



Tattoo Based Identification: Sketch to Image Matching

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Outline

- Background
- Proposed approach
- Tattoo sketch-image database
- Experimental results
- Summary and future work



Background

- Harris Interactive: One in five (21%) U.S. adults have at least one tattoo^[1]
 - Most gang members have tattoos in their bodies



Some examples of gang tattoos (http://www.gangink.com/index.php?pr=GANG_LIST)

[1] Harris Interactive: <http://www.harrisinteractive.com/NewsRoom/HarrisPolls/tabid/447/mid/1508/articleId/970/ctl/ReadCustom%20Default/Default.aspx>

Background

- Tattoos on human body provide important clues to the identity of a suspect



Tattoos assist in arrest of suspects^[1,2] !

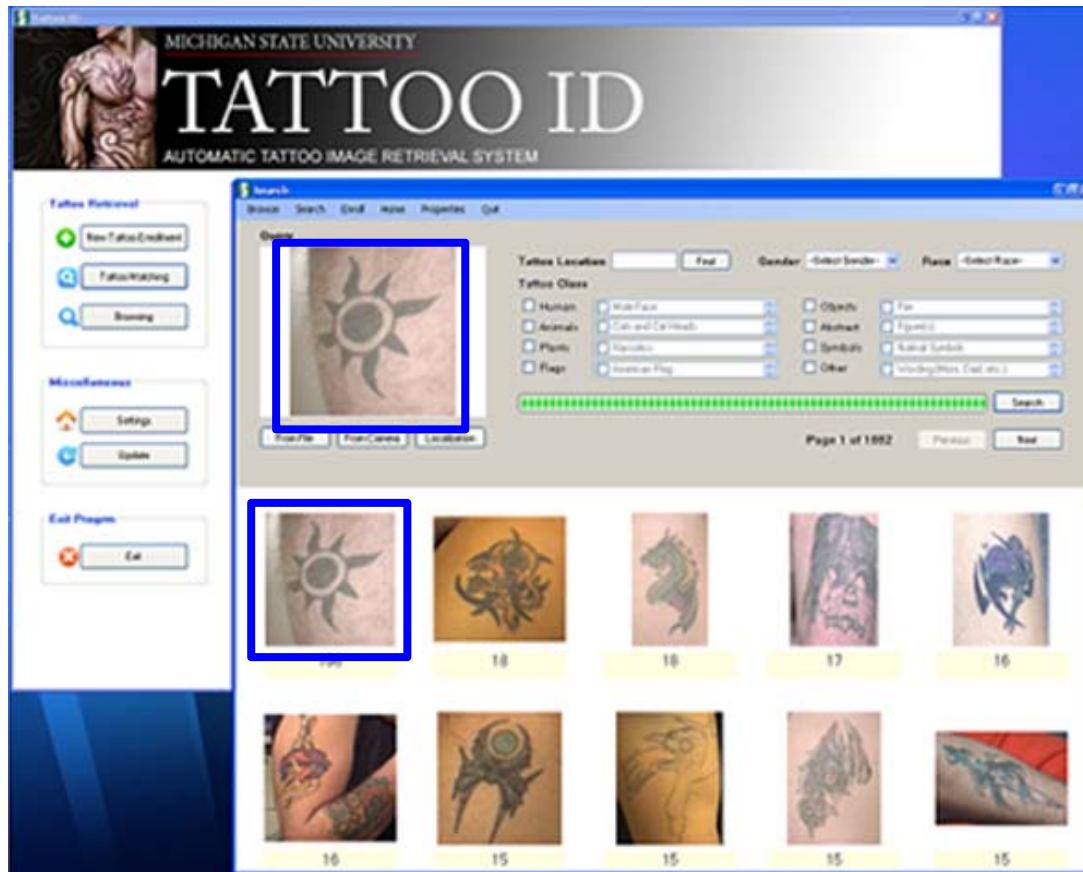
[1] <http://www.tampabay.com/news/publicsafety/crime/article1249486.ece>

[2] <http://portcitydaily.com/2012/09/26/tattoos-aid-in-arrest/>



Background

- Tattoo image-to-image matching *[Jain'07, Acton and Rossi'08, Lee'12]*



The **query** image is a “**near duplicate**” of the **true tattoo** image if present in the database



Background

- Tattoo image of the suspects may not be available - Draw a **tattoo sketch** following the verbal description of the eyewitness



