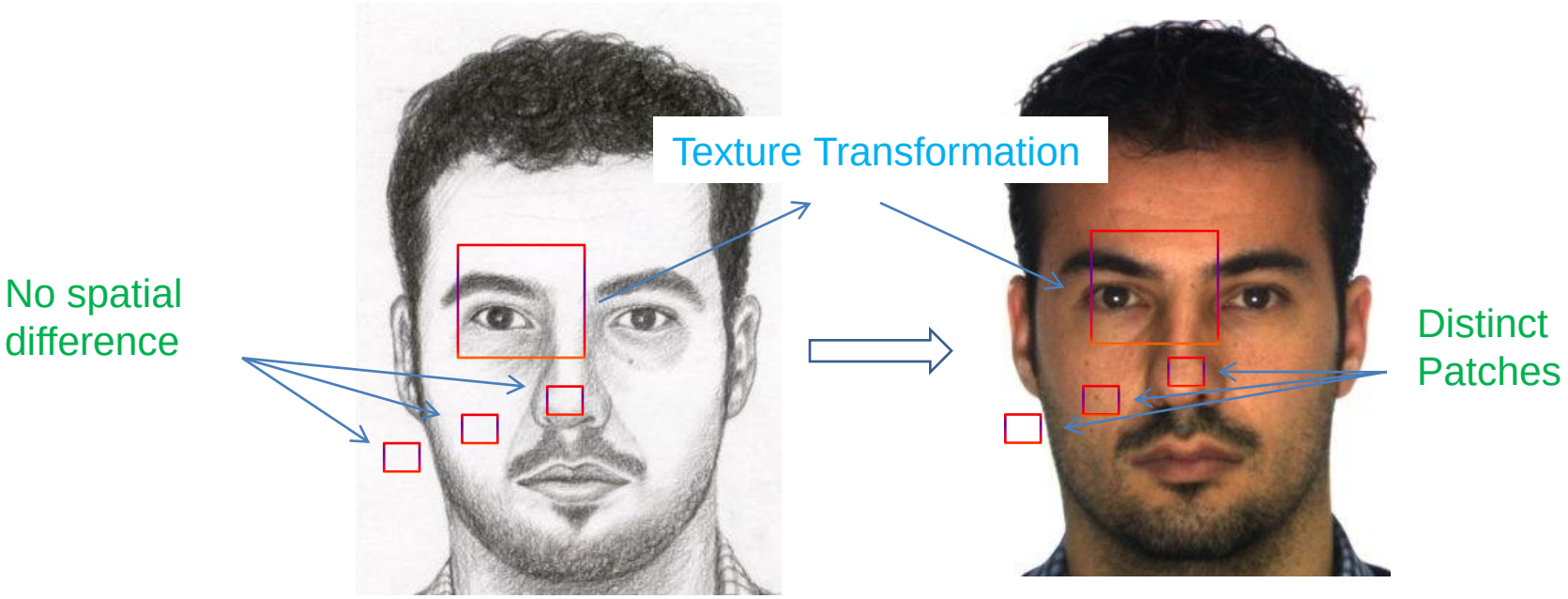

Figure : An Example of Sketch Photo Image Pairs (AR Database)

Applications

- Law Enforcement : Automatic retrieval of photos of suspects from a police mug-shot database, given a sketch artist's rendering from an eye-witness description
- Film Industry
- Entertainment

Query sketch drawn by artist

Image Database

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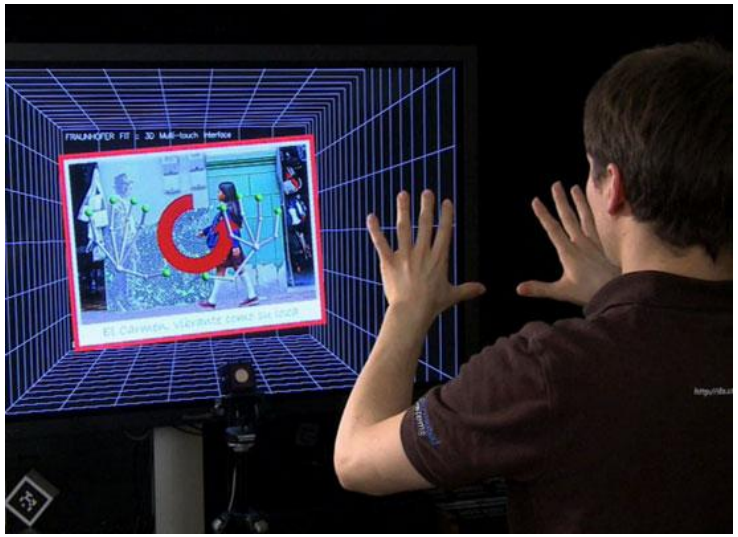
Multi-touch system



Gusture directed system

Photo Synthesis

- Sketch to Photo synthesis techniques
  - Using local texture analysis : Wang, Tang'09
- Photo to Sketch synthesis techniques
  - Using a global linear models : Wang '04 , '02
    - Eigen-face methods : Tang'03
  - Using local texture analysis : Liu & X. Tang 05

Global linear models :

