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Author{s}:	Carmen García-Mateo, Dijana Petrovska, Massimo Tistarelli

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Abstract:	This document is the supporting report corresponding to educational material recorded by BioSecure in 2005, during both a Summer School and a Residential Workshop.
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EXECUTIVE SUMMARY

BioSecure supports or fully organises a number of educational events aiming at training young scientists in the field of biometrics. This document contains the description of the recordings of the lectures made during two of those events: the Summer School organised in Alghero in June 2005 and the first BioSecure Residential Workshop held in Paris during August 2005.

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1 INTRODUCTION

As a so-called “Network of Excellence” supported by the European Commission, one of the main objectives of BioSecure is to spread excellence. Aiming at that, a number of different activities are taking place, either directly organized by BioSecure or by supporting others initiatives. Among them are the “Summer School for Advanced Studies on Biometrics” and the “BioSecure Residential Workshop”. Both events target at training future scientist and experts on the field and aim to last in time by putting available the recorded material.

The 2nd International Summer School on Biometrics was held from June 6th to 10th 2005 in Alghero, Italy. Its main objectives were to provide a comprehensive view of the most up-to-date technologies and leading research in almost all areas of biometrics. The school schedule included a series of lectures from the invited lecturers as well as a session specifically devoted to the presentation of the student’s contributions. The lectures were given by the 15 leading scientists in their respective fields, both from academia and industry. Regarding the participants, twelve out of 40 participants were from industry and the rest were both students or researchers from academia.

The 1st BioSecure Residential Workshop was held in Paris during August 2005 (from Monday, 1st to Friday, 26th) and was organized by GET. More than ninety doctoral, postdoctoral, senior and invited researchers met together during four weeks, to advance mono-modal and multi-modal evaluation experiments integrating reference systems and research prototypes.

This document describes the educational activities carried out in each event, and the material collected.

2 SUMMER SCHOOL FOR ADVANCED STUDIES ON BIOMETRICS FOR SECURE AUTHENTICATION

2.1 Description of the Summer School

The 2nd International Summer School on Biometrics was held on June 6th to 10th 2005 in Alghero, Italy. After the first edition in 2003, its main objectives are to provide a comprehensive view of the most up-to-date technologies and leading research in almost all areas of biometrics (programme attached as Annex A). This year the school was focused on multimodal biometrics, involving all modalities and scenarios as well as methodologies for fusion of modalities.

The school is not only devoted to scientists specifically in the biometrics field, but it targets PhD students and post-docs as well as professionals and industrials in the field willing to deepen and widen their knowledge in the biometrical technologies.

The peculiarity of this summer school, the only one in the biometrics field, is to give the opportunity to all participants, both the students and the lecturers, to share their space and time for one entire week, with the possibility to closely interact at every time during the day. In fact, not only the lectures themselves, but all “non teaching” time spent together is an opportunity to share ideas, ask questions, plan new experiments and find innovative solutions. All this is highly facilitated by two factors: the number of students is relatively small (40 people) and they are all staying, with the lecturers, in the same accommodation facilities. The beauty of the environment and the hotel structures and services also facilitated the building of a warm spirit.

All lectures were given by the 15 leading scientists in their respective fields, both from academia and industry (abstracts of the lectures are provided hereafter, as Annex B). The lecturers were from 8 countries, including Europe, China, Japan and the United States. In order to give a better view of all disciplines related to biometrics few lecturers were from different research areas, rather than biometrics. For example, Prof. Sadaoki Furui is a highly reputed expert in speech and signal processing, Prof. Roberto Cipolla is a well known researcher in the area of computer vision and robotics, while Prof. Alessandro Verri is a scientist working in the area of machine learning.

The school schedule included a series of lectures from the invited lecturers as well as a session specifically devoted to the presentation of the student’s contributions (Annex C). The best papers, selected by a committee from the lecturers themselves, were also awarded a prize for their innovative content.

The school participation was quite variegated. Twelve out of 40 participants were from industry and the rest were both students or researchers from academia. The 40 participants were coming from 17 different countries: 27 of them from 8 EU countries and 13 from 9 non-EU countries, including countries as far as the United States and Australia.

Several scholarships were given to the participating PhD students. Two students from a non-EU eastern country were partially supported by the school halving the school fees. Thirteen students from the BioSecure consortium were fully supported. Consequently, almost 40% of the students were partially or fully supported.

2.2 Description of the Material

All lectures were given using either Power Point or Pdf presentations. All presentations have been collected and are available.

All lectures have been also videotaped on 8mm digital mini tape.

An agreement has been also established with Elsevier Science Publishers to produce an innovative special issue of the international journal Image and Vision Computing, including most of the lectures given as well as a selected number of papers from the school participants. The special issue is currently under preparation and it is intended to be published by July 2006.

2.3 Availability and Distribution

The presentation files are currently available for limited distribution under the written permission of the lecturers themselves.

The videotaped lectures are also available, and currently hosted by UNISS (the school organizer). Also in this case, the availability of the material is subject to the written permission of each individual lecturer to distribute the content of the recorded lecture.

A procedure to reverse all lectures on video files is under preparation and subject to the availability of resources to finish the process.

3 BIOSECURE RESIDENTIAL WORKSHOP

3.1 Description of the Workshop

In order to overcome the current impediments and limitations in existing biometric systems, and thus to increase trust and confidence in biometric solutions, the BioSecure Network of Excellence works through integrating multidisciplinary research efforts and facilitating objective evaluations to address a range of challenging issues in the field of biometrics. To achieve these goals the BioSecure Network of Excellence takes in charge the development or improvement of existing open-source systems for speech, face, talking face, signature, fingerprint, hand and iris modalities, as well as for development of multi-modal biometric experiments. These reference systems along with existing publicly available databases and assessment protocols define the building blocks of the BioSecure integrated performance evaluation framework.

This evaluation framework was put in practice during the 1st BioSecure Residential Workshop. More than ninety doctoral, postdoctoral, senior and invited researchers met together during four weeks, to advance mono-modal and multi-modal evaluation experiments integrating reference systems and research prototypes. This exercise will lead to a worldwide biometric evaluation campaign to be launched in 2007.

The 1st BioSecure Residential Workshop was held in Paris during August 2005 (from Monday, 1st to Friday, 26th) and was organized by GET.

In parallel to the working sessions, a number of lectures were given. There were invited speakers from outside the network, as well as researchers from the network. All the information necessary for this event can be found at <http://www.tsi.enst.fr/biosecure>. As this document is dedicated to multimedia courses material, the next section is focused only on the lectures given during the event.

3.2 Description of the Material

The full program of the lectures can be found in Annex D. Lecturers were asked to sign an agreement to disseminate their material. The majority of them signed favourably this agreement. Some of them, as indicated in the list, agreed only for partial diffusion.

Annex E contains the abstracts of all the lectures as well as the biographies of the speakers.

3.3 Availability and Distribution

The lectures were videotaped, and transformed for streaming, using “SMIL” format. They are going to be available for streaming on the www.biosecure.info page.

ANNEX A

SUMMER SCHOOL PROGRAMME

	9 - 10:45	Coffe break	11 - 12:45	Lunch break	14 - 15:45	Coffe break	16 - 17:45	
Monday June 6	Ben Schouten Biometric systems and applications		Pim Tuyls Privacy protecting biometrics	13:00 - 14:00	John Mason Introduction to speaker recognition		Alessandro Verri Classifiers and learning theory	19:30 <i>Welcome cocktail</i>
Tuesday June 7	Mark Nixon Gait recognition		Josef Bigun Feature extraction in Biometrics	13:00 - 14:00	Sadaoki Furui Advanced speaker recognition		16:30 <i>Visit to Alghero</i>	
Wednesday June 8	Josef Kittler Multiple classifier fusion for authentication		Farzin Deravi Biometric standardization and testing	13:00 - 14:00	Stan Z. Li Face recognition: technical challenges and research		Student presentations	
	9 - 10:45	Coffe break	11 - 12:45	Lunch break	14:30 - 16:15	Coffe break	16:30 - 18:15	
Thursday June 9	Boat trip on Capo Caccia bay			13:00 - 14:30	Richard Guest Signature verification		Davide Maltoni Fingerprint recognition and performance evaluation	20:00 <i>Gala dinner</i>
Friday June 10	Roberto Cipolla Real time face and body detection		Massimo Tistarelli Biologically-inspired biometrics	13:00 - 14:30	Arun Ross Multimodal biometric systems and integration			

ANNEX B

ABSTRACTS OF THE SUMMER SCHOOL LECTURES

Monday June 6th

BIOMETRICAL SYSTEMS AND APPLICATIONS

PRIVACY PROTECTION OF BIOMETRIC DATA: WHERE CRYPTOGRAPHY AND BIOMETRICS MEET

REAL-TIME DETECTION AND TRACKING OF FACES, HANDS AND THE HUMAN BODY

SUPPORT VECTOR METHODS AND BIOMETRIC CLASSIFICATION

Tuesday June 7th

GAIT RECOGNITION – A BIOMETRIC WITH SHAKESPEARE’S BACKING

SPEAKER RECOGNITION TECHNOLOGY

STATE-OF-THE-ART SPEAKER RECOGNITION TECHNOLOGY

Wednesday June 8th

MULTIPLE CLASSIFIER FUSION FOR BIOMETRIC AUTHENTICATION

TESTING BIOMETRIC SYSTEMS AND STANDARDIZATION

FACE RECOGNITION: TECHNICAL CHALLENGES AND RESEARCH DIRECTIONS

Thursday June 9th

BIOMETRIC SIGNATURE VERIFICATION: CURRENT STANDARDS AND FUTURE CHALLENGES.

FINGERPRINT RECOGNITION

Friday June 10th

DIRECTIONAL FEATURE EXTRACTION IN BIOMETRIC VISION

BIOLOGICALLY-INSPIRED BIOMETRIC SYSTEMS

FUSION IN BIOMETRICS: AN OVERVIEW

Biometrical Systems and Applications

Ben A. M. Schouten

European Biometric Forum, Dublin, Ireland

and

*Signals and Images Centre for Mathematics and Computer Science
P.O Box 94079 1090 GB
Amsterdam, The Netherlands*

Following the value chain model for implementation of biometrics, a successful design, deployment and operation of biometric systems depends highly on the scientific results for existing biometrical technologies and components. These existing technologies as well as new solutions need to be evaluated on their performance. However it is often forgotten that the biometric is only one part of a fully deployed application.