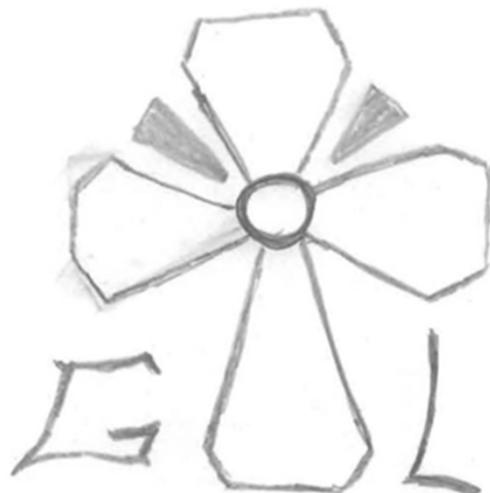
Tattoo and face sketches of a suspect who attempted an abduction of a 13-year-old girl, released by the Royal Canadian Mounted Police (RCMP) in Chilliwack in January 2011



Tattoo sketch to image matching

- Challenges

Tattoo sketch



(i) Different **modalities** (sketch vs. photo)

(ii) **Inaccurate** description or drawing of a tattoo sketch w.r.t. suspect's true tattoo image

(iii) **Deformations** between tattoo sketch & image

Tattoo image





Proposed Approach

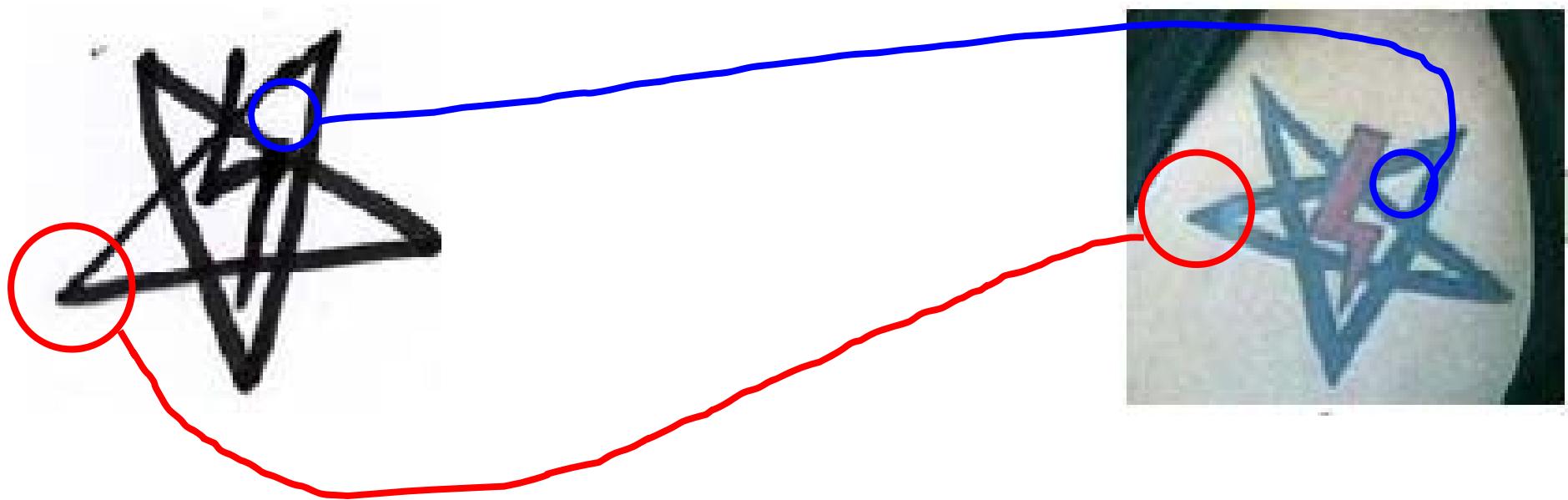
- Motivation
 - Deformations between holistic tattoo patterns





