From the Chair of the Scientific Advisory Board…

The papers in Volume 24 of the *JFDE* center around signature verification as a case in point for comparing automatic system with the results of forensic handwriting examiners (FHEs), for verifying basic assumptions underlying the implementation of computerized models of handwriting and eventually for using computer models for investigating *template ageing* effects. The four scientific research papers were selected from the presentations at the 16th Conference of the International Graphonomics Society (IGS) held in Nara, Japan in June 2013.

The first paper by **Marianela Parodi et al., "Online Signature Verification: Automatic Feature Selection vs. FHEs' choice,"** compares the discriminative power of a set of features widely used by FHEs with those specifically designed for an automatic signature verification system. The results of a set of experiments on automatic verification, performed on a publicly available data set containing both Western and Chinese signatures, show that the performance obtained by an ad-hoc designed system when using the former feature set is comparable to the one achieved when the latter one is used instead. On the basis of the experimental findings, the authors argue that if all the features that FHEs look at could be implemented the performance might even be better. They also observe, however, that such an implementation seems hard to do since some features used by FHEs, such as line quality and ink intensity variations, just to mention a few examples, are not appropriately defined to be computed automatically,

Along the same line, **Muhammad Imran Malik[i] et al. In "Man vs. Machine,"** addresses the very fundamental question of whether or not FHEs are better than machines in signature verification in the second paper. To answer the question, the authors have submitted the same set of features as in the Parodi, et al. paper, containing genuine, disguised and forged signatures. These signatures were submitted to both FHEs and different state-of-the-art automatic systems: the results were compared in different ways. When the comparison involved overall accuracy, the experimental results show that the average accuracy of the automatic system was better than the results for FHEs, but that the best humans outperformed the best machines in all the trials. However, when the performance is given in terms of both false acceptance rate, which measures how often a forgery is considered as genuine, and false reject rate, which measures how often a genuine is considered as a forgery, the human experts outperformed nearly all the systems. The paper is completed by a more detailed study that investigates the effect of training and expertise on human performance: surprisingly, the experimental findings suggest that none of them exert any influence on the performance. On the basis of the results, the authors conclude that the most significant difference between human experts and automatic systems is that the former exhibits a larger degree of variations between the average performance and the best performance than the latter ones. Both, experts and machines, are very accurate in detecting genuine signatures but both encounter difficulties in dealing with disguised signatures. Eventually, the authors warn not to overestimate the potential of the automatic systems, since the performance reported in the study was obtained on "clean" data, assumed that many specimens of genuine signatures were available, and because it is not known to what extent these factors influenced the performance of the systems.

In the third paper **"Modeling Stability in On-Line Signatures," Antonio Parziale, et al**. introduce a novel definition of stability regions that builds upon handwriting generation and motor control studies. Stability regions are defined as the longest similar sequences of strokes between a pair of genuine signatures. The stability regions are then used to select the most stable signatures, as well as to estimate the extent to which these stability regions are encountered in both genuine and simulated (forged) signatures, thus modeling the signing habit of a subject. Experimental results on the SUSig database show that the proposed model can be effectively used for signature verification. The authors observe that, in case of a highly automated handwriting movement as a signature, its central neural coding is less prone to variations than the peripheral parameters reflecting the timing properties of the muscular system activated by the action plan. As a consequence, the authors conjecture that sequence of strokes corresponding to

well learned movements will appear in many instances of a signature.

Joanna Putz-Leszczynska in "The Influence of Ageing on a Dynamic Signature Verification System," addresses the so-called template ageing problem (i.e. the problem that arises when a template and the reference pattern represents human characteristics that change over time) in the final paper selected from the IGS conference. To investigate such a problem, that author has collected on-line signatures in three different sessions spanning a time period of seven years between the first and the last, and with the second session taking place one month after the first one. The statistical analysis of the results show that the signature templates do suffer because of ageing and that such an ageing phenomenon has a remarkable negative impact on the performance of the automatic on-line signature verification system.

