



# European Association for Signal Processing

## Summer school report

### *21<sup>st</sup> International Summer School for Advances in Biometric Authentication: Biometrics: Trustful, Fair and Privacy-friendly*

The 2024 Eurasip summer school on biometrics has been held on June 3<sup>rd</sup> to 7<sup>th</sup> 2024 in Alghero, Italy. This was the 21<sup>st</sup> 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 addressed the scientific and technological advances observed in the last 20 years, wishing to tide up the knowledge accrued over the past two decades with the current trends in AI and related fields. The school particularly addressed how the most advanced technologies can be applied to build automatic systems for personal recognition which are fair and trustful while preserving the user's privacy.

Several subjects were taught at the summer school forming a total of 29 hours of theoretical lectures from 21 different lecturers and one informal round table.

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 the design of ethical systems, large-scale evaluation and the deployment of biometrics technologies in forensic cases. This 21<sup>st</sup> 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 keynote, by **prof. Anil Jain**, among the fathers of today's Biometrics, presented an overview of the progress made in the last two decades and the current state of the art in Biometric technologies and the most promising applications for future developments. **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 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 Meta 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 the use of generative AI in biometrics. **Prof. Massimo Tistarelli**, from University of Sassari, proposed a number of open and challenging scientific questions to illustrate the past and the envisioned future of face recognition research. **Prof. Anoop Namboodiri**, from IIT Hyderabad, described the scientific challenges and research outcomes resulting from the most massive deployment of biometrics: the AADHAAR system in India. **Prof. Michael King**, from Florida Tech University, well described the bias effects in the AI models currently deployed and designed for the development of biometric systems. All lecturers, among the most highly reputed experts in their fields, presented the most up-to-date view in Biometric technologies.

To facilitate the participation of people from far and low income countries, all school sessions were delivered in hybrid mode. 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 3**

- **Prof. Massimo Tistarelli** (University of Sassari, Italy) *Opening and presentation of the school courses.*
- **Prof. Vishal Patel** (Johns Hopkins University, USA) *Federated Learning for Biometric Applications.*
- **Prof. Alessandro Verri** (University of Genova, Italy) *Machine Learning (for Biometrics).*
- **Prof. Anil Jain** (Michigan State University, USA) *Introduction to Biometrics.*
- **Prof. Lior Wolf** (Tel Aviv University, Israel) *Deep Learning for Biometrics.*
- **Prof. Xiaoming Liu** (Michigan State University, USA) *Biometric Recognition at a Distance.*

- **Tuesday June 4**

- **Prof. Nicholas Evans** (EURECOM, France) *Speaker Recognition.*
- **Prof. Davide Maltoni** (University of Bologna, Italy) *Hands on Fingerprint Recognition with OpenCV and Python.*
- **Prof. Massimo Tistarelli** (University of Sassari, Italy) *30 Years of Face Recognition Research.*
- **Prof. Tomaso Poggio** (Massachusetts Institute of Technology, USA) *Machine Learning: Recent Progress in Approximation, Optimization and Generalization.*

- **Wednesday June 5**

- **Prof. Christoph Busch** (Hochschule Darmstadt, Germany) *Privacy-preserving Biometrics.*
- **Prof. Arun Ross** (Michigan State University, USA) *Trustworthy Biometrics and Generative AI.*

- **Thursday June 6**

- **Prof Mark Nixon** (University of Southampton, UK) *Gait and Soft biometrics and some practical issues.*
- **Dr. Jonathon Phillips** (NIST, USA) *30 Years of Face Recognition Evaluations.*
- **Prof. James Haxby** (Dartmouth College, USA) *Commonality of the Fine-Grained Structure of Neural Representations.*
- **Prof. Ida Gobbini** (University of Bologna, Italy) *Mechanisms for Face Recognition in Humans.*

- **Prof. Alice O'Toole** (University of Texas at Dallas, USA) *Face and Body Representations in Deep CNNs.*
- **Dr. Eric Poiret** (Idemia, France) *Exploiting biometrics: An Industrial Perspective.*
- **Friday June 7**
  - **Anoop Namboodiri** (IIT Hyderabad) *Towards billion-scale search for biometric de-duplication*
  - **Prof. Didier Meuwly** (Netherlands Forensic Institute, Netherlands) *Forensic Biometrics: the Use of Biometric Data and Databases in Forensic Applications.*
  - **Prof. Michael King** (Florida Tech University, USA) *Understanding Bias in Biometrics.*
  - **Prof. Emilio Mordini** (Responsible Technology, France) *Biometrics Physical Privacy.*
  - **Prof. Massimo Tistarelli** (University of Sassari, Italy) *Concluding remarks and discussion.*

The school program was enriched by a **round table**, hold on Wednesday evening, on the impact of bias and fairness in AI models

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 questions and statements online. 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.

The school participants were offered the possibility to display a poster on their research activity (posted for the entire week) and to submit a research paper to be orally presented at the special session organized on Thursday evening.

51 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 11 different countries (in brackets is the number of participants):

- Belgium (1), Chile (2), China (4), Czech Republic (4), France (4), Germany (6), India (1), Italy (10), Lithuania (3), Mexico (1), Poland (1), Rwanda (9), Singapore (2), UAE (1), USA (2).

The availability of a remote connection allowed many students from underdeveloped countries, such as Africa, to participate to the school defraying the travel costs.

This year's students demonstrated a strong interest in the impact of AI models in the development of novel biometric technologies. 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 keynote has been delivered by Prof. Anil Jain, possibly the most outstanding and highly reputed scientist in the field of biometrics and prof. Tomaso Poggio, among the founders of Machine Learning and the relation with Neuroscience and Artificial Intelligence. 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.

Out of the 51 participants, **10 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.