## C39 A Study of Wrist Identification for Forensic Applications

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**Learning Overview:** After attending this presentation, attendees will understand how wrist images may serve as a biometric trait for criminal and victim identification.

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by adding a new aspect of personal identification and provide a new way to support the identification of suspects and victims, whose faces and tattoos are not in the images, but whose wrists are still visible (e.g., child sexual abuse, rioters, or terrorist images).

To avoid being identified in digital images, criminals may intentionally hide their faces or tattoos. Biometric traits such as veins, skin marks, height, skin color, weight, race, etc., are used by some of the existing methods to solve this problem. Although soft biometric traits, including gender, race, height, weight, or skin color, offer useful information, they are not distinctive enough. Using skin marks and veins requires good quality, high-resolution images, which in some cases may be unobtainable. Even though good quality images are provided, body parts may not have enough skin marks or clear veins, or they may not be visible enough (e.g., wearing long sleeves). On the other hand, an individual's wrist can still be visible in these images. Terrorists and rioters expose their wrists in gestures of triumph, greetings, salutes, or when holding weapons; whereas pedophiles may show their wrists when touching victims. Wrists were neglected by the biometric community though, and per this study's research, no wrist identification algorithm for forensic applications has been proposed.

To explore the potential of wrists for forensic applications, a wrist identification algorithm, which includes skin segmentation, key point localization, image to template alignment, large feature set extraction, classification and post-recognition score analysis, is proposed. The proposed algorithm and six state-of-the-art biometric methods designed for palm print, palm vein, and fingerprint matching are evaluated on NTU-Wrist-Image-Database-v1, which consists of 3,945 images from 731 different wrists, including 205 pairs of wrist images collected from the internet, taken under uneven illuminations with different poses and resolutions. The database also includes two different images of a masked rioter who exposed his wrist and was photographed by an Associated Press photographer during the Baltimore, MD, riots in 2015.

The experimental results demonstrate that the proposed algorithm outperforms the state-of-the-art palm print, palm vein, and fingerprint matching methods. Moreover, the proposed algorithm successfully matches the masked Baltimore rioter within top ten ranks. In particular, he is retrieved at the first and eighth rank, depending on the algorithm parameter. This example and other experimental results demonstrate that a wrist is a useful clue for forensic investigation.

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**Wrist, Criminal and Victim Identification, Biometrics**