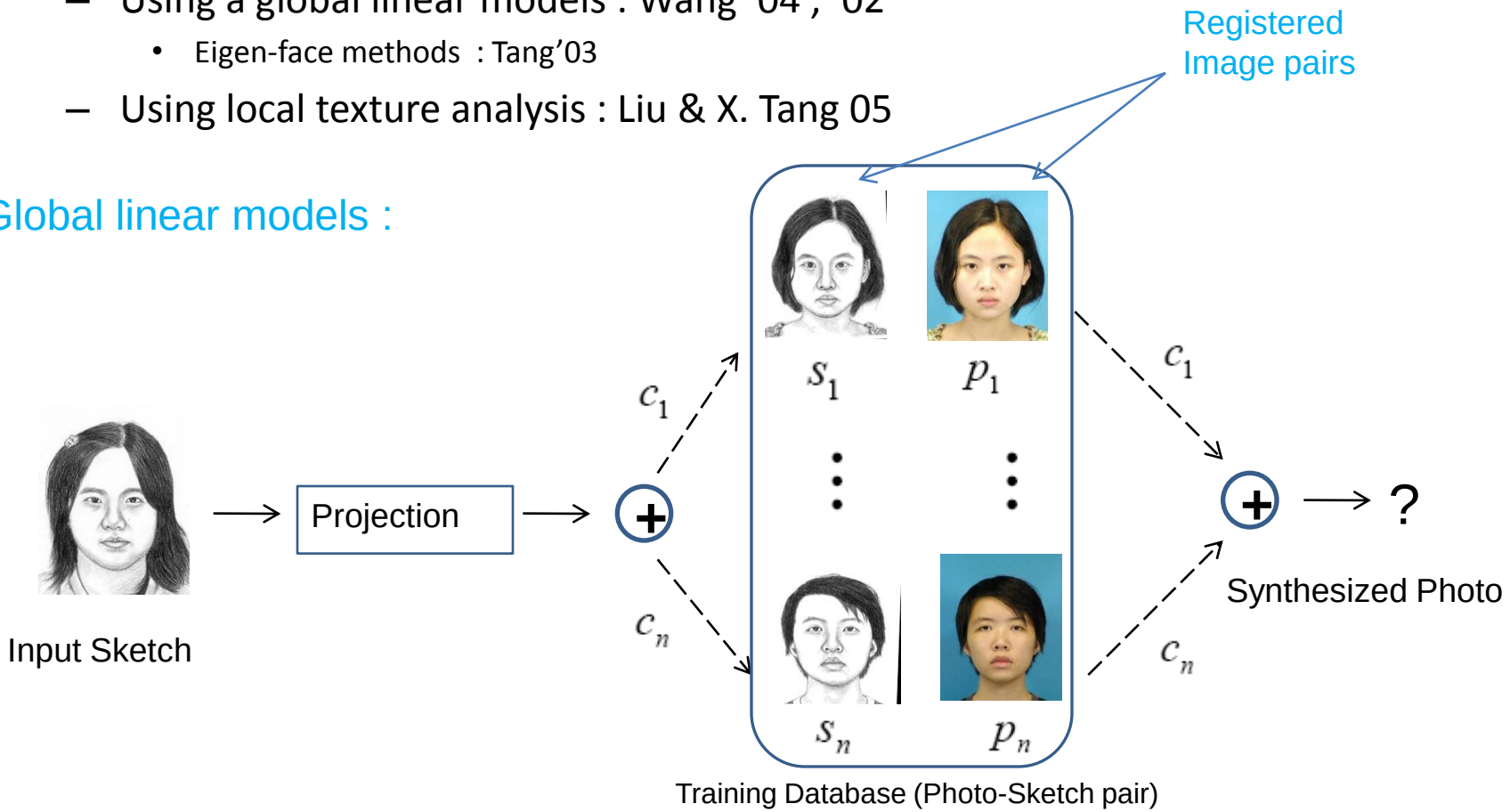
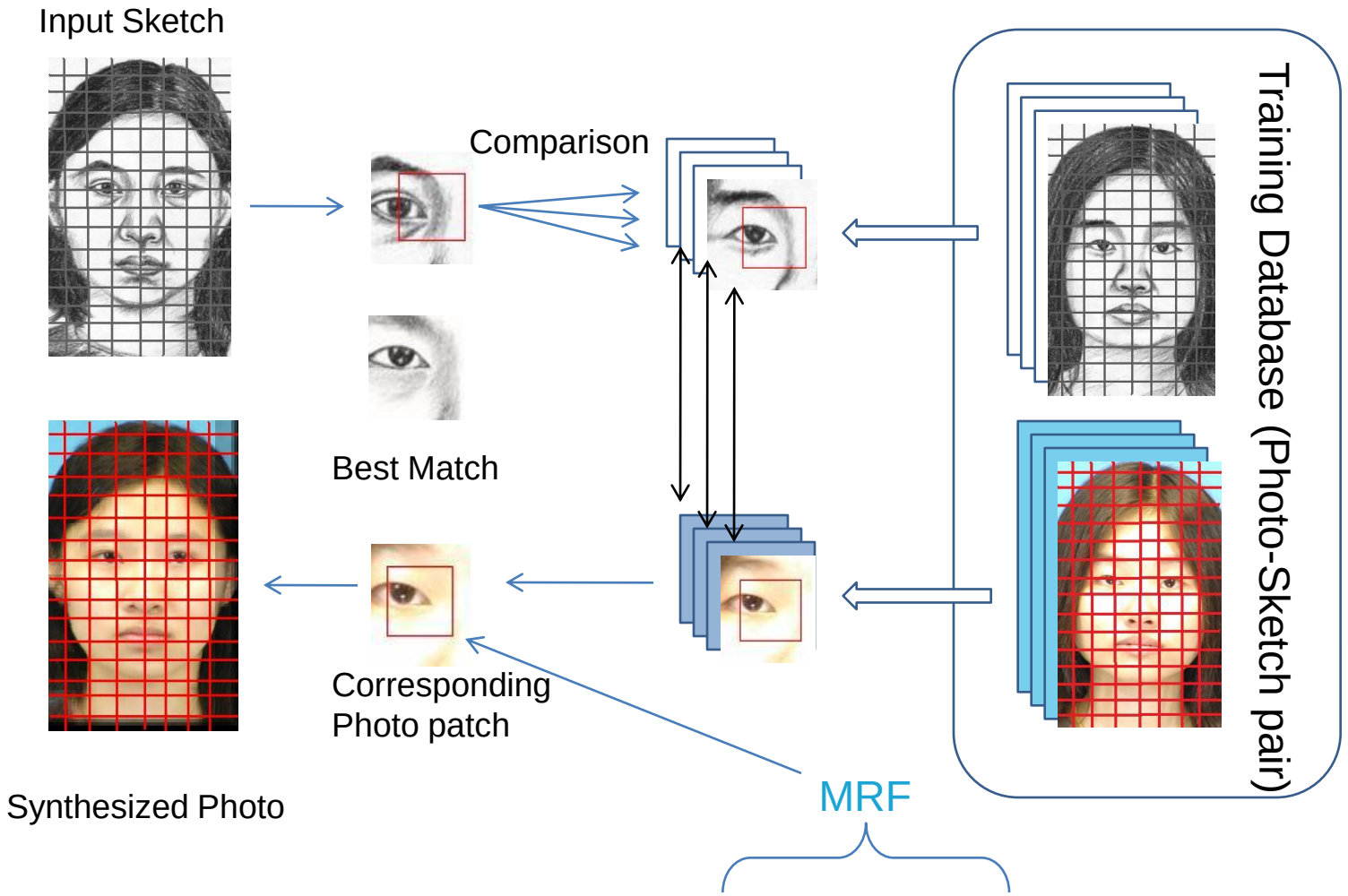


