Summer school report

18th International Summer School for Advances in Biometric Authentication: Biometrics for AI/AI for Biometrics

The 2021 IAPR/IEEE summer school on biometrics has been held on May 30th to June 4th 2021 in Alghero, Italy. This was the 18th 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 the European Association for Biometrics, IAPR and IEEE and co-organized by the COST Action CA16101 "MULTI-modal Imaging of FOREnsic SciEnce Evidence - tools for Forensic Science".

The school main theme was related to the mutual benefit of Biometrics and current deep learning approaches, and how biometric technologies can advance the state of the art in the design of intelligent machines.

Despite the Covid-19 outbreak, this has been for the second time in a row, among the best school editions both for the large participation, the highest in the past 20 years, and the outstanding lecturers, some of them could never present a lecture in the past editions.

Several subjects were taught at the summer school forming a total of 36 hours of theoretical lectures from 21 different lecturers and several hours of guided practical sessions using MatLab[1] 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 humanoid robotics, large-scale evaluation and the deployment of biometrics technologies in forensic cases. This 18th edition of the summer school, featured a line-up of exceptional lecturers, some who established the foundations of Biometrics and AI, and also selected from the editorial boards of top-level scientific journals. Prof. Tomaso Poggio, among the fathers of computational neuroscience and machine learning, presented a keynote on the most recent findings in developing a theory and a mathematical framework for deep learning. 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. John Daugman, the first to propose the use of iris to perform recognition and the inventor, among many patents, of the iris code. Prof. Arun Ross, from Michigan State University, presented a lecture on the commonalities between Biometrics and AI. Prof. Anil Jain, among the fathers of today's Biometrics, presented a quick overview of the state of the art in Biometric technologies and the open problems for the future. All lecturers, among the most highly reputed experts in their fields, presented the most up-to-date view in Biometric technologies and Forensic applications.
Two round tables has been held during the week, to summarize the key elements emerged from the lectures and to wrap up some conclusions on the future for Biometrics and AI.

Given the current Covid-19 outbreak several technological platforms have been used to facilitate the student's engagement and to maximize the benefits of ongoing discussions without the physical presence. A major constraint to be faced was the variety of time zones from which the participants and the lecturers were connected. This required, in the last two months before the school, to carefully design the schedule, and to adapt the format of the lectures to be best followed despite of the very early or very late time of the day.

[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.

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

- **Sunday June 7**
  - **Prof. Massimo Tistarelli** (University of Sassari, Italy) *Opening and presentation of the school courses.*
  - **Dr. Thirimachos Bourlai** (West Virginia University, USA) *Practical Biometric Systems and Project- PART 1.*
- **Monday June 8**
  - **Prof. Alessandro Verri** (University of Genova, Italy) *Machine Learning for Biometrics.*
  - **Prof. Lior Wolf** (Tel Aviv University and Facebook, Israel) *Deep Learning for Biometrics: from Technologies to Meta-technologies*.
  - **Prof. Vishal Patel** (Johns Hopkins University, USA) *Federated Learning for Biometric Applications.*
  - **Prof. Anil Jain** (Michigan State University, USA) *Biometrics: Past, Present and Future.*

  Round table 1 *– moderated by Prof. Enrico Grosso: Research directions in Biometrics for AI and AI for Biometrics*
    - *M. Nixon; V. Patel; A. Verri; L. Wolf.*
- **Tuesday June 9**
  - **Prof. Davide Maltoni** (University of Bologna, Italy) *Hands on Fingerprint Recognition with OpenCV and Python.*
  - **Prof. John Daugman** (Cambridge University, UK) *Big Biometric Entropy: Collision Avoidance on a Global Scale*.
  - **Prof. Massimo Tistarelli** (University of Sassari, Italy) *AI for Face-based Human Recognition*.
  - **Prof Mark Nixon** (University of Southampton, UK) *On Gait and Soft biometrics.*
  - **Prof. Christoph Busch** (Hochschule Darmstadt, Germany) *Morphing attack detection.*
- **Wednesday June 10**
  - **Prof. Nicholas Evans** (EURECOM, France) *Speaker Recognition, Spoofing and ASV Spoof*.
  - **Prof. Giulio Sandini** (Italian Institute of Technology, Italy) *From Computer Vision to iCub and the Quest for Cognition.*
  - **Prof. James Haxby** (Dartmouth College, USA) *Commonality of the Fine-Grained Structure of Neural Representations.*
  - **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) *Individual Differences in the Neural System for Face Perception and Recognition.*
- **Thursday June 11**
  - **Dr. Laurent Kazdaghli** (Idemia, France) *Exploiting Biometrics: An Industrial Perspective*.