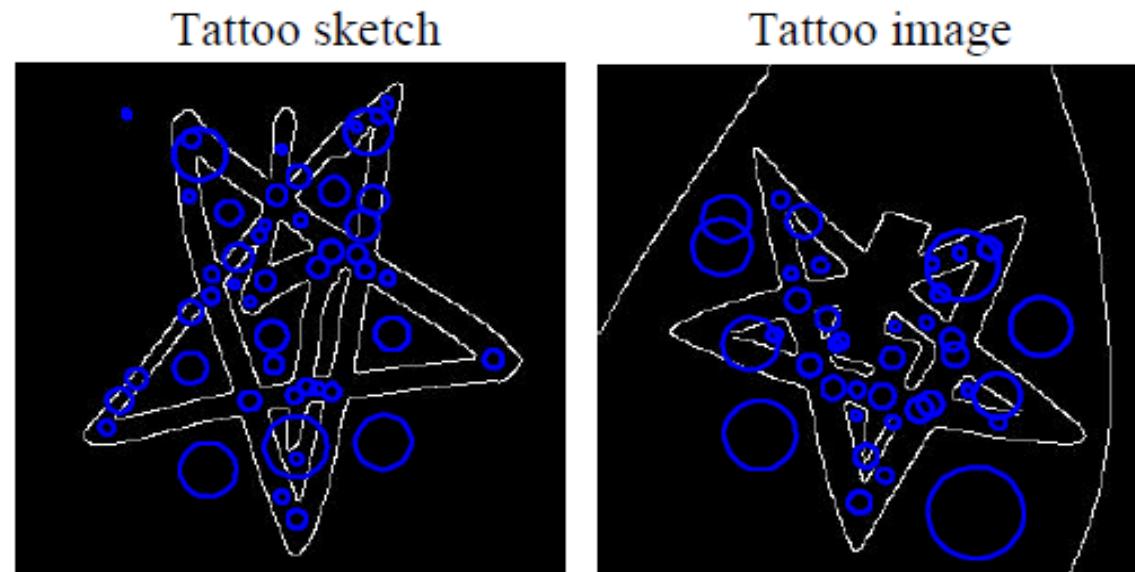
Proposed Approach

- Motivation
 - Similarities between local patterns

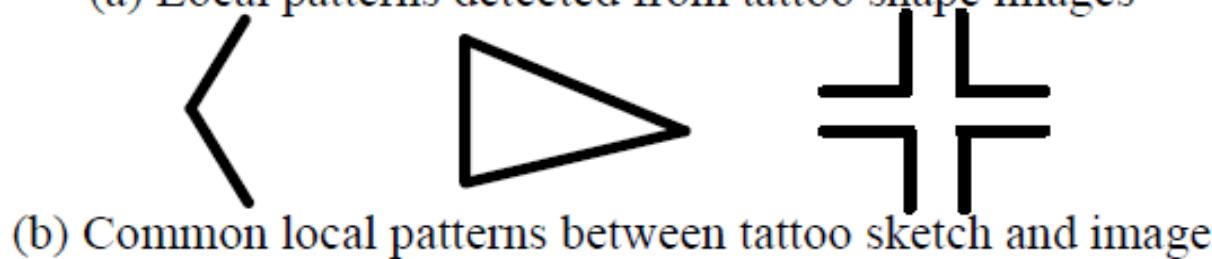


Proposed Approach

- Detecting local patterns from tattoo shape (Canny edge detector) images using SIFT



(a) Local patterns detected from tattoo shape images

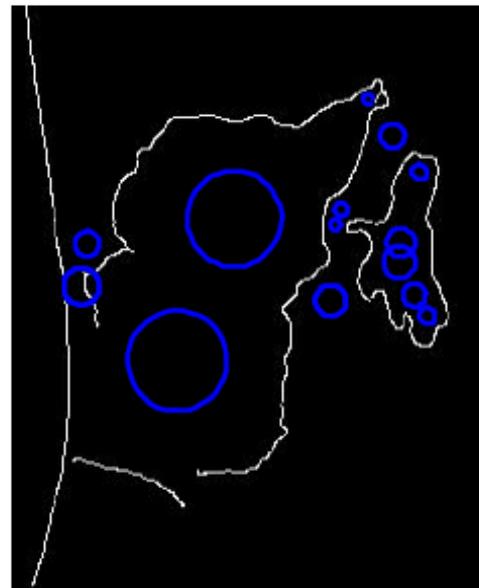


Proposed Approach

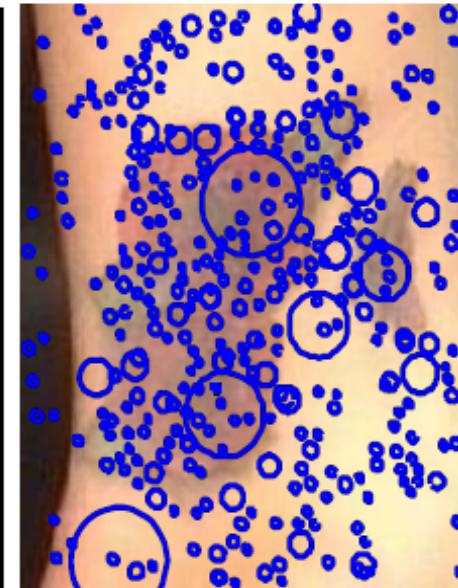
- Some tattoo shape extractions may not be good
 - We should also use the tattoo appearance image