Photo Synthesis

Local Texture Analysis : Patch Matching Algorithm



Ref : Q. Liu & X. Tang 05, X. Wang & X. Tang '08 '09

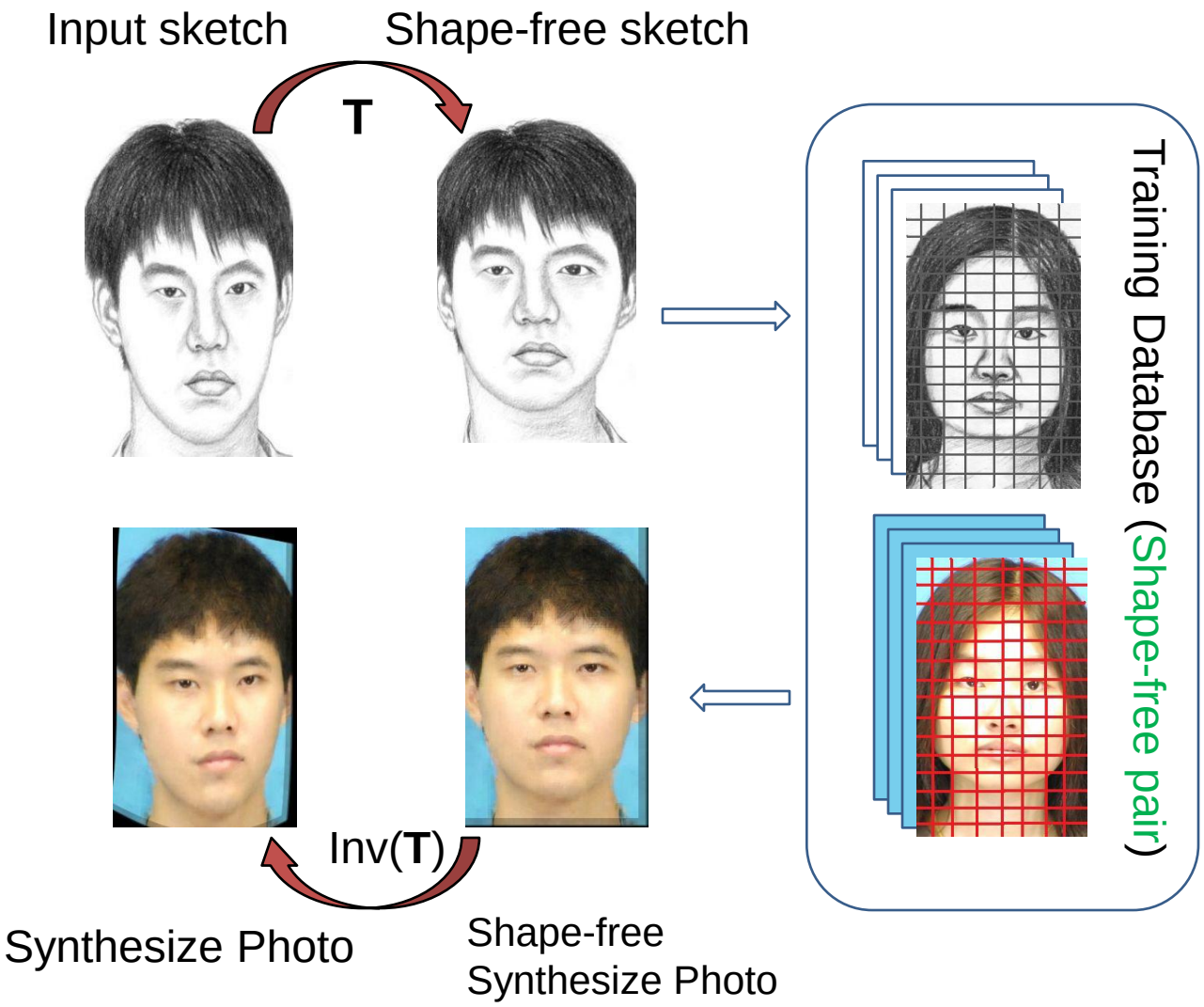
Drawback of previous models

- All the models so far are based on
  - Either Learning on Global texture analysis (Tang 2004)
    - Unable to synthesize local information
  - Or Learning on local texture analysis(Wang 2009)
    - Can't handle global shape variation

Can we learn global shape and Local texture together ?

