European Association for Signal Processing

Summer school report

*19th International Summer School for Advances in Biometric Authentication:
Continually Learning Biometrics*

The 2022 Eurasip summer school on biometrics has been held on June 6th to 10th 2022 in Alghero, Italy. This was the 19th 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 Eurasip, the European Association for Biometrics, the IAPR and IEEE.

The school main theme was related to the "continual learning" paradigm, which both involves the way we build machines capable of learning from their experience, but also the need for students and professionals to learn continuously to build better systems and capitalize from experience. The school particularly addressed how the most advanced technologies for personal recognition may impact the society and how it can applied for social good.

Despite the Covid-19 outbreak, this has been by far, among the best school editions both for the large participation, and the outstanding lecturers.

Several subjects were taught at the summer school forming a total of 30 hours of theoretical lectures from 20 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 continual learning, large-scale evaluation and the deployment of biometrics technologies in forensic cases. This 19th edition of the summer school, featured a line-up of exceptional lecturers, selected from the editorial boards of top-level scientific journals and conferences. The opening, by prof. Anil Jain, among the fathers of today's Biometrics, presented the fundamentals and an overview of the state of the art in Biometric technologies and the open problems. 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. John Daugman, the first to propose the use of human iris for recognition, developed a lecture on the role of entropy in the sensorial data for identification and applied his findings to iris recognition. Prof. James Haxby, an outstanding neuroscientist from Dartmouth College, 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. Arun Ross, from Michigan State University, presented a lecture on iris and periocular biometrics. All lecturers, among the most highly reputed experts in their fields, presented the most up-to-date view in Biometric technologies.

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[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.

Given the current Covid-19 outbreak, all school sessions were delivered in hybrid mode, allowing participants on site and connected remotely to follow all lectures. Several technological platforms have been used to facilitate the engagement of all participants and to maximize the benefits of ongoing discussions, also without the physical presence.

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

- **Monday June 6**
  - **Prof. Massimo Tistarelli** (University of Sassari, Italy) *Opening and presentation of the school courses.*

  - **Prof. Anil Jain** (Michigan State University, USA) *Introduction to Biometrics.*

  - **Prof. Alessandro Verri** (University of Genova, Italy) *Machine Learning for Biometrics.*

  - **Prof Mark Nixon** (University of Southampton, UK) *On Gait and Soft biometrics and some practical issues.*

  - **Prof. Tomaso Poggio** (Massachusetts Institute of Technology, USA) *Thoughts on Machine Learning.*

  - **Dr. Thirimachos Bourlai** (West Virginia University, USA) *Practical biometric recognition systems and project - PART 1.*

- **Tuesday June 7**
  - **Prof. Vincenzo Lomonaco** (University of Pisa, Italy) *Introduction to Continual Learning.*

  - **Prof. Davide Maltoni** (University of Bologna, Italy) *Hands on Fingerprint Recognition with OpenCV and Python.*

  - **Prof. Arun Ross** (Michigan State University, USA) *Biometrics and image forensics.*

  - **Prof. Massimo Tistarelli** (University of Sassari, Italy) *Face recognition in the wild: Challenges and perspectives*.

  - **Prof. Christoph Busch** (Hochschule Darmstadt, Germany) *Morphing Attack Detection - State of the Art and Challenges.*

- **Wednesday June 8**
  - **Prof. John Daugman** (Cambridge University, UK) *Big Biometric Entropy: Collision Avoidance on a Global Scale.*

  - **Prof. Nicholas Evans** (EURECOM, France) *Speaker Recognition, Spoofing and ASV Spoof*.

  - **Prof. Alice O'Toole** (University of Texas at Dallas, USA) *Understanding face representations in deep CNNs.*

  - **Prof. James Haxby** (Dartmouth College, USA) *Commonality of the Fine-Grained Structure of Neural Representations.*

  - **Prof. Ida Gobbini** (University of Bologna, Italy) *Individual Differences in the Neural System for Face Perception and Recognition.*

- **Thursday June 9**
  - **Prof. Lior Wolf** (Tel Aviv University and Facebook, Israel) *Deep learning for biometrics: from technologies to meta-technologies*.
  - **Dr. Jonathon Phillips** (NIST, USA) *Evaluations for Face Recognition and Explainable AI for Biometrics.*
  - **Dr. Dora Csillag** (Idemia, France) *Exploiting biometrics: An Industrial Perspective.*

- **Friday June 10**
  - **Prof. Emilio Mordini** (Responsible Technology, France) *Ethical Implications of Biometric Recognition.*
  - **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 recognition systems and project - PART 2.*
  - **Prof. Vishal Patel** (Johns Hopkins University, USA) *Federated Learning for Biometric Applications.*
  - **Prof. Massimo Tistarelli** (University of Sassari, Italy) *Concluding remarks and discussion.*

The school program was enriched by 2 panel sessions, hold on Tuesday and Thursday evening, on the impact of privacy regulations to biometrics research and the application of continual learning principles. All participants greatly appreciated these additional sessions and actively contributed to the discussion.

A particular effort was devoted to choose the applications for lecturing and to share data:

- Zoom Meetings was selected as the main platform to broadcast and record the lectures, as it allows to fully control the audio and video of the lecturers and of the participants. The technical staff carefully monitored all sessions and facilitated the participation of the audience, both on site and online, 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.

Thanks to the Zoom platform, remote participants could not only directly ask questions, but also submit written questions and statements. In this way, also the most shy students could be actively involved and well interact with the lecturers.

In order to allow all participants to follow 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. Some of the participating students also shared their current research topics with 11 posters, displayed outside the lecture hall.

56 participants, mainly from European countries, but also from India and Africa, 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 19 different countries (in brackets is the number of participants):

- Africa (15), China (1), Croatia (2), Czeck Republic (1), Denmark (1), France (5), Germany (6), India (6), Italy (6), Lithuania (3), Netherlands (1), Norway (2), Portugal (1), Saudi Arabia (1), Singapore (1), Switzerland (1), UK (3).

The availability of a remote connection allowed more students from underdeveloped countries, such as Africa and India, 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 continual learning in the development of novel biometric technoclogies. 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 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.

A unique introductory keynote has been delivered by Prof. Anil Jain, possibly the most outstanding and highly reputed scientist in the field of biometrics. The discussion was actively fostered by Prof. Anil Jain. The students actively participated to the discussion and very interesting conclusions were drawn on several aspects of biometrics and the application to forensic science, as well as to other scenarios involving the greater public.

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 60 participants, **34 students could benefit of a full or partial scholarship** to cover the registration fees, thanks to the financial support generously provided by Eurasip, IAPR, IDEMIA and the IEEE Biometrics Council. All sponsorship support has been widely advertised during the school week.

For the future editions of the school we plan to continue the open evening discussions. 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.