Tattoo
image



Local patterns
detected in
shape image

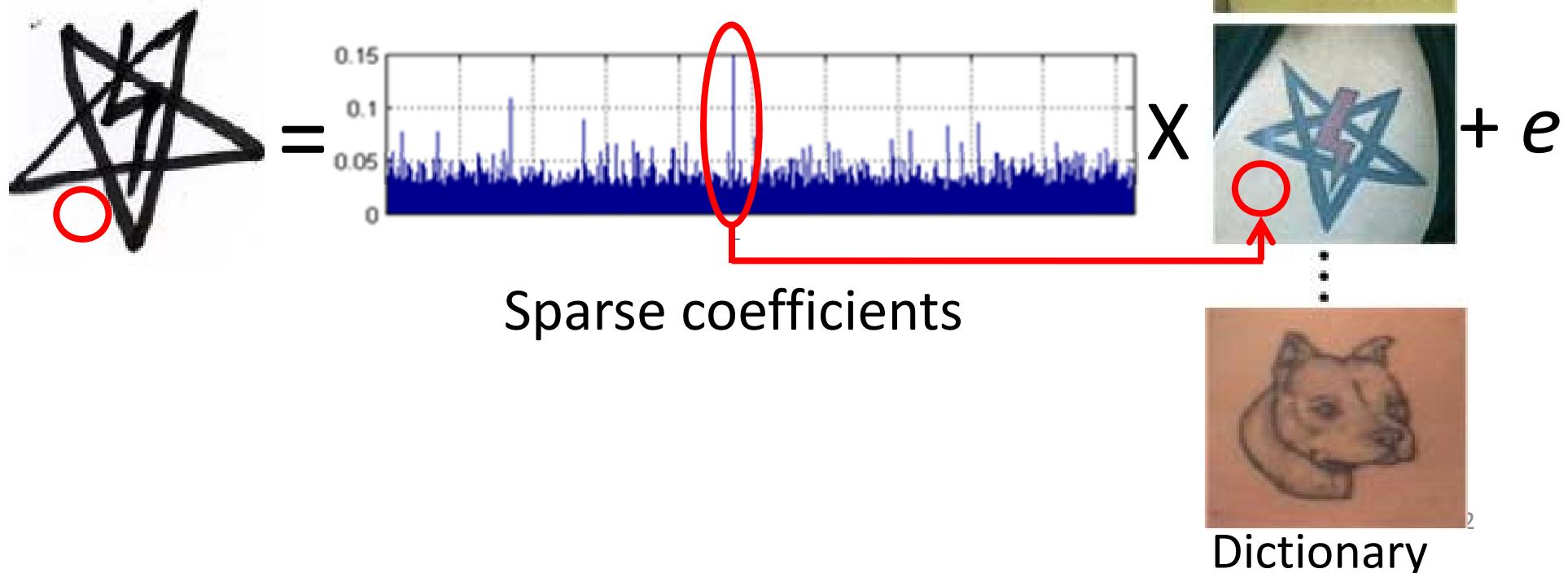


Local patterns
detected in
appearance image



Proposed Approach

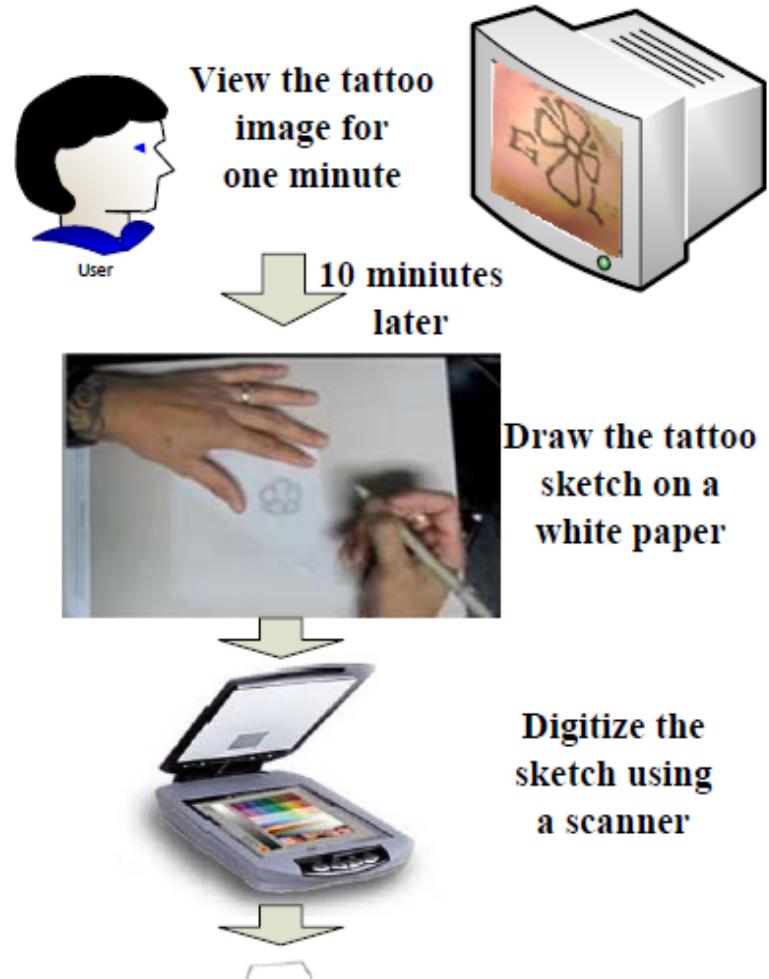
- The **larger the number** of common local patterns between tattoo sketch and tattoo image, the **higher** their **similarity**
 - For each local pattern: SRC





Tattoo sketch-image database

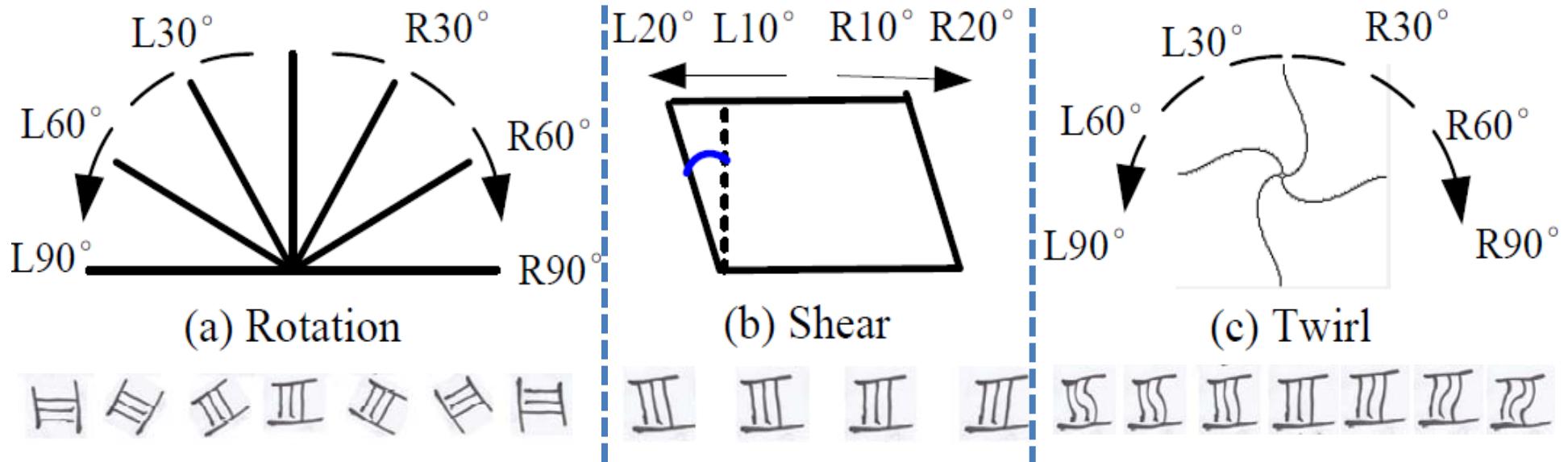
- There is no operational tattoo sketch data set that we could find from law enforcement agencies
- we construct a data set consisting of 100 tattoo sketches drawn by two different subjects, each sketch corresponding to a tattoo image
- 10,000 tattoo images provided by the Michigan State Police are used to populate the gallery
 - 100 sketch images
 - We have released this database in our website:
 - <http://biometrics.cse.msu.edu/pubs/databases.html>