Fig : Photo-synthesis using overlapping block matching technique

1.
We transform all the images (Training + Test) into shape free domain
(Image Warping)



2.
Learn the shape-free images locally to get shape-free Synthesize photo

3.
Then Transform back to it's original Shape

Transform images into a fixed shape (Image Warping)

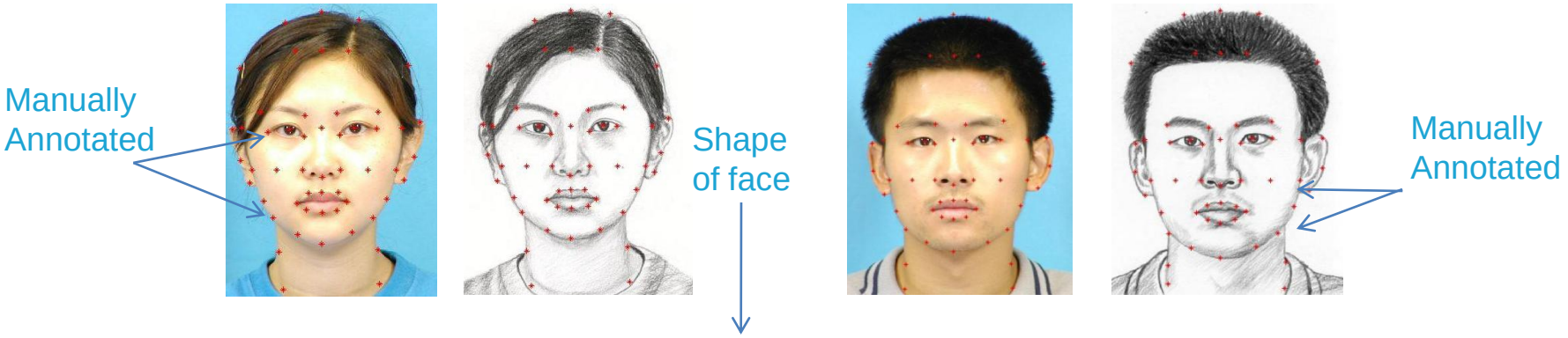


Figure : Annotation points(control points) plotted on photo sketch image pair

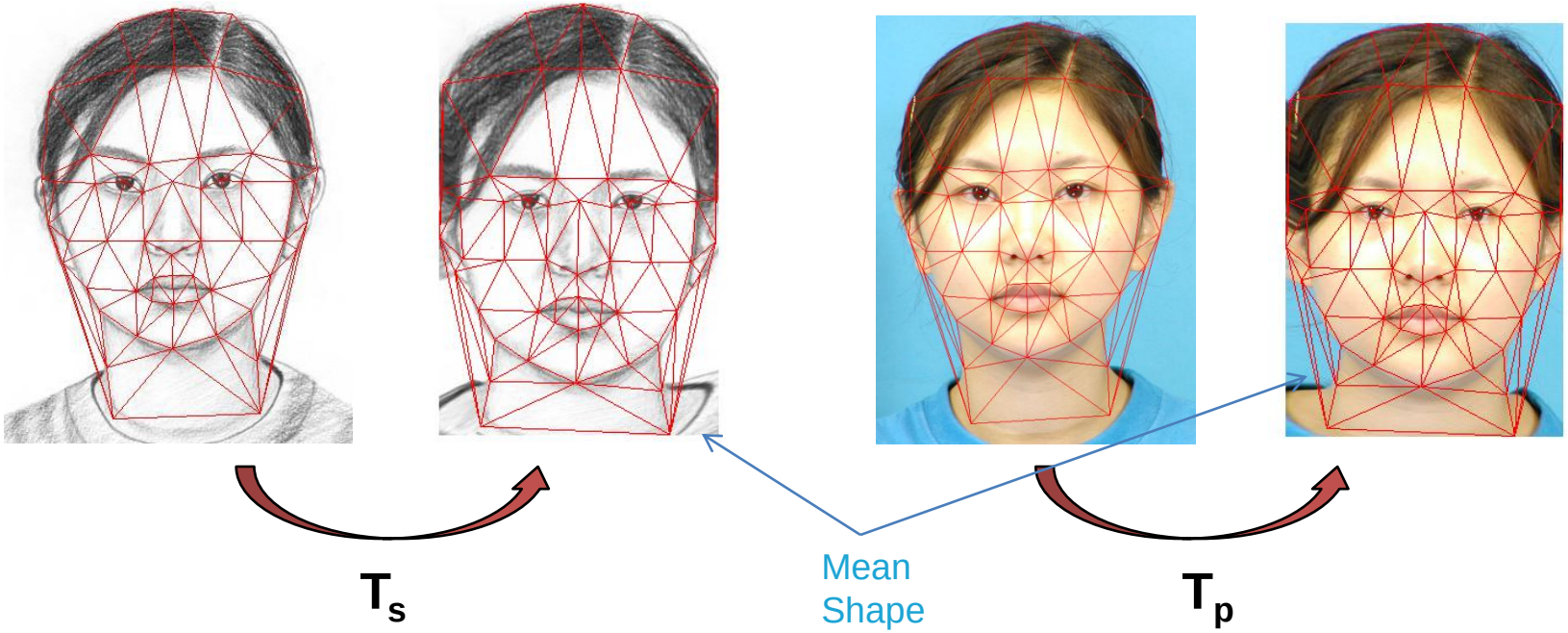


Image Warping

A piecewise linear transformation is applied separately to each triangular region of the image [1].

