



European Association for Signal Processing

Summer school report

16th International Summer School for Advances in Biometric Authentication: Biometrics and Forensic Science in the Deep Learning Era

The 2019 Euraspip summer school on biometrics has been held on May 27th to 31st 2019 in Alghero, Italy. This was the 16th edition of a strongly established training course started in 2003 to promote knowledge dissemination and research in Biometrics and related fields. The school was technically co-sponsored by Euraspip, IAPR and IEEE and co-organized by the EU RISE project IDENTITY.

The school main theme was related to the application of deep learning technologies to biometrics and forensic science. The school particularly addressed the impact of deep learning in developing more efficient and secure biometric systems.

Several subjects were taught at the summer school forming a total of 24 hours of theoretical lectures from 17 different lecturers and 4 hours of guided practical sessions using MatLab¹ tools. The subjects ranged from fundamentals such as machine learning and pattern recognition techniques, applied to biometrics, as well as more advanced topics such as neuroscience and applied subjects such as biometric spoofing and biometric template protection, large-scale evaluation and the deployment of biometrics technologies in forensic cases. This 16th edition of the summer school, featured a line-up of exceptional lecturers, selected from the editorial boards of top-level scientific journals and conferences. Prof. James Haxby, an outstanding neuroscientist, presented a lecture on the representation of visual data in the brain and the topographic mapping to design such representations from fMRI recordings. Prof. Lior Wolf, from Facebook research labs, presented an overview of how to deploy deep learning and convolutional neural networks in biometrics. Prof. Vishal Patel, from Rutgers University, presented a lecture on the use of mobile devices for continuous authentication. All lecturers, among the most highly reputed experts in their fields, presented the most up-to-date view in Biometric technologies and Forensic applications.

The complete list of lecturers and the presented lectures is as follows:

- **Monday May 27**
 - **Prof. Arun Ross** (Michigan State University, USA) *An introduction to biometrics in forensic applications.*
 - **Prof. Alessandro Verri** (University of Genova, Italy) *Machine learning (in biometrics).*
 - **Prof. Julian Fierrez** (Universidad Autonoma de Madrid) *Iris recognition*
 - **Prof. Massimo Tistarelli** (University of Sassari, Italy) *Face recognition*

¹ The school committee is grateful to MathwWorks for providing a special trial version of MatLab software, specifically for the school students to develop the practical sessions.

- **Tuesday May 28**

- **Prof. Davide Maltoni** (University of Bologna, Italy) *Fingerprint recognition.*
- **Prof Mark Nixon** (University of Southampton, UK) *Soft Biometrics.*
- **Dr. Thirimachos Bourlai** (West Virginia University, USA) *Practical biometric recognition systems and project - PART 1.*
- **Prof. Lior Wolf** (Tel Aviv University and Facebook, Israel) *Deep learning techniques for biometrics.*
- **Student presentations (8)**

- **Wednesday May 29**

- **Dr. Jonathon Phillips** (NIST, USA) *Progress and challenges in face and person recognition.*
- **Prof. Jean-Luc Dugelay** (EURECOM, France) *Malevolent schemes in face recognition applications.*
- **Prof. Alice O'Toole** (University of Texas at Dallas, USA) *Understanding face representations in deep CNNs: Face space theory evolves.*
- **Prof. Ida Gobbini** (University of Bologna, Italy) *Mechanisms for recognition of familiar faces.*
- **Prof. James Haxby** (Dartmouth College, USA) *Commonality of the fine-grained structure of neural representations.*

- **Thursday May 30**

- **Student presentations (4)**
- **Round table:** The role of Deep Learning in Biometrics and Forensic Science
- **Prof. John Mason** (University of Swansea, UK) *Speaker recognition.*
- **Dr. Michael Brauckmann** (Idemia, France) *Exploiting biometrics: an industrial perspective.*

- **Friday May 31**

- **Prof. Vishal Patel** (Rutgers University, USA) *Continuous authentication in the mobile world.*
- **Prof. Didier Meuwly** (Netherlands Forensic Institute, Netherlands) *The use of biometric data in forensic practice.*
- **Dr. Thirimachos Bourlai** (West Virginia University, USA) *Practical biometric recognition systems and project - PART 2.*
- **Prof. Emilio Mordini** (Responsible Technology, France) *Biometrics and Forensic Science in the Deep Learning Era.*
- **Prof. Massimo Tistarelli** (University of Sassari, Italy) *Concluding remarks and discussion.*