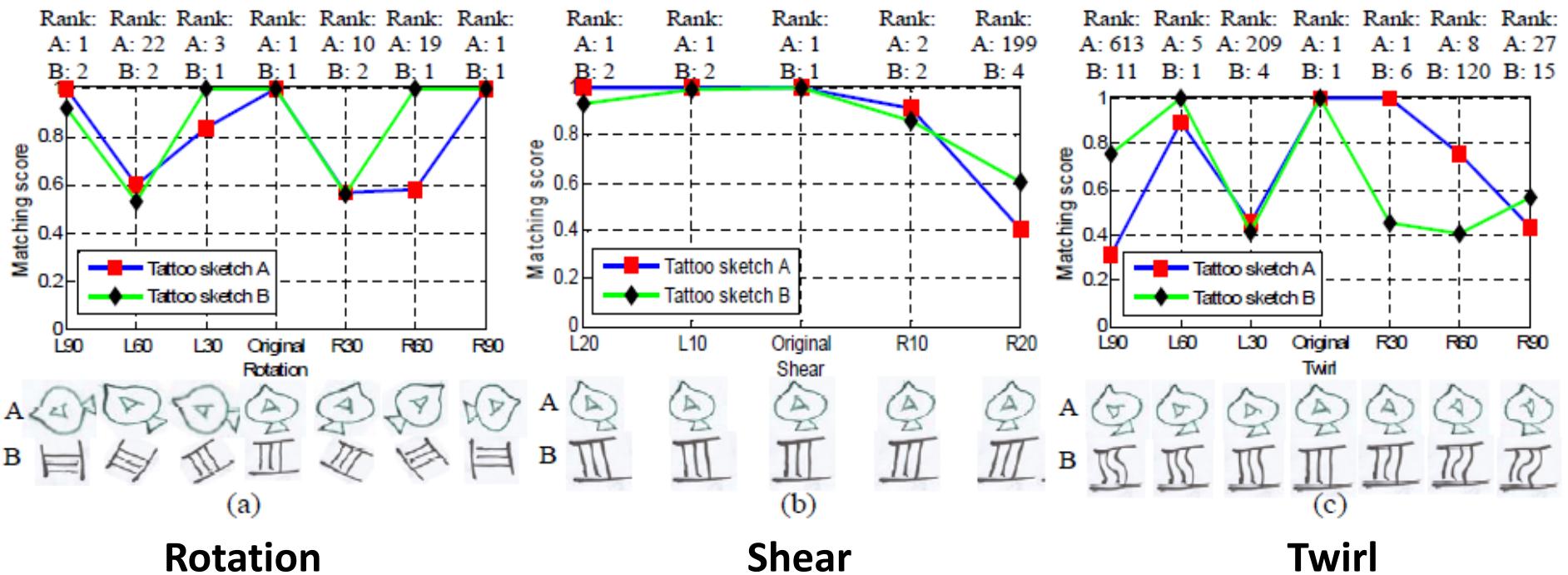
Experimental results

- Robustness to deformations



Experimental results

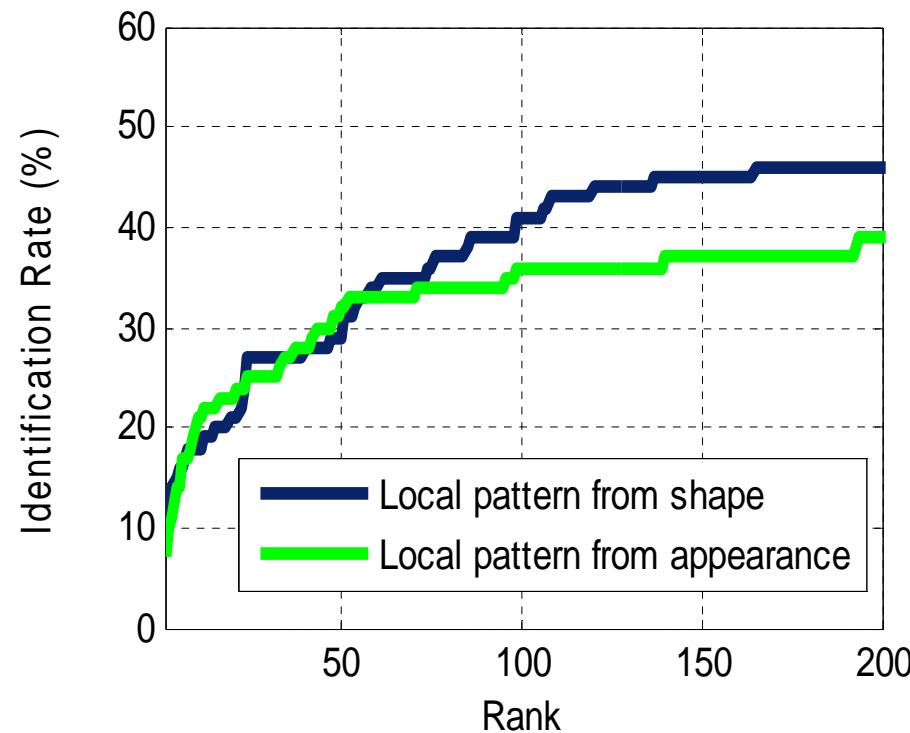
- Robustness to deformations





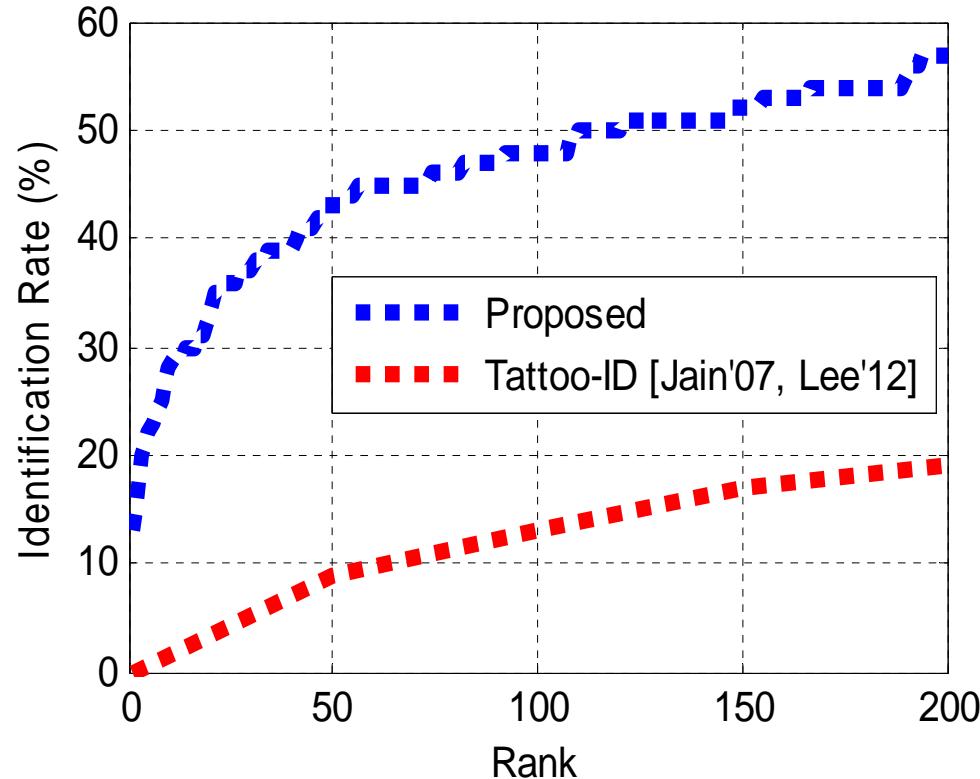
Experimental results

- Local pattern detection from shape images vs. appearance images



Experimental results

- Comparison with a state-of-the-art matcher –
Tattoo-ID [*Jain'07, Lee'12*]