- Find a Delaunay triangulation of the base control points.
- Using the three vertices of each triangle, infer an affine mapping from base to input coordinates.

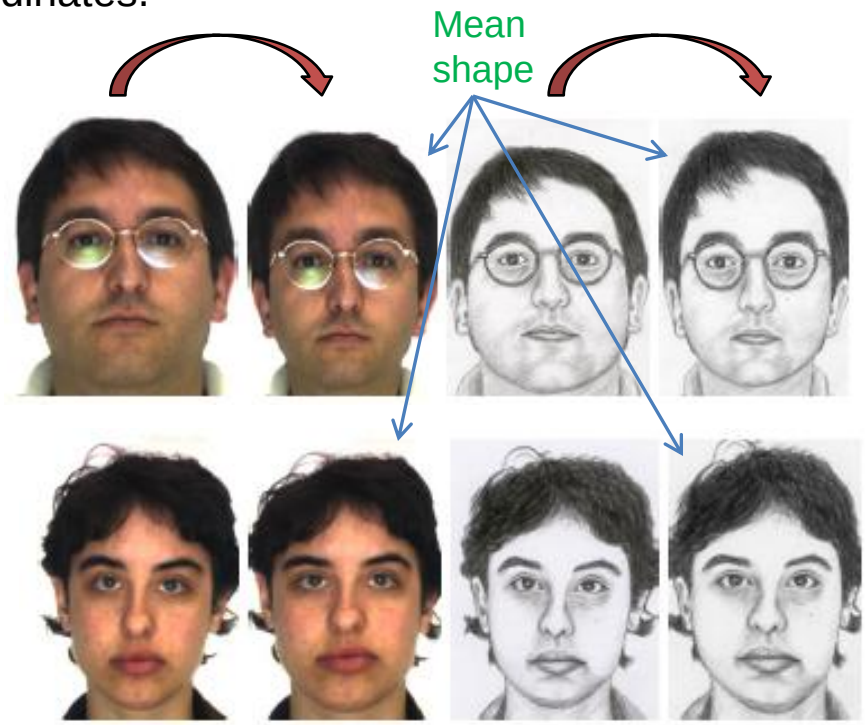


Figure : Photo and sketch Images after warping

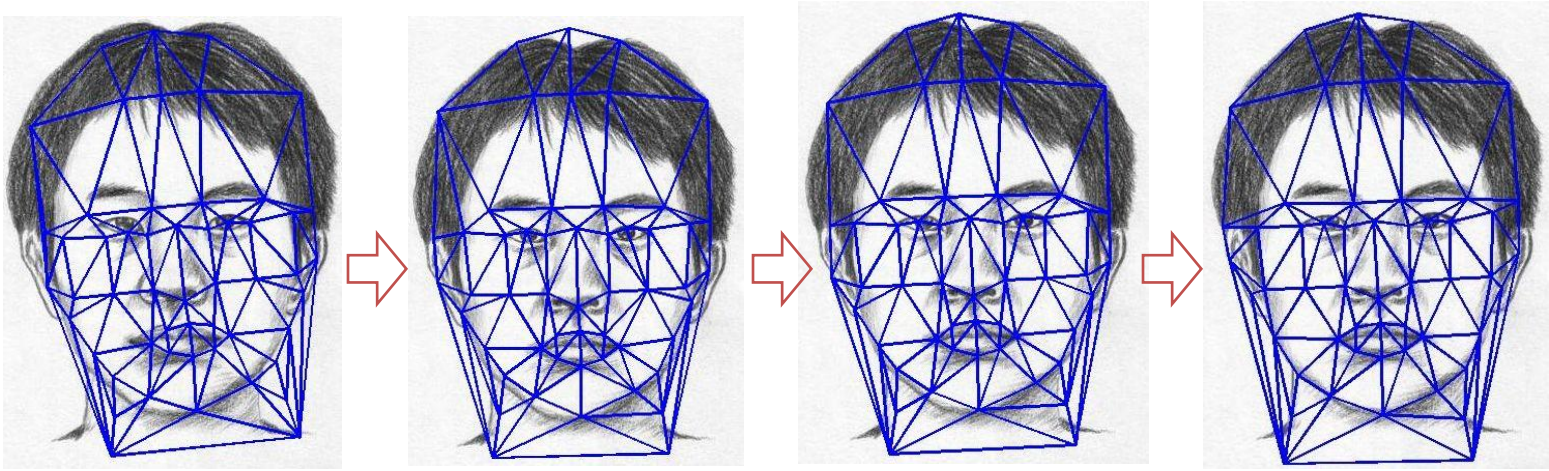
Annotation points for test sketch

- Why manually annotation for Test Sketch is not feasible?
  - Annotation points are in a fixed order
  - Missing a point would blow up Warping algorithm
  - Points should be correctly annotated
  - Time consuming process
- Alternative solution ?