System developers should be aware that requirements capture and system definition for biometric-enabled systems are more time-consuming and expensive activities than for most other IT systems. Biometric subsystems are often not designed with security in mind, and systems integrators will need to address the security requirements of the deployed application in this light. The fears and concerns of a significant segment of the user population need also to be addressed as early as possible in the design process, to ensure that appropriate mechanisms are in place to reassure such users. The concerns may relate to privacy or to safety issues, which may be addressed in part through legal and regulatory measures.

In this course we will elaborate on the requirements, design and application scenario's of biometrical systems from different perspectives. We will shed light into the future of biometrics and address possible research topics for the future.

As a guidance (reader) we will use the BIOVISION roadmap for biometrics in Europe to 2010.

http://www.eubiometricforum.com/index.php?option=com_docman&Itemid=26

Privacy Protection of Biometric Data: Where Cryptography and Biometrics Meet

Pim Tuyls

Philips Research Lab, The Netherlands.

In this lecture we first explain the privacy risks associated with using biometric data for authentication. It turns out that the main threat originates from the unprotected storage of biometric templates in the enrolment database.

Motivated by this, we have designed a biometric authentication system that reveals as little information as possible on the biometric template of the user. The main idea of the solution i.e. building a biometric verification system where the hash of the biometric is stored in the reference database. Since biometric data are noisy however such a “password”-like technique can not be applied straightforwardly. Additional techniques have to be applied in order to remove the noise.

A key component for a privacy preserving biometric authentication system is a secrecy extractor (fuzzy extractor). A secrecy extractor extracts a random string from noisy data in a robust way. Therefore, we need so called “helper” data and secret extraction codes. We will study a special case which is given by so called shielding functions. In order gain more insight in the construction and its security we ll deal with some basic examples. Finally, we will introduce information theoretic techniques to show that the proposed construction does not deteriorate the performance of a biometric verification system.

It turns out that it is unavoidable to leak some information on the biometric template from an information theoretic point of view. Under cryptographic assumptions however biometric authentication can be performed without leaking any information on the biometric template. We will give the audience a small introduction to techniques that can be used to achieve this.

In a second part we give some concrete implementations of a template protecting biometric authentication systems. First start with acoustic ear identification and secondly we explain how it can be applied to template protection of fingerprints.

Real-time detection and tracking of faces, hands and the human body

Roberto Cipolla

University of Cambridge, UK.

We review methods for detecting faces, hands and the human body in a monocular image sequence. In particular we present a novel algorithm for tracking faces using a Relevance Vector Machine (RVM) based displacement expert. The framework provides a much needed sparsity in template matching for locating and estimating the pose of objects. The framework will also be extended to estimate the 3D poses of articulated objects such as hands and the human body in a multiple hypothesis framework.

Support Vector Methods and Biometric Classification

Alessandro Verri

University of Genova, Italy

In this talk the learning from examples problem is presented within the framework of Regularization Networks. The important notion of Reproducing Kernel Hilbert Space is briefly reviewed. We then show that within this framework several learning methods can be easily obtained. In particular we derive Support Vector Methods and discuss their basic mathematical properties: existence, uniqueness, and consistency. We then illustrate methods for tuning the SVM parameters and in particular for selecting the regularization parameter. The main computational issues behind the implementation of SVMs are presented and, finally, some experimental results in biometric applications are described.

Gait Recognition – A Biometric with Shakespeare’s Backing

Mark S. Nixon

Electronics and Computer Science, University of Southampton, UK

Recognising people by their gait is one of the newer biometrics. It concerns recognising people by the way they walk or run. Until relatively recently there was evaluation by few techniques on relatively small databases, though with encouraging results. The potential of gait as a biometric has further been encouraged by the considerable amount of evidence available, especially in medicine and literature. This evident potential motivated development of new databases, new technique and more rigorous evaluation procedures, especially through the support of the DARPA Human ID at a Distance program, whose gait researchers included: the Universities of Maryland, South Florida, Carnegie Mellon, Southampton, Georgia Institute of Technology and MIT. By these approaches, it is evident that gait can indeed operate as a biometric, with especial performance at a distance when the subject is at too low a resolution, or when obscuration makes it impossible to deploy other biometrics. There are ongoing studies in this new biometric which not only concern recognition technique potential but also concern deployment capability (viewpoint invariance, fusion with other biometrics etc.). In terms of potential, it is interesting that current studies on gait focus on potency of measurements and the effects of covariate factors, in common with contemporaneous studies on other biometrics.

We shall first concentrate on the context of gait in biometrics, highlighting the support for the notion of gait as a biometric in literature, medicine, biomechanics and psychology. We shall describe the new techniques we have developed and their evaluation on the Southampton databases to gain insight into the potential for gait as a biometric. We will also describe some of our new approaches aimed to aid generalization capability for deployment of gait recognition. We shall show on these new and much larger databases, how our novel techniques continue to provide encouraging results for gait as a biometric, let alone as a human identifier, with especial regard for recognition at a distance.

Speaker Recognition Technology

John Mason

University of Swansea, UK

There are several components or levels of information embedded in the acoustic speech signal, the most obvious of which is the spoken message itself. In the context of biometrics the key question is the identity of the person speaking. These two ideas lead respectively to automatic *speech* and automatic *speaker* recognition. This presentation covers the fundamental aspects of automatic *speaker* recognition, many of which just happen to be common with the complementary task of automatic *speech* recognition.

The first part deals with features. Speech is very much a behavioural biometric in that the important information components are buried in the time domain signal and this signal is practically infinite variation, encompassing differing messages, different people, different times, different conditions, and so on. The task of *speaker* recognition is to extract the identity of the person speaking while neutralising variations such as the text. Likewise the task of automatic *speech* recognition is to extract the message or text component while neutralising all the other unwanted variations, including that of the speaker. Interestingly, and perhaps a little counter-intuitively, features that tend to be used in both of these tasks are the same short-term spectral based cepstral representations. The fundamental ideas behind cepstra are presented.

The second part of the presentation considers aspects of classification with emphasis on the idea of data-driven models and the important concept of normalisation. In *speech* recognition vast quantities of speech data, perhaps more than any one person might hear in a lifetime, can be used to train a speech recogniser. Clearly this is not possible in the case of a *speaker* recogniser, since typically data for a given speaker is likely to span only seconds or minutes. Strategies for speaker modelling must reflect this practical limitation. The importance of the quantity and, as with all biometrics, the quality of speech data is discussed.

The final part of the talk introduces assessment strategies that have evolved out of the open evaluations over the last 10 years

State-of-the-art Speaker Recognition Technology

Sadaoki Furui

*Department of Computer Science
Tokyo Institute of Technology, Japan*

1. Speaker recognition methods
 - 1.1 Classification of speaker recognition methods
 - 1.2 Structure of speaker recognition systems
 - 1.3 Relationship between error rate and number of speakers
 - 1.4 Intra-speaker variation and evaluation of feature parameters
 - 1.5 HMM (hidden Markov model) and GMM (Gaussian mixture model)
 - 1.6 Evaluation methods
2. Increasing robustness
 - 2.1 Likelihood/distance normalization
 - 2.2 Increasing robustness against noise
 - 2.3 Higher-level information
3. Examples of speaker recognition systems
 - 3.1 Text-dependent speaker recognition systems
 - 3.2 Text-independent speaker recognition systems
 - 3.3 Text-prompted speaker recognition systems
4. Multimodal speaker recognition
 - 4.1 Feature fusion
 - 4.2 Combination with face images
 - 4.3 Combination with ear images
5. Outstanding issues and problems

Multiple Classifier Fusion for Biometric Authentication

Josef Kittler

*Centre for Vision, Speech and Signal Processing
University of Surrey
Guildford, Surrey GU2 7XH, UK
j.kittler@eim.surrey.ac.uk*

Individual biometric modalities are continuously developed to improve their performance by sensor, system and algorithmic improvements. However, a very attractive alternative is to gain enhanced performance and robustness of biometric systems by combining multiple biometric experts. Recent research has demonstrated that both, the fusion of intra-modal experts as well as multi-modal biometrics impact beneficially on the system performance. In the former case the benefits derive from pooling the opinions of individual intra-modal experts. In the latter, complementary biometric information is brought to bear on the personal identity authentication problem. The issues involved in multiple biometric expert fusion and its potential will be discussed and illustrated on the problem of combining face and voice based identification.

Testing Biometric Systems and standardization

Farzin Deravi

Department of Electronics, University of Kent, UK

A review of best practice guidelines for testing biometric systems. The distinction between, technology, scenario and operational testing will be studied.

Performance metrics will be reviewed and methods of reporting test results will be covered. Emerging issues for biometric test and evaluation will also be explored.

This talk will also provide an overview of ongoing standardisation efforts in the area of biometrics. Major parts of the ISO SC37 work programme will be covered. Insights to the standardisation process will be provided and the upcoming new work items will be highlighted.

Face Recognition: Technical Challenges and Research Directions

Stan Z. Li

Center for Biometrics and Security Research

and

*National Laboratory of Pattern Recognition
Institute of Automation, Chinese Academy of Sciences,
Beijing 100080, China
szli@nlpr.ia.ac.cn*

Face recognition performance has improved significantly since the first automatic face recognition system developed by Kanade. Face detection, facial feature extraction, and recognition can now be performed in “realtime” for images captured under favourable, constrained situations. Although progress in face recognition has been encouraging, the task has also turned out to be a difficult endeavour, especially for unconstrained tasks where viewpoint, illumination, expression, occlusion, accessories, and so on vary considerably. In this talk, I will analyze challenges from the viewpoint of face manifolds and points out possible research directions towards highly accurate face recognition. I will show that the challenges come from high nonconvexity of face manifolds, in the image space, under variations in lighting, pose and so on; unfortunately, there have been no good methods from theories of pattern recognition for solving such difficult problems, especially when the size of training data is small. However, there are two directions to look at towards possible solutions: One is to construct a “good” feature space in which the face manifolds become less complex i.e., less nonlinear and nonconvex than those in other spaces. This includes two levels of processing: (1) normalize face images geometrically and photometrically, such as using morphing and histogram equalization; and (2) extract features in the normalized images which are stable with respect to the said variations, such as based on Gabor wavelets. The second strategy is to construct classification engines able to solve less, although still, nonlinear problems in the feature space, and to generalize better. A successful algorithm usually combines both strategies. Still another direction is on system design, including sensor hardware, to make the pattern recognition problems thereafter less challenging.

Biometric Signature Verification: Current Standards and Future Challenges

Richard Guest

University of Kent, UK.

