C27 The FearID Ear Print Identification System

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Attendees will learn about the use of ear prints in criminal investi- gation and identification. This presentation will show the value of the use of ear prints in criminal investigation and identification.

In recent years, forensic individualization based on earmarks has been under fire. To solidify the scientific basis for ear print / earmark identifi- cation, the EU financed Forensic Ear Identification (FearID) project was started in nine institutes over Italy, the U.K. and the Netherlands. The FearID research project aims to obtain estimators for the strength of evi- dence of ear prints found on crime scenes. For this purpose, a sample of ear prints from 1,229 donors over three countries has been collected.

On the basis of two manual annotations, of which one is knowledge- based, methods for automated classification were developed and used for training of a system that classifies pairs of prints as 'matching' or 'non- matching'. The manual annotations were twofold: on the one hand, of operators denoting the contour of the ear prints to facilitate segmentation of the image, on the other, of anthropological specialists anatomically denoting specific locations in ear prints. From the annotated contour a con- nected structure is determined that is represents the imprint, and which is referred to as *superstructure*. On the basis of this superstructure, further analysis is performed using various image processing techniques. The anthropological annotation is analyzed through a method called Vector Template Matching (VTM). Here, following its annotation, each print has a template constructed, consisting of labeled points representing ear print landmarks and *minutiae,* distinguished into different classes. Prints are compared by assessment of the similarity between their templates.

A matching system was developed using samples of about 2/3 of the ear print donors as a training set, with data-fusion at the feature level. The analysis of the outcomes is based on the statistical method of (binary) *logistic regression* (BLR). Based on the training data, the BLR method extracts a linear combination of the used features, optimally separating pairs of matching from pairs of non-matching prints.

Testing of the developed matching system was performed using the remaining 1/3 of the sampled ear prints. Comparing lab quality prints this leads to a matching system with an equal error rate of 4%. Starting from a database containing two prints per ear, hit list behavior is such that in 90% of all query searches the best hit is in the top 0.1% of the list. The results become less favorable (equal error rate of 9%) for print/mark comparisons.

The system may be improved further by on the one hand using more image processing techniques and pattern recognition methods, on the other by making annotation data less operator dependent. The current study has focused on the performance of a semi-automated ear print / mark classifi- cation system. With respect to ear print / mark identification in court this may not be the most relevant issue, since performance of experts is crucial there. On the basis of the sample, performance of experts may be tested by presenting hit lists following query searches and scoring the results.

Ear Prints, Identification, Classification