Active Shape Model (ASM)

Active Shape Model

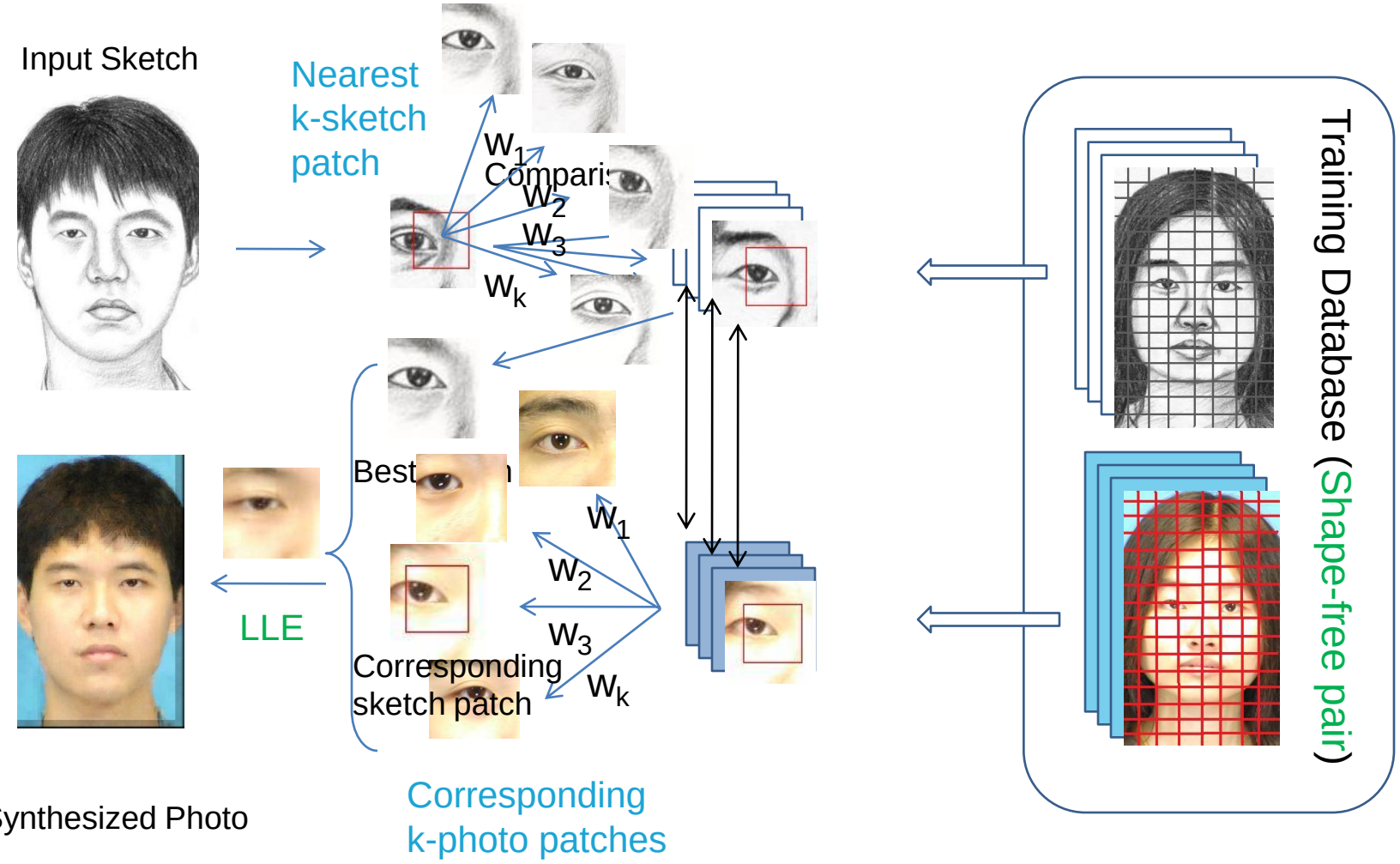
- It's a statistical model on shape of objects.
- Captures the natural variability within a class of shapes of objects in training image.
- Learn the shape of manually annotated training sketch face
- Iteratively deform to fit to the face in a new Test sketch on the basis of initial approximation.