The last paper of this issue, a pilot study by **Jessica Owen, "Screening the Handwriting of Different Individuals Using CEDAR-FOX,"** the author reports an experiment using the CEDAR-FOX software by searching a large data set of handwritten documents for detecting those produced by the same writers. The study was conducted on the New Zealand Police Document Examination Section's Anonymous Letter Database, and the performance of the software was measured in terms of the attributed authorship, the amount of user intervention required, and the time required to process the documents. Based upon this pilot study, the author concludes that CEDAR-FOX is a promising tool for searching large databases of documents for finding common authorship, but that some not yet explained anomalies, as well as the time required to use it in real cases, are still a major obstacle to its routine use in their forensic laboratory.

Angelo Marcelli

(end note)

i Muhammad Malik won the annual Association of Forensic Document Examiners' award for the best research in handwriting identification by a graduate student who presented at the 16th Conference of IGS.

From the Editor…

In addition to the scientific papers, a current book, *Forensic Document Examination: Fundamentals and Current Trends* by Jane A. Lewis (2014, Academic Press, San Diego) is reviewed by Vickie Willard, and a commentary by Andrew Sulner, immediate past Chair for the Jurisprudence Section of the American Academy of Forensic Sciences., from the January 2014 *Academy News* is reprinted with permission. The commentary, "A Critical Look at Some Needed Reforms in the Landscape of Forensic Science Education and Mentorship Training Standards," discusses bias that results from traditional approaches to the training and education of forensic document examiners (FDEs) and the need for reform. Both Sulner and Willard are Diplomates of the Board of Forensic Document Examiners.

The Editors would like to thank the peer reviewers for this issue for their dedicated work in assisting the authors and the *JFDE* with the scientific papers. The peer reviewers are (in alphabetical order): Carolyne Bird (Australia); Michael Caliguiri (USA); Claudio De Stefano (Italy); Sonia Garcia (France); Richard Guest (UK); Giuseppe Pirlo (Italy); Arend Van Gemmert (USA); and Emily Will (USA).

Patricia Fisher

Online SignatureVerification: Automatic Feature Selection vs. FHE's Choice

Marianela Parodi [1], Juan C. Gómez [1], Linda Alewijnse [2], Marcus Liwicki [3]

Abstract. *In this paper, the discriminative power of a set of features which seems to be relevant to signature analysis by Forensic Handwriting Experts (FHEs) is analyzed and particularly compared to the discriminative power of automatically selected feature sets. This analysis could help FHEs to further understand the signatures and the writer behaviour. In addition, two information fusion schemes are proposed to combine the discriminative capability of the two types of features being considered. The coefficients in the wavelet decomposition of the different time functions associated with the signing process are used as features to model them. Two different signature styles are considered, namely, Western and Chinese, of one of the most recent publicly available Online Signature Databases. The experimental results are promising, especially for the features that seem to be relevant to FHEs, since the obtained verification error rates are comparable to the ones reported in the state-of-the-art over the same datasets. Further, the results also show that it is possible to combine both types of features to improve the verification performance.*

Reference: Marianela Parodi, Juan C. Gomez, Linda Alewijnse, Marcus Liwicki (2014). Online Signature Verification: Automatic Feature Selection vs. FHS's Choice. J. Forensic Document Examination, Vol. 24, pp. 5-19.

Keywords: Online signature verification, FHE based features, Automatic feature selection, Information fusion

1. Introduction

Signature verification is one of the most popular methods for identity verification. It is a non-invasive biometric technique and people are familiar with the use of signatures in their everyday life. Automatic signature verification has long been considered an important research area in the field of biometrics [Plamondon and Lorette, 1989], [Leclerc and Plamondon, 1994], [Plamondon and Srihari, 2000], [Impedovo and Pirlo, 2008].

Two categories of signature verification systems can be distinguished taking into account the acquisition device, namely, offline and online systems. For offline systems, only the image of the signature is available. For online systems, dynamic information acquired during the signing process is available. In this case, the signature is parameterised by several discrete time functions such as x and y pen coordinates, pen pressure and, when available, pen inclination angles. Researchers have long argued about the effectiveness of the different time functions for verification purposes. There are conflicting results regarding their importance [Kholmatov and Yanikoglu, 2005], [Maramatsu and Matsumoto, 2007], [Houmani et al., 2009], and the discussion is still open.

The interest in the online approach has increased in recent years due to the widespread use of electronic pen-input devices. Nevertheless, there are certain applications that demand the use of the offline approach. Forensic Handwriting Experts (FHEs) only have the offline data available in their daily casework. To perform a forensic signature comparison it is then

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