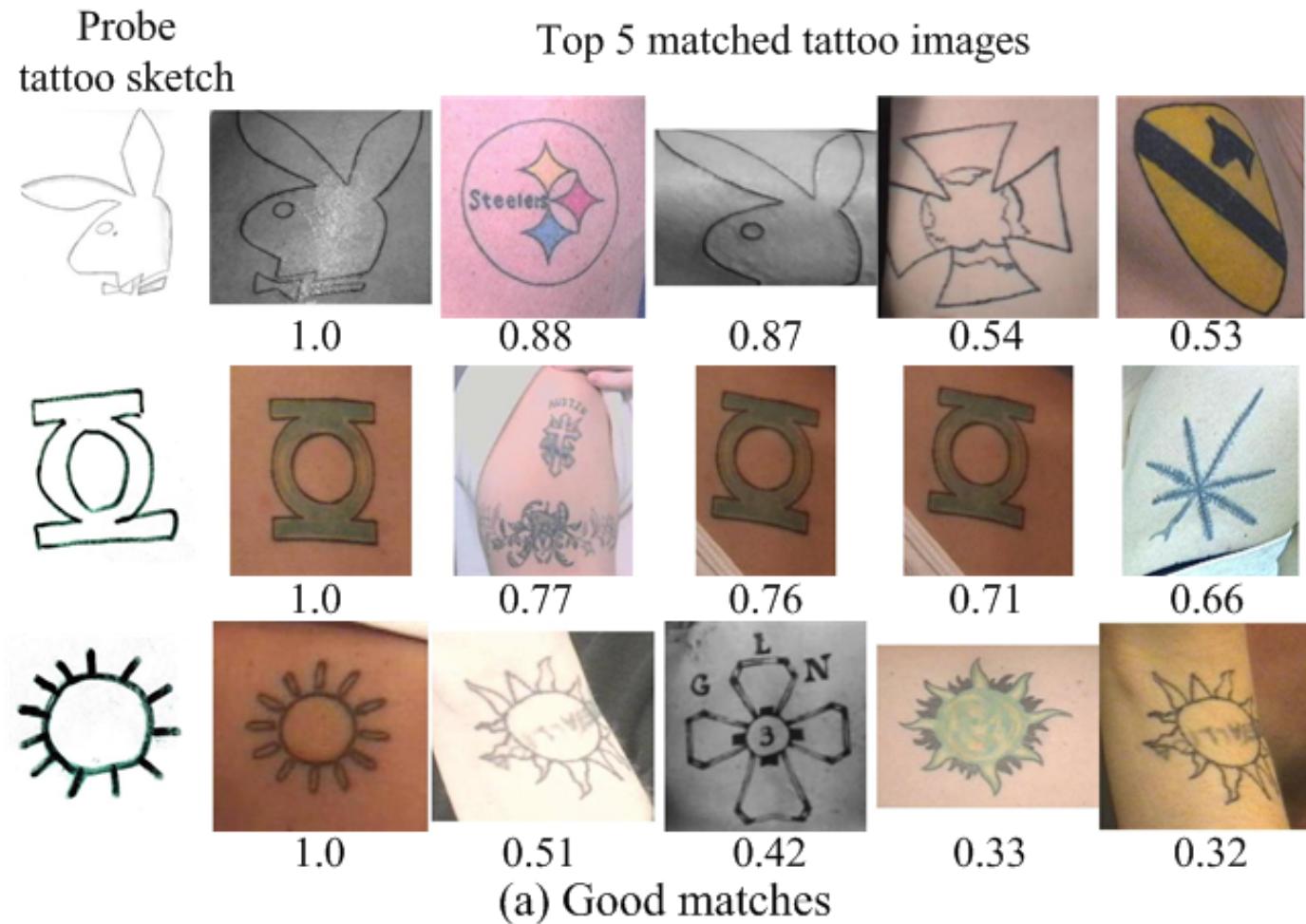
A. K. Jain, J.E. Lee, R. Jin: Tattoo-ID: Automatic Tattoo Image Retrieval for Suspect and Victim Identification. PCM 2007.

17

J.E. Lee, W. Tong, R. Jin, and A. K. Jain, "Image Retrieval in Forensics: Tattoo Image Database Application", IEEE Multimedia, Vol. 19, No. 1, pp. 40-49, 2012.

Experimental results

- Examples of tattoo sketch to image matching





Experimental results

- Examples of tattoo sketch to image matching

Probe
tattoo sketch



1.0



0.91



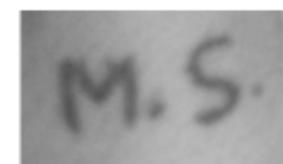
0.84



0.78



0.77



Rank:
2790



1.0



0.72



0.64



0.57



0.53



Rank:
1483

(b) Poor matches



Experimental results

- Computation cost
 - Tattoo-ID: 30 Secs. per retrieval with C++ implementation
 - Proposed: 55 Secs. per retrieval with Matlab implementation

Testing platform: WIN7, Intel Core2 2.4G, 4G RAM

Gallery size: 10,100 tattoo images



Summary and future work

- Summary
 - We constructed a tattoo sketch database, and proposed a scheme for matching tattoo sketches to tattoo images
 - Our method outperforms a state-of-the-art matcher
- Future work
 - Increase the size of tattoo sketch database
 - Improve the performance by integrating human annotations of tattoos, and by introducing structural constraints between various local patterns



Thank you!

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