- **Dr. Jonathon Phillips** (NIST, USA) *Evaluations for Face Recognition and Explainable AI for Biometrics.*
- **Prof. Arun Ross** (Michigan State University, USA) *AI and Biometrics: Oppurtunities and Challenges.*
- **Prof. Tomaso Poggio** (Massachusetts Institute of Technology, USA) *Observations on deep puzzles*.

***Round table 2** – moderated by Prof. Alice O'Toole: Research directions in Biometrics for AI and AI for Biometrics*

  - *J. Phillips; D. Meuwly; T. Poggio; A. Ross.*

- **Friday June 12**
  - **Prof. Didier Meuwly** (Netherlands Forensic Institute, Netherlands) *Forensic biometrics: the Use of Biometric Data and Databases in Forensic Applications.*
  - **Dr. Thirimachos Bourlai** (West Virginia University, USA) *Practical Biometric Systems and Project - PART 2.*
  - **Prof. Emilio Mordini** (Responsible Technology, France) *Ethics of Biometrics: an Overview.*
  - **Prof. Massimo Tistarelli** (University of Sassari, Italy) *Concluding remarks and discussion.*

Given the impossibility of a physical presence, the school could not maintain some of the planned features, such as the special evening sessions. However, the wise application of three main communication platforms and two round tables, enabled to establish a good level of engagement among the participants and with all lecturers. A particular effort was devoted to choose the applications for lecturing and to share data:

- Zoom Webinars was selected as the main teaching platform, as it allows to fully control the audio and video of the lecturers and of the participants. The applications divides the participants between "Attendees", or general audience, who do can not be seen or heard, and "Panelists", the section for the lecturers, who have full control of audio, video, polling, answering questions and screen share. This arrangement avoided any disturbance or intrusion during the lectures. The technical staff carefully monitored all sessions and allowed to facilitate the participation of the audience by enabling the audio-video resources whenever needed at the end of each lecture, or during the lecture.
- Slack has been used to provide a fast communication channel among all participants and the lecturers. Everybody could exchange documents, send messages and make quick calls for discussion, without the need to explicitly exchange personal data such as the phone number or the email.
- Gather.town has been used to allow the participants to meet each other and to share 11 posters showing their current research. The application allowed also to establish a quick communication among the participants visiting the virtual environment.

The format of the lectures was one hour of live or recorded presentation, followed by 30 minutes for discussion. In order to allow all participants to benefit from all lectures, despite of the large time differences due to the different time zones, all lectures were recorded and made available at the end of each day for two weeks.

67 participants from 8 different time zones, ranging from CET-6 to CET+7.5, attended the school lectures. The class was formed by students, researchers, professionals and officers, coming from different universities, research centres, private companies and public offices in the following 26 different countries (in brackets is the number of participants):

- Albania (4), Australia (3), Belarius (1) Belgium (1), Brasil (1), Chile (1), China (1), Denmark (3), Finland (1), France (5), Germany (4), Greece (2) India (3), Italy (8), Lithuania (2), Malaysia (5), Malta (1), Netherlands (3), Pakistan (1), Portugal (3), Romania (1), UK (3), Ukraine (1), United Arab Emirates (1), USA (7).

The lack of a physical logistic allowed to greatly reduce the registration fees, but also to allow more students from poorer countries, such as Malaysia and Eastern Europe, to participate to the school defraying the travel costs and also being enrolled for a symbolic price.

This year's students demonstrated a strong interest in the impact of AI for biometrics and to forensic cases. Most of them are either working directly in the design of biometric systems, for the deployment in the society 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. As a result, both the students and lecturers have been much involved in technical discussions and plans for collaborations.

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.

Two round tables were organized. The discussion was actively fostered by the moderators and the panelists. The students actively participated to the discussion and very interesting conclusions were drawn on several aspects of biometrics and AI.

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 11 posters, which were available during the entire week.
Out of the 67 participants, 40 students could benefit of a full or partial scholarship to cover the registration fees, thanks to the financial support generously provided by the COST Action CA16101, Hochschule Darmstadt, IAPR, IDEMIA and the IEEE Biometrics Council. All supporting organization, including also the European Association for Biometrics, the University of Sassari, the Italian Association for Computer Vision, Machine Learning and Pattern Recognition, has been widely advertised during the school week.

For the future editions of the school, hopefully to be held with physical presence, we plan to re-establish the open evening discussions, firstly started two years ago. These informal meetings were very much appreciated and provided several promising hints for further research and discussion. A list of potential topics for discussion may be also requested to the participants before the school beginning.