
Preface

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Biographical notes: Marina L. Gavrilova is an Associate Professor at the Department of Computer Science, University of Calgary, and founder and Co-Director of Biometric Technologies Laboratory and SPARCS Laboratory. Her primary research interests include geometric and adaptive computing, information processing, biometrics and visualisation. She published over 100 works, including World Scientific September 2007 Bestselling Book on image processing in biometric, upcoming book on Voronoi Diagrams in Intelligent Computing with Springer and a number of special issues in journals such as *IEEE RAM*, *IJCGA*, *Journal of Supercomputing* and others. Since 2007, she is Editor-in-Chief of the *Transactions on Computational Sciences Journal*, Springer-Verlag.

Md. Maruf Monwar is a PhD student of Computer Science at the University of Calgary. He received his BSc (Hons) and MSc in Computer Science & Technology from the University of Rajshahi, Bangladesh, and MSc in Computer Science from the University of Northern BC, Canada. He is an Assistant Professor at the Department of Computer Science & Engineering, University of Rajshahi, Bangladesh, and currently is on study leave. His primary research interests include biometric fusion, expression recognition and biological data processing.

This special issue on ‘Multimodal Biometric and Biometric Fusion’ is composed of seven papers reporting on the state-of-the-art developments in the emerging field of multimodal biometrics.

The issue presents seven papers reporting on a variety of unique problems related to multimodal biometrics, including score normalisation method and multimodal biometric authentication, state of the art in biometric fusion techniques, indexing of multimodal biometric databases, single-sensor multi-instance fingerprint and Eigenfinger recognition using score combination methods, biometric person authentication with liveness detection based on audio-visual fusion, biometric feature fusion and optimisation of biometric sensor network.

The first paper ‘A simple score normalisation technique for multimodal biometric authentication’ by Belén Ruiz, María J. Poza, Luis Puente and Angel García presents a new technique to perform unimodal system fusion using prior-to-match score method for multimodal biometric authentication. The proposed score normalisation technique consisting of a bilinear transformation applied to the independent scores, so that the unimodal thresholds become uniform and the data closest to these thresholds have greater separation between them, thus resulting in a better fusion scheme. Provided

experimentation confirms that the procedure improves the final results when compared with classic normalisation procedures. Several score fusion strategies were used in the experiments, including classification algorithms such as Support Vector Machines and Neural Networks, and score combination procedures based on Weighted Sum and Weighted Product algorithms.

The second paper 'Multimodal biometrics: state of the art in fusion techniques' by Tejas Joshi, Somnath Dey and Debasis Samanta provides state-of-the-art review of recent developments on biometric system fusion. It reviews five levels at which information fusion can be carried out in the multimodal biometric system, including sensor level, feature level, match score level, rank level and decision level. Authors provide critical analysis of pros and cons of such systems, and impact on overall system performance.

Another aspect of multimodal biometric system development is presented in the third paper 'An efficient technique for indexing multimodal biometric databases' by Umarani Jayaraman, Surya Prakash, Phalguni Gupta. In this paper, authors explore effects of new indexing technique which can be used in an identification system with large multimodal biometric database. In this technique, multi-dimensional feature vectors of each trait (iris, signature, ear and face) are normalised and projected to a lower dimensional feature space. The reduced feature vectors are later fused at feature level and used to index the database by forming Kd-tree. Authors perform an extensive study of the performance of the method and demonstrate that the proposed technique significantly reduces the data retrieval time as well as the possible error rates.

The fourth paper 'Single-sensor multi-instance fingerprint and eigenfinger recognition using (weighted) score combination methods' by Andreas Uhl and Peter Wild is devoted to the problem of finding a suitable fusion method by investigating the effect of matcher-specific combination weights on recognition accuracy and comparing cross-feature and intra-feature score combinations. When multiple instances of single biometrics can be acquired from a single input simultaneously, a multiple-step acquisition at additional transaction time cost can be avoided. Authors present a rotation-invariant, peg-free multi-instance fingerprint and eigenfinger-based biometric system extracting multiple features from a single scan of the human hand. Extensive experimentation and performance analysis concludes the paper.

The fifth paper 'Biometric person authentication with liveness detection based on audio-visual fusion' by Girija Chetty and Michael Wagner presents a novel approach to liveness detection based on audio-visual features. The authors present a technique to include liveness checks in the person identity authentication systems, and thus to ensure that biometric cues are acquired from a live person who is actually present at the time of capture. Incorporating liveness functionality in identity authentication systems can guard the system against advanced spoofing attempts such as manufactured or replayed videos. The proposed audio-lip correlation features measure the degree of synchrony between lip motion and acoustic speech. The tensor-lip motion features extract lip dynamic information from intensity and depth subspace of 3D video sequences. A new authentication paradigm on multi-stage evaluation protocols based on a Support Vector Machine for speech (digit) recognition, and a Gaussian mixture model for speaker authentication with liveness checks allows a significant performance improvement over traditional authentication approaches.

The sixth paper 'A method towards biometric feature fusion' by Lin Huang, Hanqi Zhuang and Salvatore D. Morgera proposes a new method to fuse information from two or more biometric sources at feature fusion level. A key aspect of the method is

to use an optimisation procedure to regulate the contribution of each individual biometric modality to the concatenated feature vector. As an example, the effectiveness of the method is demonstrated by integrating features of static face images and text-independent speech segments.

The seventh and final paper of the issue 'Situation assessment and autonomous control and optimisation of biometric sensor network' by Kalyan Veeramachaneni and Lisa Osadciw merges the gap between biometric and sensor network area. In this paper a novel adaptive sensor management algorithm is presented for a biometric sensor network. A distributed detection framework is adapted for varying security requirements in the network. Accuracy and time are the two objectives that the system attempts to minimise. Both objectives are tied into a single objective function by weighing them. A particle swarm optimisation algorithm is designed to achieve best possible designs for a given set of weights. Results are presented for different weights applied to the bi-objective problem.

The Special Issue Editors would like to extend their sincere appreciation for assistance and help during each stage of the Special Issue preparation to Editor-in-Chief Prof. Khalid Saeed and the Editorial Staff at Inderscience Publishers.

We hope that the collection of papers presented in this issue will be a valuable resource for all *IJBM* readers, and will stimulate further research into the exciting area of multimodal biometrics.