The school week also included three special sessions on Monday, Tuesday and Thursday evening, devoted to an informal meeting and open discussion among the participants and the lecturers. Monday evening was devoted to a Doctoral Consortium meeting, moderated by prof. Thirimachos Bourlai. Tuesday evening, prof. Arun Ross guided a discussion on “Privacy issues in Biometrics”. Finally, prof. Didier Meuwly, proposed some burning issues on the application of Forensic Biometrics to real cases.

38 participants attended the school lectures. The class was formed by students coming from different universities, industries and research centres in the following 15 different countries (in brackets are the number of participants, if greater than one):

- Albania (2), Australia (2), Austria (3), Brazil (2), Czech Republic (2), Finland, France (4), Germany (3), Israel (3), Italy (3), Malaysia, Netherlands (3), Russia (3), Switzerland, United Kingdom, USA (3).

This year’s students demonstrated a strong interest in the application of biometrics to forensic cases as well to other scenarios. Most of them are either working directly in the design of biometric systems or pursuing high-level scientific research in the field. This not only facilitated the interaction between students and lecturers, but also stimulated and challenged even the most experienced lecturers with questions and requests for explanations in the course of almost all presentations. As a result, both the students and lecturers have been much involved in technical discussions and plans for collaborations.

Most of the students actively took part in the practical sessions. A project was assigned to group splits of the class and an award was assigned to the best projects.

Remarkably, also representatives of government agencies and forensic laboratories attended the school courses. This not only denotes the high reputation gained by the school, but also a deep interest of different government offices in the adoption and newer biometric technologies at the service of the citizens.

A round table on the usefulness and limitations of deep learning for biometric recognition was held on Thursday afternoon. The discussion was actively fostered by Prof. Alice O’Toole and Prof. Vishal Patel. The students actively participated to the discussion and very interesting conclusions were drawn on the impact of deep learning for biometrics and forensic science.

The school participants were offered the possibility to display a poster on their research activity and to submit a research paper to be orally presented at the special session organized during the week. The participants presented 20 posters, which were available during the entire week.

Twelve Phd students made an oral presentation of their on-going research work:

- **Jacqueline Cavazos** University of Texas at Dallas - USA “Accuracy comparison across face recognition algorithms: Where are we on race bias?”
- **Takoua Guiga** Orange Labs - France “Behavioural Authentication Based on Smartphone Protected Personal Communication Data”
- **Denis Migdal** ENSICAEN - France “Don't listen to my Keystroke Dynamics!”
- **Rahimeh Rouhi** University of Bologna - Italy “Social Network Forensics through Smartphones and Shared Images”
- **Martin Sakin** Brno University of Technology - Czech Republic “Use of Thermal Cameras in Home Environment”

- **Rafael Soares Padilha** University of Campinas - Brazil “Two-tiered facial verification for mobile devices”
- **Dominik Söllinger** University of Salzburg - Austria “PRNU-based Detection of Finger Vein Presentation Attacks”
- **Jan Tinka** Brno University of Technology - Czech Republic “Connecting Brain Signals with Concepts Classifiable by Machine Learning on Other Data”
- **Yuval Nirkin** Bar-Ilan University - Israel “On Face Segmentation, Face Swapping, and Face Perception”
- **Alice Towler** University of New South Wales - Australia “Do professional facial image comparison training courses work?”
- **Victor Varela** University of New South Wales – Australia “Eye movements and human face perception: An holistic analysis and proficiency classification based on frontal 2D face images”
- **Maëlig Jacquet** Ecole Polytechnique Federal de Lausanne “Comparison of generic and suspect-anchored score-based likelihood ratio assignation models using automatic face recognition systems”

For the future editions of the school we plan to continue with the open evening discussions, firstly started this year. These informal meetings were very much appreciated and provided several promising hints for further research and discussion. In the next school edition more care will be devoted in the guidance of the discussion and possibly on taking notes of the discussion outcomes. A list of potential topics for discussion may be also requested to the participants before the school beginning.