The human signature has been used for thousands of years as a method of personal authorisation and verification. Indeed, it is still the most widely used and accepted form of legal admissibility applied to documents and transactions. Despite this long history of usage, conventional visual methods of authenticity assessment are prone to forgery and fraud – a situation recognised by credit card companies and banks as they move to alternative systems for consumer transactions (such as chip-and-pin).

Modern automatic biometric signature systems provide a solution to this problem by assessing both the constructional aspects of the signature (for example timing, velocity and pen rhythms) alongside the conventional assessment of the drawn signature image.

This talk highlights the main developments using signatures as part of automated biometric systems: techniques for assessing the signature image, methods for analysing the constructional aspects of a signature, feature selection and combination, performance assessment, hardware considerations, enrolment and verification strategies and data interchange formats. The talk will conclude with a summary of the major challenges ahead for signature as a biometric modality.

Fingerprint recognition

Davide Maltoni

University of Bologna, Italy

This lecture introduces fingerprint recognition in a top-down fashion. Some general schemes are provided to explain the overall architecture of a fingerprint recognition system. Then, the main components (acquisition device, feature extraction, and matching) are discussed in detail. Different state-of-the-art approaches are presented and compared, and the most critical difficulties characterizing fingerprint recognition are pointed out referring to FVC2002 and FVC2004 (Fingerprint Verification Competition) results. Hot topics like aliveness detection and synthetic generation of fingerprints are also discussed. Live examples and demos of several techniques are shown during the lecture to better explain some concepts.

Directional feature extraction in biometric vision

Josef Bigun

University of Halmstad, Sweden

Directional processing of visual signals is the largest single analysis toolbox of mammalian visual system which also feeds other specialized visual processing areas, [Hube, Lorban, Zeki], such as face recognition. Directional analysis is gaining increased traction even in Computer Vision, as it moves from single problem solving systems towards multi problem solving systems. Nearly all applications of image analysis have now alternatives that are based on direction fields extracted in one way or the other. The necessary tools are more modern and allow advanced signal processing already at the signal level, that was hitherto reserved to processing of high level tokens, such as binarized and skeletonized edge maps. This is even more so for biometric vision, where directional features are among the most successful features of face recognition, fingerprint recognition, hand geometry recognition, iris recognition. As the biometrics goes multimodal, using the same feature set and an in-depth understanding of them becomes crucial, not the least to build compact systems.

In 2-D, the earliest solutions to the problem of finding the direction of an image patch, consist in projecting the image, onto a number of fixed orthogonal functions. The thus obtained projection coefficients are used to derive the orientation parameter of the model. When the used number of filters is increased, the local image is described better and better but the inverse mapping of the projections to an optimal orientation increases in complexity rapidly. Here we will follow a different approach that models the shapes of iso-curves of images via direction tensor fields. The concept offers a unified theory to both Gabor filtering based direction tensor field estimation and Gaussian derivatives based direction tensor field estimations, both being among the most popularly used directional features in biometric vision.

Biologically-inspired biometric systems

Massimo Tistarelli

University of Sassari, Italy

Biometric recognition has attracted the attention of scientists, investors, government agencies as well as the media for the great potential in many application domains. It turns out that there are still a number of intrinsic drawbacks in all biometric techniques. In this paper we postulate the need for a proper data representation which may simplify and augment the discrimination among different instances or biometric samples of different subjects. Considering the design of many natural systems it turns out that spiral (circular) topologies are the best suited to economically store and process data. Among the many developed techniques for biometric recognition, face analysis seems to be the most promising and interesting modality.

The ability of the human visual system of analyzing unknown faces, is an example of the amount of information which can be extracted from face images. Nonetheless, there are still many open problems which need to be “faced” as well. The choice of optimal resolution of the face within the image, face registration and facial feature extraction are still open issues. This not only requires to devise new algorithms but to determine the real potential and limitations of existing techniques. In this paper several different methods for face matching are presented, based on diverse similarity measure but on different image representations. The methods are tested with conventional and also new databases, obtained from real subjects in real working environments.

Fusion in Biometrics: An Overview

Arun Ross

University of West Virginia, USA

Multibiometrics refers to the consolidation of evidence presented by multiple sources of biometric information in order to determine or validate a person's identity. Some of the limitations imposed by a unimodal biometric system can be effectively addressed by employing a multibiometric system. Fusion in such a system can occur at different modules including the sensor, feature extraction, matching and decision-making modules. This lecture will discuss the various levels of fusion that are possible in a multibiometric system and present integration strategies based on the MCS (Multiple Classifier System) literature. Emphasis will be on fusion at the match score level and, therefore, topics related to score normalization and user-specific parameters will be presented. The lecture will also discuss the incorporation of soft-biometric traits in the fusion module of a multibiometric system. Finally, a discussion about multibiometric systems that are currently deployed will be presented.

ANNEX C

LIST OF STUDENT PAPERS PRESENTED AT THE SUMMER SCHOOL

A Framework for Eigenspace Fusion in Statistical Models of Shape and Appearance

Constantine Butakoff, Alejandro Frangi

Abstract. In this paper an extension to the eigenspace fusion method [1] to fuse more than two eigenspaces, with weights and unbiased covariance matrix estimate (originally biased estimate was proposed) is presented. As the major contribution the paper presents Active Shape and Active Appearance Model (ASM and AAM) fusion strategies from several weighted models. To demonstrate that the models constructed from different sets of observations and fused together perform at least as well as the models constructed from all the observations a comparative assessment on segmentation precision is performed on the AR database.

Index Terms—AAM, ASM, model fusion, statistical model, segmentation.

Risk Management approach on biometric systems

Sabine Delaitre

ICT Unit, IPTS, JRC, European Commission
Edificio Expo, c/ Inca Garcilaso s/n
E-41092 Sevilla, Spain
sabine.delaitre@cec.eu.int

Abstract. This paper introduces issues of risk management applied to biometrics. A biometrics study has been recently carried out by the ICT unit team1 and biometric technologies have been examined from a SELT perspective (social, economic, legal and technological) [1]. This paper presents an introduction on biometrics challenges in the Information Society and reports the SELT aspects of biometrics implementation. Based on the results of the Biometrics study and aiming at illustrating risk management on biometrics, the last section deals with the application of a risk process model on one of the threats highlighted by the study, and more precisely on the identity theft regarded as a real threat of the wide implementation of biometrics.

A Dynamic Gesture Recognition System Based On The Visual Analysis of the Movements of the Hand

Giulia Gastaldi, Alessandro Pareschi, Silvio P. Sabatini, Fabio Solari and Giacomo M. Bisio
Department of Biophysical and Electronic Engineering, University of Genoa
Via Opera Pia 11a - 16145 Genova - ITALY
giulia@dibe.unige.it

Abstract. A system for gesture recognition based on the visual appearance of hand movements is presented. Gestures are defined as the temporal evolution of 3D poses of the user's hand. Each gesture is described by five temporal sequences corresponding to the time evolution of the stereo depth information at the finger-tips. To this end feature processing directly exploits binocular disparity information considered in its *full* spatio-temporal dimension. Hidden Markov Models are used to represent the statistical properties of the gesture. The high recognition rate obtained by experimental testing on a five gesture alphabet validates the approach.

Speaker verification and identification using Phoneme Dependent Multi-Environment Models based Linear Normalisation in adverse and dynamic acoustic environments

L. Buera, E. Lleida, J.D. Rosas, J. Villalba, A. Miguel, A. Ortega, O. Saz.
University of Zaragoza, Spain
lbuera, lleida, jdrosas, villalba, amiguel, ortega, oskarsazg@unizar.es

Abstract. In adverse acoustic conditions, speaker verification and identification system rates degrade very significantly. In order to compensate this effect, several techniques can be applied. In this paper Phoneme Dependent Multi-Environment Models based Linear Normalization, PD-MEMLIN, is presented as a solution in order to clean signal in a early processing step. In this algorithm, clean and noisy spaces are modelled by mixtures of gaussians for each phoneme, and a linear transformation is learnt with stereo data for each phoneme pair of gaussians: one for the clean space and the other one for the noisy space. Some experiments with Spanish SpeechDat Car database were carried out in order to study the behavior of the proposed technique in verification and identification tasks. With an UBM-GMM verification system, important average improvement in Equal-Error Rate (EER) is obtained (70.20%). The improvement in identification task with a GMM system is 48.69%.

Recognition of Faces with Variations in Disguise

Richa Singh, Mayank Vatsa, Afzel Noore

Lane Department of Computer Science & Electrical Engineering
West Virginia University, Morgantown, WV, 26506
{richas, mayankv, [noore](mailto:noore@csee.wvu.edu)}@csee.wvu.edu

Abstract. We present a novel approach for recognizing faces to handle the challenges due to disguise. The algorithm uses 2D log Gabor wavelet to extract the textural features based on the phase information of the face. This information is invariant to low to medium variations in disguise. The algorithm has been tested on a database prepared particularly for disguise. A comparison with three other existing algorithms has also been performed using the same database. Experimental results show that the proposed algorithm is able to effectively detect the original faces from various disguises compared to other algorithms. The accuracy of the proposed algorithm is between 98.2% for minor variations in disguise to 71.2% for major variations due to multiple combinations of disguise.

Enhancing Accuracy and Security of Multi-biometric Template using RDWT Watermarking

Mayank Vatsa, Richa Singh, Afzel Noore

Lane Department of Computer Science and Electrical Engineering
West Virginia University, Morgantown, WV 26506.
{mayankv, richas, [noore](mailto:noore@csee.wvu.edu)}@csee.wvu.edu

Abstract. Biometric systems provide a powerful way to recognize an individual. Possible Attacks on biometric templates necessitates the protection of templates. We present a watermarking algorithm to protect the biometric template and use multi-biometrics to improve the verification accuracy. This approach is based on redundant discrete wavelet transform which embeds face into voice, thus combining the two physiological and behavioral traits for recognition. The robustness of the watermarking algorithm is evaluated by comparing the recognition accuracy using face recognition, speaker recognition and multimodal algorithms. Experimental results show that the watermarking algorithm is robust to several attacks and the accuracy of 95.3% is achieved using multimodal biometrics.

Do "Virtual Personalities" in Multimodal Biometrics Lack of Real Humans' Important Features?