Initial Approximation | 3rd Iteration | 5th Iteration | After convergence

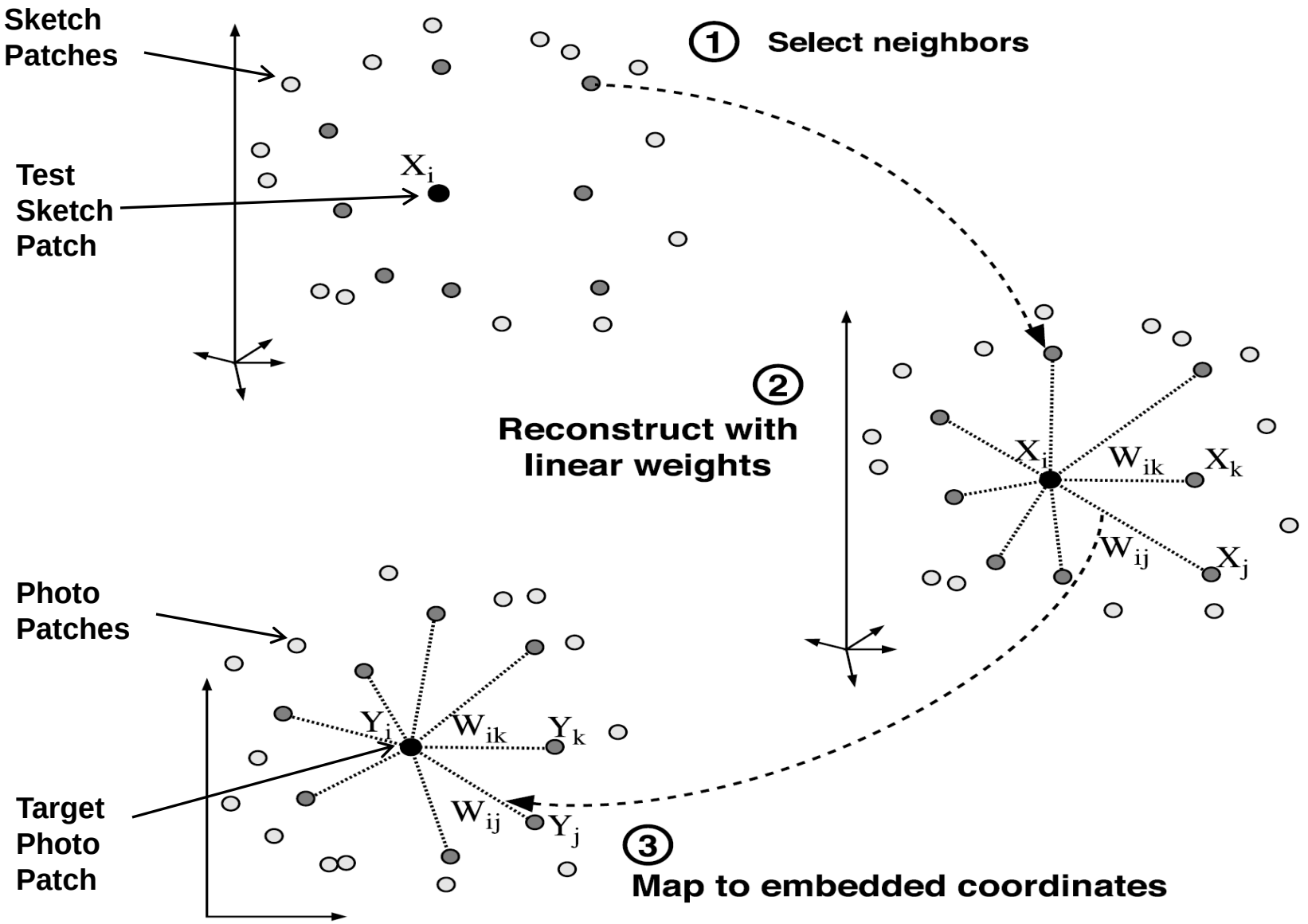
Photo Synthesis in Shape-free domain

Learning Based Technique : Patch Matching Algorithm (LLE based)