Elena Vildjiounaite, Mikko Lindholm and Heikki Ailisto

VTT Electronics

P.O.Box 1100 FI-90571, OULU, Finland

firstname.surname@vtt.fi

Abstract. Current practices in performance evaluation of multimodal biometric systems usually imply creation of own databases of scores by every research group. These databases are often of fairly small size, less than 100 persons, and often they are so-called "virtual databases": data from one biometric modality belonging to one set of people is arbitrarily paired with the data of another modality which belongs to another set of people, assuming no correlation between modalities. This work studies performance of multimodal verification system on database of 62 real people in comparison with performance of the same system on 50 databases of 62 virtual personalities created from these real people. Test results show that in spite of system performances on virtual databases differ significantly from each other, the system performance on overwhelming majority of virtual databases is better than on the real database, and suggest that it is needed to study further factors affecting system performance with real people.

Biometric multimodal speaker verification using lip movement and speech

Maycel Isaac F., Josef B.

Department of Computer Science, Graduate School of Information, Science and Engineering
Halmstad University
P.O. Box 823,
SE-301 18 HALMSTAD, SWEDEN

Abstract. We present a multimodal speaker recognition method using speech analysis, motion analysis [1], and the structure tensor [2]. The opticalflow defines the apparent motion in the image plane by means of brightness pattern in the spatio temporal image data. The linear symmetry tensor in 2-D defines normally the dominant direction of an image. Here by projecting the 3-D data to 2-D we obtain projection coefficients which we use to evaluate the 3-D orientations of brightness patterns. Lip motion analysis can thus be achieved by use of only 1D signal processing techniques because the filters we use are separable. An additional advantage is that lip contour extraction is not needed.

The motion and the 2D orientation features of the speaker's mouth are combined with the acoustic features in the framework of an HMM-based recognition, where a text-dependent, phoneme HMMs are trained using the combined features. Experiments have been carried out using the audio-visual XM2V.

ANNEX D

PROGRAMME OF LECTURES AT THE RESIDENTIAL WORKSHOP

Lecture Agenda

Monday, August 1st

14-15 h

J. L. Wayman, "Two interesting mathematical problems in biometrics"

Tuesday, August 2nd

11.30-12.30 h

John Daugman, "Iris Recognition: Fundamental Principles, Origins and Metrics of Randomness"

14-15 h

Massimo Tistarelli, "Face Recognition: from Human to Machine Vision"

Wednesday, August 3rd

11.30-12.30 h

John Daugman, "Statistical Decision Theory. Current Large-Scale Deployments of Iris Recognition, and Issues Raised"

14-15 h

Jugurta Montalvao, "Online Prototype Generation Strategy for Behavioural Biometric"

Thursday, August 4th

11.30-12.30 h

Farzin Deravi, "Biometrics standardisation"

14-15 h

Slobodan Ribaric, "A Biometric Identification System Based on Eigenpalm and Eigenfinger Features"

Friday, August 5th

11.30-12.30 h

John Daugman, "Iris Recognition: Anti-spoofing Liveness Testing, Stable Biometric Keys, and Further Research Directions"

14-15 h

J. L. Wayman, "Two interesting mathematical problems in biometrics" - Part II: Review of progress made during the week

Monday, August 8th

11.30-12.30 h

Tieniu Tan, "Ordinal Representations for Biometric Patterns"

14-15 h

David Zhang, "Palmprint Authentication: Technologies"

Tuesday, August 9th

11.30-12.30 h

Ethem Alpaydin, "Cost-Conscious Classifier Ensembles"

14-15 h

Jonathon Phillips, "Quantitative Review and Meta-Analysis of Biometrics," and "Linear, Generalized Linear, and Generalized Linear Mixed Models Applied to Analyzing Recognition Performance Results"

Wednesday, August 10th

11.30-12.30 h

Tieniu Tan, "Gait Recognition: Recent Developments and Future Directions"

14-15 h

Santiago Cruz, "The level of scores in biometrics"

Thursday, August 11th

11.30-12.30 h

David Zhang, "Palmprint Authentication: System Design"

14-15 h

Jonathon Phillips, "The Face Recognition Grand Challenge and Face Recognition Vendor Test (FRVT) 2005, and their testing protocols and statistical analysis"

Friday, August 12th

11.30-12.30 h

Ian H Witten, "Keystroke behaviometrics"

14-15 h

Simon Dobrisek, "Exploiting Speech Recognizers for Speaker Recognition"

Tuesday, August 16th

11.30-12.30 h

Patrick Kenny, "Joint Factor Analysis versus Eigenchannels in Speaker Verification"

14-15 h

Jiri Matas, "WaldBoost for Face Detection"

Wednesday, August 17th

11.30-12.30 h

Chafic Mokbel, "Stochastic Techniques, Biometrics and Cryptosystems"

Thursday, August 18th

11.30-12.30 h

David Delgado, "Topics on statistical modelling of shape and appearance in facial biometrics"

14-15 h

Gopal Gupta, "Combining motion and shape in online handwritten signature verification"

Friday, August 19th

14-15 h

Julian Fierrez, "Multi-Algorithm Approaches for Signature and Fingerprint Verification"

Monday, August 22nd

11.30-12.30 h

Josef Kittler, "Multiple classifier systems in decision-level fusion of multimodal biometric experts"

14-15 h

Farzin Deravi, "Testing Biometric Systems"

Tuesday, August 23rd

11.30-12.30 h

D. T. Toledano, "ATVS@NIST'05: The use of higher-level features (prosodic & phonetic) for speaker recognition"

14-15 h

Andrzej Drygajlo, "Biometrics for Identity Documents" & "Robustness and Reliability in Biometrics"

Wednesday, August 24th

11.30-12.30 h

Jana Dittmann, Claus Vielhauer, "Online Handwriting: Issues of sensor interoperability and biometric hashing"

14-15 h

Ian H Witten, "Unmasking: Identity verification in an adversarial situation"

Thursday, August 25th

11.30-12.30 h

Jean-Francois Bonastre, "Evaluation paradigm; advantages and limits"

14-15 h

Alvin Martin, "A Decade of NIST Speaker Recognition Evaluations"

ANNEX E

ABSTRACTS OF THE RESIDENTIAL WORKSHOP PLENARY LECTURES

E.1

ABSTRACTS OF THE LECTURES

BioSecure 1st Residential Workshop

Book of Abstracts

Ethem Alpaydin
Bogazici University, Istanbul
<http://www.cmpe.boun.edu.tr/~ethem/>

Title: Cost-Conscious Classifier Ensembles

Abstract:

Ensemble methods improve the classification accuracy at the expense of testing complexity, resulting in increased computational costs in real-world applications. Developing a utility-based framework, we construct two novel cost-conscious ensembles; the first one determines a subset of classifiers and the second one dynamically selects a single classifier. Both ensembles successfully switch between classifiers according to the accuracy-cost trade-off of an application.

Joint work with Cigdem Demir (Gunduz). To appear in Pattern Recognition Letters.

Jean-Francois Bonastre
LIA (IUP)
Universite d'Avignon, France

Title: Evaluation paradigm; advantages and limits

Abstract:

The evaluation campaign paradigm is very successful in speaker recognition. A large improvement in automatic Speaker recognition was observed during the last decade, in terms of performance but also in terms of resources available (including databases, protocols, scoring tools...). These improvements are mainly linked to the NIST campaigns. Moreover, evaluation campaigns present also some cons, like a lot of low level development duties, a small part of new solutions and, more important, some possible misunderstanding in results interpretation.

This talk proposes to show the interest of evaluation paradigm and the limits of such campaigns. It also proposes some basics for maximizing the ratio pro/cons.

Santiago Cruz-Llanas
University of Zaragoza

Title: The level of scores in biometrics

Abstract:

In biometric systems there are usually different levels of representation: signals, features, scores, ranks and decisions. The talk is intended to be a discussion about the role of 'scores' in biometrics. Two main aspects to be considered are:

- Statistics of scores: its use to give traditional and non-traditional measures of performance for biometric systems.
 - Biometric fusion at the level of scores.
-

John Daugman
University of Cambridge
Computer Laboratory

Title: Iris Recognition: Fundamental Principles, Origins and Metrics of Randomness

Abstract:

An introduction to the iris and its random, complex, yet stable patterns that allow it to serve as an identifying biometric. This lecture will include: anatomy and physiology of the iris; its developmental morphogenesis; separation of its genotypic from its epigenetic properties; the photonics of iris tissue (appearance at different wavelengths); optical aspects of acquiring an image of the iris; "iridology;" various metrics of the degree of randomness in iris patterns, and comparative discrimination entropies; computer vision aspects of finding an eye in an image and localising the boundaries of the iris and the eyelids; detecting and excluding eyelashes and scrubbing away specular reflections; normalisation and the creation of a doubly-dimensionless coordinate system that is size invariant and pupillary dilation invariant; and encoding of the isolated iris pattern.

Title: Statistical Decision Theory. Current Large-Scale Deployments of Iris Recognition, and Issues Raised

Abstract:

Survey of Neyman-Pearson statistical decision theory and its relation to Bayesian classification. How iris identification decisions are made in the current large-scale deployments of the Daugman algorithms, such as the 12,000 daily iris recognition transactions that occur in the UAE each involving exhaustive search against a database of 600,000 enrolled IrisCodes, generating about 7 billion iris comparisons per day. How the minuscule probability of False Matches is prevented from accumulating despite such vast numbers of opportunities for False Matches. Results from 200 billion iris comparisons, and the detailed shape and tails of the imposters' distribution of Hamming Distance scores. Issues concerning multi-biometrics: can there be a benefit from combining a strong biometric and a weak biometric?

Title: Iris Recognition: Anti-spoofing Liveness Testing, Stable Biometric Keys, and Further Research Directions

Abstract:

Approaches to confirming the vitality of an iris ("liveness testing"). Spoofing threats and how they can be countered. Comparison of the decidability of a vitality test versus the decidability of the underlying biometric matching test. How a stable short string of bits can be generated from an unstable long biometric template, allowing biometrics to be combined effectively with cryptography, and how this may help to overcome the core problems that biometric templates themselves are neither very secret nor revocable. Improved user interfaces; iris recognition at a distance and with non-cooperative subjects; future research directions.

David Delgado Gomez
CILab
Pompeu Fabra University

Title: Topics on statistical modelling of shape and appearance in facial biometrics

Abstract:

In recent years, the model-based approaches toward segmentation on non rigid objects named deformable template models have proven very successful. In this presentation an in-depth revision of two of these models, Active Shape Models (ASM) and Active Appearance Models (AAM) is provided. The talk will discuss how these methods build its statistical models of shape and texture and how they are used to search for new instances of the objects that they represent. Extensions of these models as Invariant Optimal Features (IOF), Homographic Shape Models or the 3D morphable models developed by Blanz and Vetter will be also discussed. Several videos to show the performance of the different techniques will

be shown in order to demonstrate their behaviour.

Farzin Deravi
Department of Electronics
University of Kent

Title: Biometric Standardisation

Abstract:

This talk will provide an overview of ongoing standardisation efforts in the area of biometrics. Major parts of the ISO SC37 work programme will be covered.

Insights to the standardisation process will be provided and the upcoming new work items will be highlighted.

Title: Testing Biometric Systems

Abstract:

A review of best practice guidelines for testing biometric systems. The distinction between, technology, scenario and operational testing will be studied. Performance metrics will be reviewed and methods of reporting test results will be covered. Emerging issues for biometric test and evaluation will also be explored.

Jana Dittmann, Claus Vielhauer
Advanced Multimedia and Security Lab
University of Magdeburg

Title: Online Handwriting: Issues of sensor interoperability and biometric hashing

Abstract:

Due to the traditional role of one specific biometric authentication trait, the handwritten signature, usage of signatures for automated user authentication appears to be particularly interesting in domains that deal with combined document and user authentication. Signatures are legally and socially accepted means for authentication for centuries and are still practiced in daily life of most people, for example, for authentication in case of credit card transactions or contract signatures. In our talk we firstly introduces an evaluation methodology based on hardware characteristics and scaled forgeries. From the results of [Vi04] we learn that authentication algorithms, which are exposed to skilled forgeries, show the tendency to result in a quantitative increase of false-classification rates in the order of a magnitude. Furthermore, a correlation between the heterogeneity of physical characteristics of different handwriting digitizer tablets and the accuracy of authentication algorithms is revealed. Tablet sets containing devices with a higher degree of different properties, thus having higher heterogeneity, will result in lower accuracy than sets of greater homogeneity, see [Viel2004].

Secondly we summarize the approach from [ViSM2002] to secure handwriting reference data by a so-called Biometric Hash. Biometric Hashes can be generated from handwriting biometrics and they can be reproduced by authentic subjects with a reasonable stability, depending on the tablet category and semantic class. Vielhauer et al. observed in [Viel2004] that their introduced generated hash values are rather stable for homogeneous tablet sets.

[ViSM2002] C. Vielhauer, R. Steinmetz, A. Mayerhofer, Biometric Hash based on Statistical Features of Online Signatures, In: Proceedings of the IEEE International Conference on Pattern Recognition (ICPR), Quebec City, Canada, Vol. 1, pp. 123 - 126, ISBN 0-7695-1696-3, 2002

[Viel2004] Vielhauer, Claus: Handwriting Biometrics for User Authentication: Security Advances in Context of Digitizer Characteristics, PhD Thesis, University Darmstadt, submitted June 2004, accepted

Simon Dobrisek
Faculty of Electrical Engineering
Laboratory of Artificial Perception, Systems and Cybernetics (LUKS)
University of Ljubljana - Slovenia
<http://luks.fe.uni-lj.si/en/staff/simond/index.html>

Title: Exploiting Speech Recognizers for Speaker Recognition

Abstract:

Different kinds of information can be extracted from speech; among them is the information about what was said (handled by speech recognizers) and information about who said it (handled by speaker recognizers). Speech and speaker recognition research both deal with the problem of automatic extraction of these two kinds of information from a speech signal. The state-of-the-art in both research fields demonstrates that the two problems are closer than one would intuitively expect. Indeed, the same acoustic features and stochastic modelling paradigm is presently used in both cases. In recent work, speech recognizers are used to extract high-level features for speaker recognition. Nevertheless, it appears that the problem of changing environment affects performance of both kinds of real-world systems in the same way.

In this talk, we first briefly discuss the relation between the speech and speaker recognition problem. Then we present several ideas how speech recognizers can be directly used or adapted for speaker recognition. From perspective of speech recognition research, the conventional GMM/Cepstral speaker model can be seen as a simplified stochastic speech model. The question is, if not-so-simplified speech models can be used in combination with speaker adaptation techniques to improve performance of speaker recognition systems.

Julian Fierrez-Aguilar
Biometrics Research Lab
ATVS - UAM - Spain
<http://fierrez.ii.uam.es>

Title: Multi-Algorithm Approaches for Signature and Fingerprint Verification

Abstract:

In the first part of the talk we describe the UPM on-line signature verification system. The system is based on two complementary modules. The first one is based on local information, which is extracted as time functions and modelled with Hidden Markov Models. The second one is based on global information, which is extracted as global features and modelled with Parzen Windows. Experiments are reported on the complete MCYT database. This corpus is also being used for system comparison and fusion within the signature working group during the FP6 NoE Biosecure Residential Workshop 2005. The database includes 8250 genuine signatures from 330 signers as well as 8250 skilled forgeries.

The second part of the talk will be focused on multi-algorithm fusion for fingerprint verification. We summarize the main results of a post-evaluation study conducted on FVC2004 by Biosecure partners in which several algorithms have been fused. In this study, we combine more than 40 state-of-the-art systems both from academia and industry.

Gopal Gupta
School of Computer Science and Software Engineering (CSSE)
Monash University, Australia

Title: Combining motion and shape in online handwritten signature verification

Abstract:

We discuss two techniques of handwritten signature verification when the signature has been captured from an electronic tablet. The first technique uses a number of features (e.g. total time, pen-up time and the total path length). The technique leads to a false rejection rate (FRR) of about half-a-per cent when tested on a database of about 1200 genuine signatures and skilled forgeries of more than 50 people. We then show why this technique is not suitable. The second technique is based on a technique for capturing the shape of a signature. The technique essentially captures the directions of the pen motion during the writing of the signature. The technique has been evaluated and shown to be promising. Further work in improving this technique is discussed.

Patrick Kenny
Centre de Recherche Informatique
Montreal, Canada

Title: Joint Factor Analysis versus Eigenchannels in Speaker Verification

Abstract:

We compare two approaches to the problem of session variability in GMM-based speaker verification, eigenchannels and joint factor analysis, on the NIST 2005 speaker recognition evaluation data. We show how the two approaches can be implemented using essentially the same software at all stages except for the enrollment of target speakers. We demonstrate the effectiveness of zt-norm score normalization and a new decision criterion for speaker recognition which can handle large numbers of t-norm speakers and large numbers of speaker factors at little computational cost. We found that factor analysis was far more effective than eigenchannel modeling. The best result we have obtained is an equal error rate of 5.2% and detection cost of 0.017 on the core condition (all trials) of the evaluation.

A draft version of a full-length article describing this work together with some supporting material is available at
<http://www.crim.ca/perso/patrick.kenny>

Josef Kittler
Centre for Vision, Speech and Signal Processing
University of Surrey, Guildford GU2 7XH, UK

Title: Multiple classifier systems in decision-level fusion of multimodal biometric experts

Abstract:

We introduce the concept of multiple classifier systems and develop a basic theoretical framework for classifier fusion. We shall discuss how this framework reflects the various issues that motivate multiple classifier system design methodology, namely small sample problems, the effect of individual classifier design choices, and parameter estimation problems. The theoretical framework leads to diverse multiple classifier system architectures. The techniques discussed will be illustrated on the problem of decision level fusion of multimodal biometric experts.

Alvin Martin
National Institute of Standards and Technology
(NIST)

Title: A Decade of NIST Speaker Recognition Evaluations

Abstract:

The NIST speaker recognition evaluations, featuring a primary task of text-independent speaker detection by automatic systems in the context of conversational telephone speech, have now been conducted annually since 1996. These evaluations have sought to foster research progress in this field and to investigate and measure the factors that affect the performance capabilities of such systems. We review here some of what has been accomplished over this ten year period.

The evaluations have attracted participants from around the world, and the number of participants has increased over the years. This year there were 27 participating sites, including 9 from North America and 12 from Europe. Various combinations of sites have cooperated in different ways over the years, the most notable perhaps being the European based ELISA Consortium.

In earlier years the evaluations investigated the effect of varying but limited speech durations, up to two minutes of training and up to thirty seconds of test data. More recent evaluations, while continuing limited data tests, have also demonstrated that greatly enhanced performance could be achieved with longer speech durations, twenty minutes or more of training and two to three minutes of test data.

The evaluations have over the years investigated the effects on performance of various types of speaker and channel conditions. This has included the effects of different handset and transmission types and of their match or mismatch between a speaker's training and test data. It has also included, to a limited extent, the effects that may result from a speaker's changing voice characteristics over time.

There have been variations in the evaluation tasks, data, and protocols over the years, in part to keep up with changing needs and technology, perhaps most notably in the inclusion of cellular data in recent years. This variation has sometimes made it difficult to track year-to-year progress, but we present here a variety of charts seeking to do this. In the last few years some substantial progress has been observed.

Jiri Matas
Department of Cybernetics
Czech Technical University, Prague

Title: WaldBoost for Face Detection

Abstract:

In many computer vision classification problems such as face detection of identity verification, both the error and time characterizes the quality of a decision. We show that such problems can be formalized in the framework of sequential decision-making. If the false positive and false negative error rates are given, the optimal strategy in terms of the shortest average time to decision (number of measurements used) is the Wald's sequential probability ratio test (SPRT). We built on the optimal SPRT test and enlarge its capabilities to problems with dependent measurements.

We show how to overcome the requirements of SPRT (i) a priori ordered measurements and (ii) known joint probability density functions.

We propose an algorithm with near optimal time and error rate trade-off, called WaldBoost, which integrates the AdaBoost algorithm for measurement selection and ordering and the joint probability density estimation with the optimal SPRT decision strategy.

The merit of the WaldBoost algorithm is demonstrated on the face detection problem. The results are superior to the state-of-the-art methods in the average evaluation time and comparable in detection rates.

Chafic Mokbel
University of Balamand
Lebanon

Title: Stochastic Techniques, Biometrics and Cryptosystems

Abstract:

For biometric persons verification stochastic modeling is generally applied. Gaussian Mixture Models

(GMM) as a particular case of Hidden Markov Models (HMM) have been successfully applied for speaker recognition, face recognition etc. In this talk we will cover several aspects relative to stochastic modeling and biometric person verification. First, the training of stochastic models is deepened especially when few amounts of data is available. In such case, the training is more known as adaptation. A unified adaptation theory will be presented as well as its implementation within the Becars toolkit.

The second part of the talk is dedicated to the combination within the GMM framework of different modalities. A review of different approaches will be done.