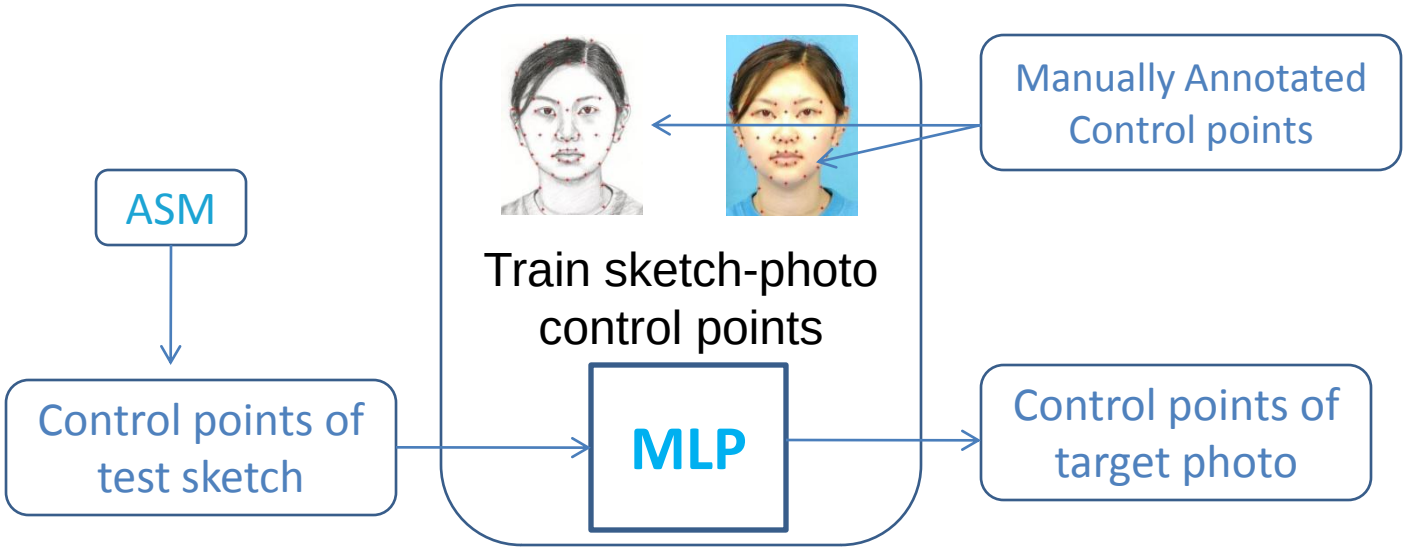


Ref : Q. Liu & X. Tang 05, X. Wang & X. Tang 09

Locally Linear Embedding framework



Warping back to it's actual shape

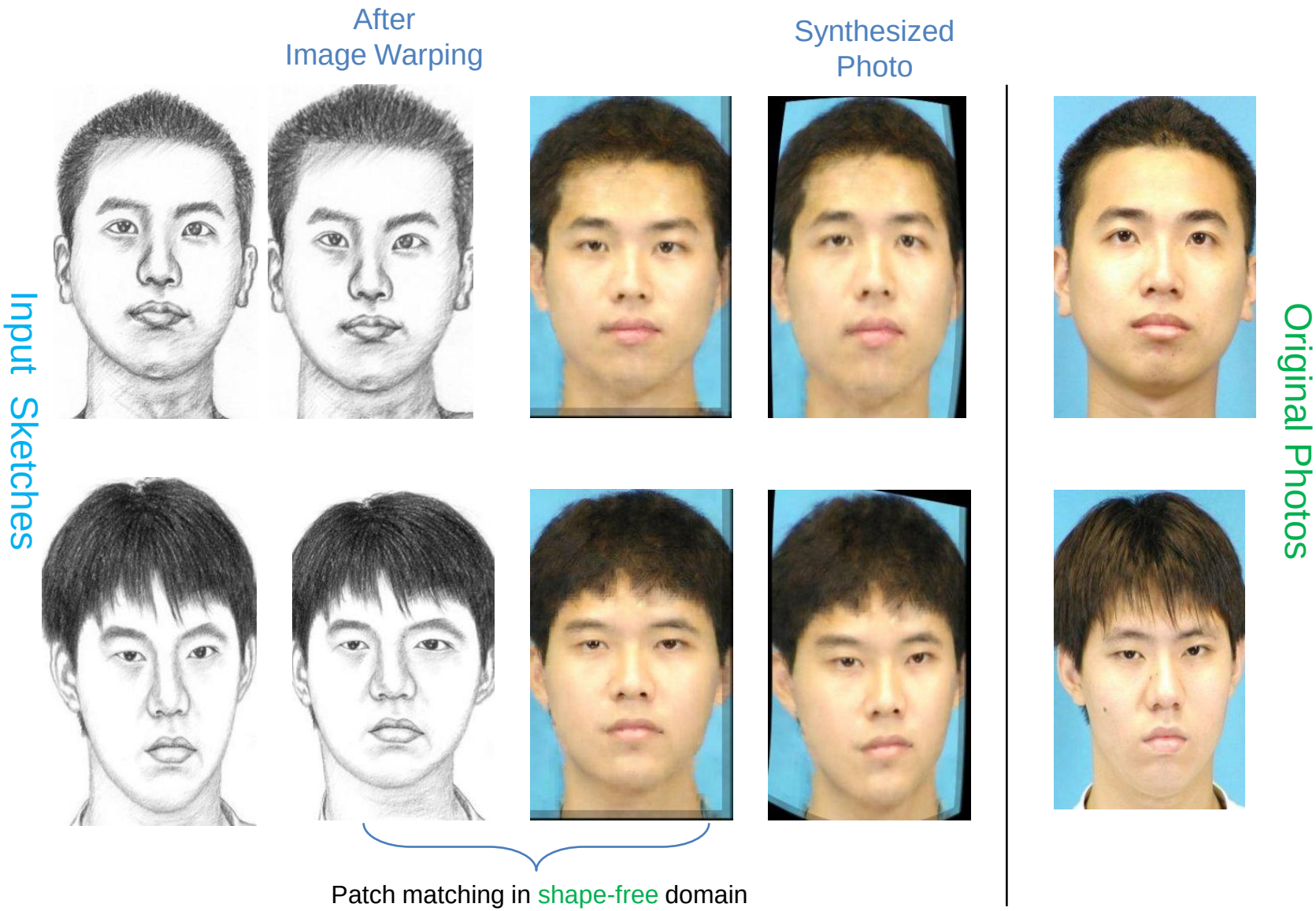


Shape-free Synthesized Photo

Inv(**T**)

After warping back to it's actual shape Synthesized Photo

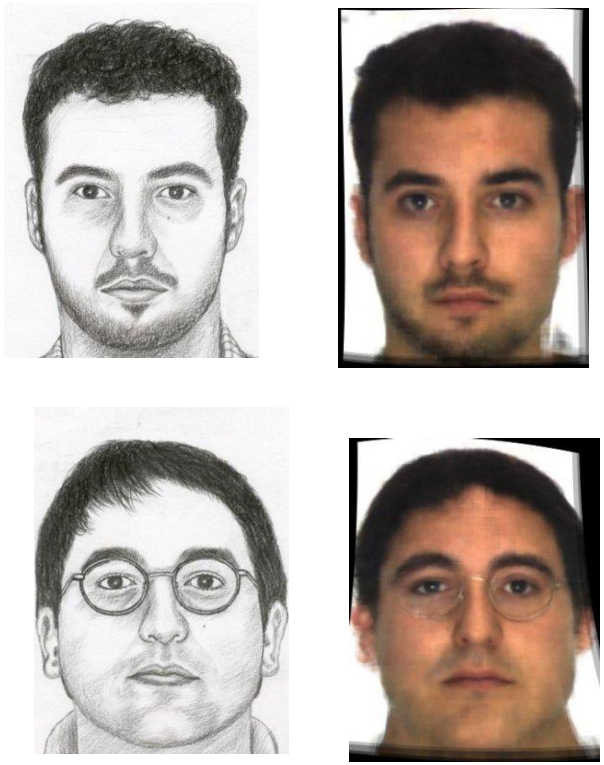
Results : Shape-free Domain



More Results

Example 2 : Shape-free photo synthesis from sketch image

Results from CUHK Database



Results from AR Database

Comparison with other models

Test Sketch

Using patch-based technique

Using our Algorithm

Conclusion

- System can synthesize photo correctly for large variation of shape of face.
- Totally automated system except initial translation of shape of test sketch for ASM.
- Limitation : Outside of shape may not be correctly reconstructed.
- Extension of this work : sketch face recognition.
- Future work : generating 3D face from sketch images

Thank You.

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