The final part of the talk is dedicated to the possible schemes for integrating biometric person verification in communication systems, e.g. over the Internet. In this scope two approaches will be described. The first one consists in using biometric techniques within the security algorithms taking into consideration the variability inherent to biometric signals and how it may be overcome in a cryptosystem. Second, the use of biometric verification system in the authentication part of a security protocol will be proposed.

Jugurta Montalvao
Federal University of Sergipe (UFS), Brazil

Title: Online Prototype Generation Strategy for Behavioral Biometric

Abstract:

An uncomfortable aspect of behavior-based biometrics (e.g. voice, calligraphy and/or keystroke dynamics based systems) is its dependence on long and tedious enrollment procedures. Algorithms based on Hidden Markov Model (HMM) usually provide low Equal Error Rate (EER) but, on the other hand, they demand a large amount of samples for the HMM parameters to be properly tuned.

In contrast, simple strategies like that applied by [Muramatsu 2003] in signature verification, and by [George 1995] in speaker identification, have in common that simple 1D and 2D histograms replace stochastic matrices used in HMM models.

In such a simplified approach, prototypes (codebook) are generated through vector quantization of a signal database. Each vector is then assumed as being a discrete state of a behavioral model, and each signal sample can be coded by a chain of prototypes labels (chain codes). From those chains, simple 1D histograms and 2D forward transition histograms can be easily obtained.

In the simplest approach, since both 1D and 2D histograms depend on the stochastic signal source, a single measure of distance between histograms (e.g. Euclidean or Mahalanobis distance), instead of likelihood computation, can be used to decide whether the sources are distinct (different speakers, for instance) or not.

This very simple approach is also very easy to implement and, usually, has a low computational burden. For instance, we have implemented a writer verification software, based on the writer calligraphy, into a PDA device with good performance, whereas a traditional HMM based approach is almost prohibitive with such a device.

Unfortunately, the performance of this kind of simplified approach seems to be very dependent on the set of prototypes, mainly when state space dimension increases. For instance, with spectral or cepstral coefficients of windowed voice signals, it seems to be very hard to find a universal set of phonetic prototypes.

However, we've found that a very simple change in this approach yields a great improvement on its performance: instead of a unique prototype generation prior to all signal coding, we propose an instantaneous prototype generation during each labeling of two or more signals.

Preliminary results from our laboratory indicate that, with this single constraint concerning the codebook generation, the need for tedious enrolment procedures can be reduced. For instance, an ERR < 1% was obtained from a single 6 s voice sample as reference (text-dependent experience with a small database). That is to say that a single 6s utterance was taken during enrollment and then used as reference database for identity verification about a month later.

Promising results were also obtained from keystroke and calligraphy based verification schemes, with the very same Online Prototype Generation (OPG) strategy and fast enrollment procedure.

However, those results were obtained from a very small multimodal database of 300 samples and 10 subjects. Thus, the proposed seminar will be an opportunity to a more detailed presentation of the OPG

strategy, its relationship to some well known algorithms, and to discuss its drawbacks and potentialities.

Headline:

- 1-Introduction
- 2- 1D and 2D Histogram based algorithms for behavioral biometry and its relationship to HMM models
- 3- Performance dependency on the discrete state estimation
- 4- The Online Prototype Generation (OPG)
- 5- Some practical results
- 6- Conclusions

References:

[Muramatsu 2003] Daigo Muramatsu, Takashi Matsumoto: An HMM On-line Signature Verifier Incorporating Signature Trajectories. ICDAR 2003.

[George 1995] A robust speaker verification biometric George, M.H. King, R.A. in: Proceedings of the IEEE 29th Annual International Carnahan Conference on Security Technology, 1995.

S. Ribaric, I. Fratric
Faculty of EE and Computing, University of Zagreb, Croatia

Title: A Biometric Identification System Based on Eigenpalm and Eigenfinger Features

Abstract:

This lecture presents a multimodal biometric identification system based on the features of the human hand. We describe a new biometric approach to personal identification using eigenfinger and eigenpalm features, with fusion applied at the matching-score level. The procedure for feature identification can be divided into the following phases: capturing the image; preprocessing; extracting and normalising the palm and stripe-like finger subimages; extracting the eigenpalm and eigenfinger features based on the K-L transform; matching and fusion; and finally, a decision based on the (k, l)-NN classifier and thresholding. The system was tested on a database of 167 people (1120 hand images). The experimental results showed the effectiveness of the system in terms of the recognition rate (100%), the equal error rate (EER = 0.58%) and the total error rate (TER = 0.94%).

Index Terms - Biometrics, multimodal systems, hand-based identification, K-L transform, eigenpalms, eigenfingers

Jonathon Phillips
Program Manager
National Institute of Standards and Technology
(NIST)

Title: Quantitative Review and Meta-Analysis of Biometrics

Abstract:

In the last few years, biometrics has emerged as an interdisciplinary field with scientific, engineering, and social components. As the scientific and engineering components of biometrics mature, the biometric community will develop its own experimental culture. The biometrics experimental culture will consist of new experimental methods and adaptation of existing methods to meet the needs of biometrics. This talk will review progress in developing a biometrics experimental culture through a quantitative review and meta-analysis. The quantitative review will identify areas where scientific progress is being made.

Meta-analysis is a technique for consolidating a group of experimental results by performing a statistical analysis of the results from multiple papers on a research topic. The better known meta-analysis can provide conclusive results from a series of inconclusive studies, or spot trends that cannot be detected

from a single experiment. However, there exists a second type of meta-analysis, which examines a field to identify potential methodological problems. The meta-analysis in this talk will identify potential methodological problems in biometric research. (The meta-analysis applied to face recognition is joint work with Elaine Newton.)

Title: Linear, Generalized Linear, and Generalized Linear Mixed Models Applied to Analyzing Recognition Performance Results

Abstract:

One area of active research in biometrics is estimating the effects of subject and image covariates on performance. Over the last couple of years we have investigated the use of linear, generalized linear, and generalized linear mixed models for studying the effects of subject covariates on face recognition performance. The latest of these studies applies a generalized linear mixed model (GLMM) to analyze face recognition performance. Subject covariate data were collected on 1,072 pairs of FERET images for analysis in a human face verification experiment. The subject data included information about facial hair, bangs, eyes, gender, and age. The verification experiment was replicated at seven different false alarm rates ranging from 1/10,000 to 1/100. A GLMM was fit to the binary outcomes indicating correct verification. Statistically significant main effects for bangs, eyes, gender, and age were found. The effect of the log false positive rate on verification success was found to interact significantly with bangs, gender, and age. These results have important implications for future evaluation of biometrics, and the GLMM methodology used here is shown to be effective and informative for this sort of data. (The work in this talk is taken from joint work with Geof Givens, Ross Beveridge, Bruce Draper, and Patrick Grother.)

Title: Overview of the Face Recognition Grand Challenge and Iris Challenge Evaluation

Abstract:

Over the last couple of years, face recognition researchers have been developing new techniques. These developments are being fueled by advances in computer vision techniques, computer design, sensor design, and interest in fielding face recognition systems. Such advances hold the promise of reducing the error rate in face recognition systems by an order of magnitude over Face Recognition Vendor Test (FRVT) 2002 results. The Face Recognition Grand Challenge (FRGC) is designed to achieve this performance goal by presenting to researchers a six-experiment challenge problem along with data corpus of 50,000 images. The data consists of 3D scans and high resolution still imagery taken under controlled and uncontrolled conditions. This talk will describe the challenge problem, data corpus, baseline performance, and preliminary results submitted from nine academic institutions and ten companies.

The National Institute of Standards and Technology (NIST) is conducting and managing the Iris Challenge Evaluation (ICE). The ICE is the first large-scale, open, independent technology evaluation for iris recognition. The primary goal of the ICE is to promote the development and advancement of iris recognition technology and assess its state-of-the-art capability. ICE is open to academia, industry and research institutes. This talk will give a brief overview of the ICE Phase I.

(The work in this talk is taken from joint work with Patrick J. Flynn, Todd Scruggs, Kevin W. Bowyer, Jin Chang, Kevin Hoffman, Joe Marques, Jaesik Min, William Worek, and Xiaomei Liu.)

Tieniu Tan
Director, National Lab of Pattern Recognition (NLPR)
Director, CAS Institute of Automation (CASIA)
Beijing 100080, China
<http://www.ia.ac.cn>

Title: Ordinal Representations for Biometric Patterns

Abstract:

In this talk, I will first describe the concept of ordinal measures of intensity images. I will then show that a unified framework for biometric pattern representations can be formed based on the use of such measures. I will argue that a number of state-of-the-art biometric algorithms can be seen as special cases of this framework, including those on iris recognition and palmprint recognition.

Title: Gait Recognition: Recent Developments and Future Directions

Abstract:

In this talk, I will first discuss the concept and basic principles of gait recognition. I will then outline recent developments by briefly describing some of the major approaches. Remaining challenges and possible future research directions are discussed at the end of the talk.

Massimo Tistarelli
Computer Vision Laboratory
University of Sassari, Italy

Title: Face Recognition: from Human to Machine Vision.

Abstract:

Biometric recognition has attracted the attention of scientists, investors, government agencies as well as the media for the great potential in many application domains. It turns out that there are still a number of intrinsic drawbacks in all biometric techniques.

The ability of the human visual system of analyzing unknown faces, is an example of the amount of information which can be extracted from face images. Face detection, facial feature extraction, and recognition can now be performed by relatively simple computer systems in "realtime" for images captured under favourable, constrained situations.

Although progress in face recognition has been encouraging, the task has also turned out to be a difficult endeavour, especially for unconstrained tasks where viewpoint, illumination, expression, occlusion, accessories, and so on vary considerably. Therefore, there are still many open problems which need to be "faced" as well. The choice of optimal resolution of the face within the image, face registration and facial feature extraction are still open issues. This not only requires to devise new algorithms but to determine the real potential and limitations of existing techniques. In this lecture several different methods for face matching are presented, based on diverse similarity measure and face representations. Moreover, some recent outcomes, related to 2D and 3D face authentication and recognition, from the Biosecure Network of Excellence are also presented.

Doroteo T. Toledano
Universidad Politecnica de Madrid

Title: ATVS@NIST'05: The use of higher-level features (prosodic & phonetic) for speaker recognition.

Abstract:

This talk will summarize the participation of ATVS at the NIST 2005 Speaker Recognition Evaluation, and will focus specially on our first experience with the use of higher-level features (prosodic and phonetic) for speaker recognition. We will present our initial (successful and unsuccessful) experiments and comment on the lessons learned and future opportunities for improvement.

References:

D. T. Toledano, C. Fombella, J. Gonzalez-Rodriguez, L. Hernandez-Gomez, "On the Relationship between Phonetic Modeling Precision and Phonetic Speaker Recognition Accuracy", to be presented at InterSpeech 2005, Libson (Portugal), September 4-8, 2005.

Jim Wayman
San Jose State University
<http://www.engr.sjsu.edu/biometrics>

Title: Two interesting mathematical problems in biometrics

Abstract:

In this talk, we will discuss two mathematical problems of immediate interest to the biometrics community. I expect both could result in papers, suitable for conference submission, by the end of the week. For both, I will propose matrix algebraic solutions.

The first problem derives from the recent ISO/IEC JTC1 SC37 WG5 meeting on international testing standards for biometrics. Current Committee Draft ISO 19795-3 is to establish standards for "interoperability testing". But how is "interoperability" between systems to be measured? An international rapporteur group has been established to consider this. I propose applying the work of H. Hotelling (J. Educational Psychology, Oct., 1933) to the analysis of the "interoperability matrix" of FNMR rates at a fixed FMR. However, Hotelling's work involves PCA analysis of symmetric matrices. An "interoperability matrix", such as that found in the recent ILO fingerprint tests, can be asymmetric, resulting in a complex eigen-system. How is a complex eigen-system to be interpreted in terms of interoperability?

The second problem is to derives from continuing work in multi-biometrics, and has been previously discussed as the "cotton-ball" problem. Closely related to GMM, in this problem we seek to understand the relationship between FMNR and FMR in terms of the within-class and between-class covariance structure and the dimensionality of the space. We assume homogeneity of the within-class structures and that both within- and between-class distributions can be completely specified by second order statistics. (Is this equivalent to assuming Gaussian distributions?). Much work has been done on various aspects of this problem, but the results need to be digested and synthesized into a unified paper.

Ian H. Witten
Department of Computer Science
University of Waikato - New Zealand
<http://www.cs.waikato.ac.nz/~ihw/>

Title: Keystroke behaviometrics

Abstract:

Behaviometrics has been defined as the field dealing with measurements, theories and analysis of patterns in all aspects of human behavior. It differs from biometrics in that it can be done on a continuous basis without interrupting or interfering with user activities behaviometric measurements can be intentionally biased or corrupted.

Two examples of behaviometric security are

- Typist identification
- Mouse-user identification

I will describe work in the area of typist identification, focusing on recent research by Nisenson et al. (2003), but also covering earlier work in applying and analyzing users' keystroke patterns for computer access security. I will also briefly review some early results on user verification through pointing characteristics.

Title: Unmasking: Identity verification in an adversarial situation

Abstract:

In the authorship verification problem, we are given examples of the writing of a single author and are asked to determine if a given mystery text was or was not written by this author. (This differs from

the authorship attribution problem, where the writings of a number of authors are available, including the author of the given mystery text.) The problem is compounded by the fact that the mystery author may be deliberately attempting to conceal his identity.

I will describe a new technique called "unmasking" (Koppel and Schler, 2004) and its use in solving an actual historical literary mystery by unmasking a prolific author who had attempted to conceal his identity. I will also present some interesting work on a Poisson process model of innovation and its application to a recent authorship identification problem involving a new poem allegedly written by William Shakespeare.

David Zhang

Biometric Research Center (UGC/CRC, Hong Kong Government)

<http://www4.comp.polyu.edu.hk/~biometrics/>

Title: Palmprint Authentication: Technologies

Abstract:

As one of the most powerful and reliable means of personal authentication, biometrics has been an area of particular interest. This interest has led to the extensive study of biometric technologies such as fingerprint and face recognition and the development of numerous algorithms, applications, and systems. Palmprints, in particular, have attracted a lot of interest, which have a number of unique advantages: they are rich in features such as principal lines, wrinkles, and textures and these provide stable and distinctive information sufficient for separating an individual from a large population.

In this presentation, we would like to provide a comprehensive introduction to palmprint technologies. It reveals automatic techniques for palmprint authentication, from the first approach based on offline palmprint images, to the current state-of-the-art algorithm using online palmprint images. Having worked on palmprints since 1996, our team certainly regards the palmprint as a very effective biometric.

Title: Palmprint Authentication: System Design

Abstract:

Based on the palmprint technologies, we will discuss various design methodologies, and architectures, as well as at the different stages of implementation of a palmprint system including palmprint segmentation, feature extraction, matching, and classification. Also, a palmprint acquisition device and a palmprint identification system prototype are given. In addition, the system performance is analyzed and the different palmprint images are tested.

To encourage more people to join us in our research into palmprint technology, we have made available part of our palmprint database for the public to download. Further details can be found on <http://www.comp.polyu.edu.hk/~biometrics/>.

E.2

BIOGRAPHIES OF THE SPEAKERS

BioSecure 1st Residential Workshop

Speaker's List and Biographies

Ethem Alpaydin
Bogazici University, Istanbul
<http://www.cmpe.boun.edu.tr/~ethem/>

Ethem Alpaydin received his PhD degree from EPF Lausanne in 1990 and did postdoc work at ICSI, Berkeley. Since then he has been teaching at Bogazici University, Istanbul where he is currently professor. He had visiting appointments at MIT in 1994, ICSI in 1997 (as a Fulbright scholar) and IDIAP. His book, Introduction to Machine Learning, has recently been published by The MIT Press.

Jean-Francois Bonastre
LIA (IUP)
Universite d'Avignon, France

Jean-Francois Bonastre obtained his PhD degree in 1994, in Avignon, in automatic speaker identification using phonetic-based knowledge. He then joined the LIA (Univ. Avignon, France) as an Associate Professor. As a member of the Natural Spoken Language Processing Group, he developed his research in speaker characterization and recognition using phonetic, statistic and prosodic information, while teaching and lecturing on various subjects covering computer science, speech processing, audio signal classification and indexing, biometry. So far, he has been supervising or co-supervising seven PhDs with the University of Avignon (4 of which have already graduated). In 2002/2003, he spent one year as an Invited Professor with Panasonic Speech Technology Laboratory (PSTL), USA.

Since 1998, his group has been actively participating every year to the NIST Campaign in Speaker Recognition Evaluation. The group has been participating in the French broadcast news evaluation campaign, ESTER, for speaker related tasks and for speech transcription tasks. He was on the organizers of the ESTER campaign.

Jean-Francois Bonastre has a longstanding experience within various committees turned towards the coordination and the general interest of the speech communication scientific community : from 2001 to 2004, he was the chairman of AFCEP (formerly GFCEP), the French-Speaking Speech Communication Association (currently a regional branch of ISCA). He was also the chairman of the ISCA SPLC (SPeech and Language Characterization) SIG for two years. He is currently a member of the management committee of the COST 275 (Biometry over Internet) and a member of the "Biosecure" European Network of Excellence. He organized the RLA2C ISCA/IEEE workshop in 1998 and participated since that date to the Program committee of the "Speaker Odyssey" series of workshops.

David Delgado Gomez
CILab
Pompeu Fabra University

David Delgado Gomez is a postdoctoral researcher at CILab at Pompeu Fabra University. He received the MS degree in Mathematics from the Universidad Autonoma of Madrid, in 2000, and the Ph.D. degree in statistical image analysis from the Technical University of Denmark in 2005. He then joined the Pompeu Fabra University as an invited professor. His current research interests include statistical methods for face recognition, exploratory data analysis techniques and data mining.

Farzin Deravi
Department of Electronics
University of Kent

Farzin Deravi obtained his first degree in Engineering and Economics from the University of Oxford in 1981 and his M.Sc. in Electronic Engineering from Imperial College, University of London in 1982. From 1983 to 1987 he worked as a research assistant at the University of Wales, Swansea where he obtained his Ph.D. In 1987 he joined the academic staff at Swansea where he was active in teaching and research in the department of Electrical and Electronic Engineering. In 1998 he joined the Department of Electronics at the University of Kent where he is Reader in Information Engineering.

His current research interests include texture recognition, fractal coding, integrated audio-visual processing and biometric systems.

Dr Deravi is a Member of the Institute of Electrical and Electronic Engineers, the Institution of Electrical Engineers, and the British Machine Vision Association. He was the founding chair of the IEE Professional Network on Visual Information Engineering and is currently an Honorary Editor of the IEE Proceedings and a member of IEE Council. He also serves on BSI, CEN and ISO committees on Biometric Standardisation.

Jana Dittmann
Advanced Multimedia and Security Lab
University of Magdeburg

Jana Dittmann studied Computer Science and Economy at the Technical University in Darmstadt. In 1999, she received her PhD from the Technical University of Darmstadt. She has been a Full Professor in the field of multimedia and security at the University of Otto-von-Guericke University Magdeburg since September 2002. Jana Dittmann specializes in the field of Multimedia Security. Her research is mainly focused on digital watermarking and content-based digital signatures for data authentication and for copyright protection. She has many national and international publications, is a member of several conference PCs, and organizes workshops and conferences in the field of multimedia and security issues. She was involved in all last six Multimedia and Security Workshops at ACM Multimedia. In 2001 and 2005, she was a co-chair of the CMS2001 conference that took place in May 2002 in Darmstadt, Germany and in September 2005 in Salzburg, Austria. She is Associated Editor for the ACM Multimedia Systems Journal and for the IEEE Transactions on Information Forensics and Security. Dr. Dittmann is a member of the ACM, IEEE and GI Informatik.

Simon Dobrisek
Faculty of Electrical Engineering
Laboratory of Artificial Perception, Systems and Cybernetics (LUKS)
University of Ljubljana - Slovenia
<http://luks.fe.uni-lj.si/en/staff/simond/index.html>

Simon Dobrisek received the B.Sc. degree in electrical engineering in 1990 and the M.Sc. degree in electrical engineering and the Ph.D. degree in electrical engineering in 1994 and 2001, respectively, from the Faculty of Electrical Engineering at the University of Ljubljana. In 1990 he became a Research Staff Member in the Laboratory of Artificial Perception, Systems and Cybernetics at the Faculty of Electrical and Computer Engineering in Ljubljana, where he is presently a fellow researcher and teaching assistant.

His research interests center around Pattern Recognition and Artificial Intelligence. He participates in research projects on spoken language technology and biometric security systems. He has authored and coauthored over 70 refereed journal and conference papers, mainly in the field of speech-to-text recognition.

Simon Dobrisek is a member of the International Speech Communication Association, the Slovenian Pattern Recognition Society within the International Association for Pattern Recognition, and the Slovenian Language Technologies Society.

Julian Fierrez-Aguilar
Biometrics Research Lab
ATVS - UAM - Spain
<http://fierrez.ii.uam.es>

JULIAN FIERREZ-AGUILAR received the M.Sc. degree in Electrical Engineering in 2001, from Universidad Politecnica de Madrid. Since 2004 he is with Universidad Autonoma de Madrid, where he is currently working towards the Ph.D. degree on multimodal biometrics. His research interests include signal and image processing, pattern recognition and biometrics. He was the recipient of the Best Poster Award at AVBPA 2003, the Rosina Ribalta Award from the Epson Iberica Foundation to the best PhD Proposal in 2005, and led the development of the UPM signature verification system for the SVC 2004 evaluation.

Gopal Gupta
School of Computer Science and Software Engineering (CSSE)
Monash University, Australia

I completed my PhD from Monash University in 1976. I worked at Monash as Lecturer and then Senior Lecturer and Deputy Head of the Department of Computer Science. After fourteen years at Monash, I moved to James Cook University in 1986 as Foundation Professor and Head to establish a new Department of Computer Science. I moved to Bond University as Dean of the School of Information Technology in 1998 and returned to Monash in October 2002. My current research interests include handwritten signature verification, data mining, information privacy and computer science education.

Jiri Matas
Department of Cybernetics
Czech Technical University, Prague

Dr. Jiri Matas graduated with honours in technical cybernetics from the Czech Technical University in Prague, Czech Republic, in 1987 and received his PhD degree from the University of Surrey, UK, in 1995, (under supervision of Prof. J. Kittler). Research interest of Dr. Matas are in the area of visual recognition and machine learning (general object recognition, face detection, AdaBoost, sequential decision making).

J. Matas has published more than 100 papers in refereed journals and conferences. The publications have more than 350 citations in the Science Citation Index. The paper "Robust wide baseline stereo from maximally stable extremal regions" co-authored by Dr. Matas was awarded the best paper prize at the British Machine Vision Conference in 2002.

J. Matas has served on the the programme committee of a number of international conferences (ICCV, CVPR, ICPR, NIPS, Face and Gesture Recognition, AVBPA), was a programme co-chair for ECCV 2004 and an area chair for CVPR 2005, ECCV 2006 and CVPR 2006.

Chafic Mokbel
University of Balamand
Lebanon

Dr. Chafic Mokbel is an associate professor at the University of Balamand, in Lebanon and is currently in charge of the University Research Council. After his PhD in speech recognition from ENST in 1992, he joined the speech lab in CNET-France Telecom where he spent seven years and became the expert of speech technologies in France Telecom. In 1999, Dr Mokbel was the leader of the speech group at IDIAP, Switzerland. In 2001, he joined the University of Balamand.

Dr Mokbel has several publications in speech and speaker recognition. He has developed several adaptation algorithms and incremental versions of EM algorithm. He has also developed several applications of speech technologies, mainly a voicexml interpreter. He holds several patents in speech

recognition. Dr. Mokbel has supervised or co-supervised several PhD students, all in the domain of speech and image processing. Dr. Mokbel in collaboration with ENST has developed the Becars freeware that implements a GMM solution.

Jugurta Montalvao
Federal University of Sergipe (UFS), Brazil

Jugurta R. Montalvao Filho was born in Aracaju, Brazil. He is graduated in Electrical Engineering from "Universidade Federal da Paraiba" (UFPB), Brazil. He also received the M.Sc. degree in Electronic and Communication from UNICAMP ("Universidade Estadual de Campinas") in 1995. In 1996, he joined the "Universidade Tiradentes", Aracaju, Brazil, and recently, in 2005, he joined the "Universidade Federal de Sergipe" (UFS). He got his Ph.D. degree in Automation and Signal Processing at the "Universite d'Orsay" (Paris XI), France, in 2000.

Jonathon Phillips
Program Manager
National Institute of Standards and Technology
(NIST)

Dr. Jonathon Phillips is a leading technologist in the fields of computer vision, biometrics, face recognition, and human identification. He is at National Institute of Standards and Technology (NIST), where is he program manager for the Face Recognition Grand Challenge and Iris Challenge Evaluation, and test director for the Face Recognition Vendor Test (FRVT) 2005. From 2000-2004, Dr. Phillips was assigned to the Defense Advanced Projects Agency (DARPA) as program manager for the Human Identification at a Distance program. He was test director for the FRVT 2002. For his work on FRVT 2002 he was awarded the Dept. of Commerce Gold Medal. His current research interests include computer vision, face recognition, biometrics, digital video processing, developing methods for evaluating biometric algorithms, and computational psycho-physics. His work has been reported in print media of record including the New York Times and the Economist. Prior to joining NIST, he developed and designed the FERET database collection and FERET evaluations at the US Army Research Laboratory. He received his BS in mathematics and MS in electronic and computer engineering from George Mason University, and his Ph.D. in operations research from Rutgers University. Dr. Phillips has organized three conferences and workshops on face recognition and three on empirical evaluation. He has co-edited three books on face recognition and empirical evaluation. He has been guest editor of special issues or sections of the IEEE Trans. on Pattern Analysis and Machine Intelligence and Computer Vision and Image Understanding. Dr. Phillips is an Associate Editor for IEEE Trans. on Pattern Analysis and Machine Intelligence, and guest editor of a special issue of Proceedings of the IEEE on biometrics. He is a member of the IEEE.

Claus Vielhauer
Advanced Multimedia and Security Lab
University of Magdeburg

Claus Vielhauer is a senior researcher at Otto-von-Guericke University of Magdeburg, Germany, where he has joined the department of computer science in 2003 as the leader of the biometrics research group, as part of the Advanced Multimedia and Security Lab (AMSL). In addition, he has been working for the Multimedia Communications Lab (KOM) of Technical University Darmstadt, Germany, from 1999 to 2004, from where he also received his M.Sc. and Ph.D. degrees in Electrical Engineering. His research interests are in biometrics with specialization in multimodal and behavioral-based recognition, biometric cryptography and applications of biometrics to multimedia, as well as Human-to-Computer Interaction (HCI). Additionally, he is elaborating methods of adopting similarity measurements and classification methods from biometric user authentication to related IT security problems such as digital watermarking,

steganography or IT forensics.

He has a great number of international publications in the areas of biometric signal processing, pattern recognition and multimedia security. Furthermore, he is member of program committees of several international conferences, e.g. ICME, SPIE EI Security, Steganography and Watermarking of Multimedia Contents, IAPR ICB (former ICBA). Further, he is a reviewer for renowned journals such as ACM Multimedia System Journal, IEEE Transactions on Signal Processing, Pattern Analysis and Applications Journal and Pattern Recognition Letters. Dr. Vielhauer has been co-organizing numerous conferences, special sessions, workshops and tutorials, for example special sessions on biometrics at IEEE ICME 2002 and 2003, the 2004 IEEE Workshop "Biometric challenges: Migrating from theory to practice" and the ACM Multimedia and Security Workshop in 2004.

Jim Wayman

San Jose State University

<http://www.engr.sjsu.edu/biometrics>

Dr. Jim Wayman is Director of the Biometric Identification Research Program of San Jose State University. He received the Ph.D. degree in engineering in 1980 from the University of California, Santa Barbara. In the 1980s, under contract to the U.S. Department of Defense, he invented and developed a biometric authentication technology based on the acoustic resonances of the human head. He joined San Jose State University in 1995 to direct the Biometric Identification Research Program. From 1997-2000, he served as Director of the U.S. National Biometric Test Center under the Clinton administration. He has written dozens of book chapters and journal articles on biometrics and is co-editor of J. Wayman, A. Jain, D. Maltoni and D. Maio (eds) Biometric Systems (Springer, London, 2005). He holds 4 patents in speech processing. He is a Fellow in the Institution of Electrical Engineers, a "core member" on the U.K. Biometrics Working Group and is a "Principle UK Expert" for the British Standards Institute shadow committee to the ISO/IEC standards body on biometrics. He is a member of the U.S. National Academies of Science Committee "Whither Biometrics?" and previously served on the NAS "Authentication Technologies and their Implications for Privacy" committee.

Ian H. Witten

Department of Computer Science

University of Waikato - New Zealand

<http://www.cs.waikato.ac.nz/~ihw/>

Ian H. Witten is Professor of Computer Science at the University of Waikato in New Zealand where he directs the New Zealand Digital Library research project. His research interests include information retrieval, machine learning, text compression, and programming by demonstration. He has published widely in these areas, including six books, the most recent being Managing Gigabytes (1999), How to build a digital library (2003) and Data Mining (2005), all from Morgan Kaufmann.

He received an MA in mathematics from Cambridge University, England; an MSc in computer science from the University of Calgary, Canada; and a PhD in electrical engineering from Essex University, England. He is a fellow of the ACM and of the Royal Society of New Zealand. He received the 2004 IFIP Namur Award, a biennial honour accorded for "outstanding contribution with international impact to the awareness of social implications of information and communication technology," and the 2005 SIGKDD Service Award, given for "an outstanding contribution to the data mining field."

David Zhang

Biometric Research Center (UGC/CRC, Hong Kong Government)

<http://www4.comp.polyu.edu.hk/~biometrics/>

David Zhang graduated in Computer Science from Peking University in 1974. He received his MSc and PhD in Computer Science from the Harbin Institute of Technology (HIT) in 1982 and 1985, respectively.

From 1986 to 1988 he was a Postdoctoral Fellow at Tsinghua University and then an Associate Professor at the Academia Sinica, Beijing. In 1994 he received his second PhD in Electrical and Computer Engineering from the University of Waterloo, Ontario, Canada. Currently, he is a Chair Professor, the Hong Kong Polytechnic University where he is the Founding Director of the Biometrics Technology Centre (UGC/CRC) supported by the Hong Kong SAR Government. He also serves as Adjunct Professor in Tsinghua University, Shanghai Jiao Tong University, Beihang University, Harbin Institute of Technology, and the University of Waterloo. He is the Founder and Editor-in-Chief, International Journal of Image and Graphics (IJIG); Book Editor, Kluwer International Series on Biometrics (KISB); and Program Chair, the International Conference on Biometrics Authentication (ICBA), Associate Editor of more than ten international journals including IEEE Trans on SMC-A/SMC-C, Pattern Recognition, and is the author of more than 10 books. Professor Zhang is a current Croucher Senior Research Fellow and Distinguished Speaker of IEEE Computer Society.