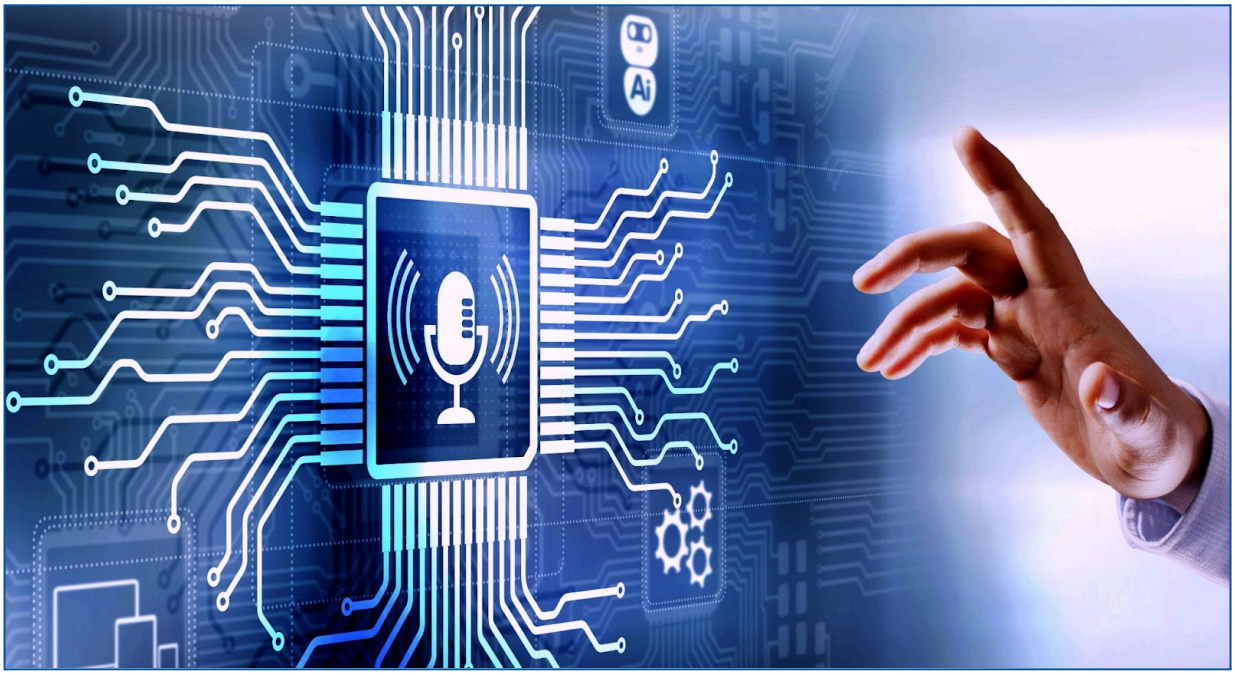
IEEE BIOMETRICS COUNCIL NEWSLETTER



Volume 53, March 2025

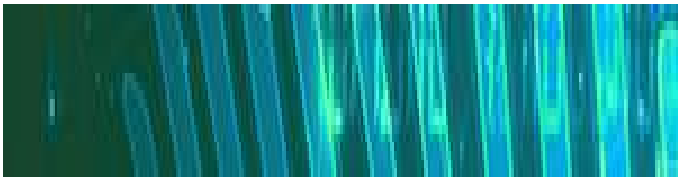
IN THIS ISSUE

Guiding Biometrics Next Generation

The 9th edition of the IAPR/IEEE Winter School on Biometrics brought more than 70 attendees to Shenzhen, China. Read all about it in the ***Council News*** section. Also in this issue, catch up with our featured ***Biometric Pioneer*** Dr. Christoph Busch of the Norwegian University of Science and Technology/ Hochschule Darmstadt. And, follow the evolving career of the 2024 IJCB Doctoral Dissertation Award winner Jeremy Speth in the most recent ***Researcher on the Rise*** column. And, help us congratulate Dr. Anil Jain of Michigan State University on receiving a **17th BBVA Foundation's Frontiers of Knowledge Award.**

GREETINGS FROM THE EIC

ANDREW TEOH BENG JIN
Yonsei University, Korea



Dear Readers of the *Biometric Newsletter,*

Welcome to the first issue of 2025! As we enter another exciting year, we know we'll continue to witness rapid advancements in biometric technologies that will re-shape our everyday lives. This edition of the *IEEE Biometrics Council Newsletter* brings you the latest insights, groundbreaking research, and key highlights from our community.

We also take this opportunity to warmly welcome the **IEEE Biometrics Council's new leadership team**, a dynamic group led by the newly appointed President, ***Dr. Stephanie Schuckers***. We look forward to this team's vision in steering the Council toward emerging frontiers in biometric research, innovation, and global collaboration. Their collective expertise promises exciting developments, and we wish them success in their endeavors.

In the spotlight in this issue is the **9th IAPR/IEEE Winter School on Biometrics**, which took place in Shenzhen, China, in January. This prestigious event brought together 77 participants from nine countries, and offered an engaging platform for knowledge exchange through expert lectures, mentoring sessions, and interactive discussions. Our coverage of this event emphasizes how emerging technologies, such as generative artificial intelligence and foundation models, will influence biometrics research and applications in the year ahead.

Another key highlight in the **Council News** section is a short report on **IEEE DataPort**, a global research data platform that enables researchers to store, access, and share large-scale biometric datasets. By offering persistent digital object identifiers (DOIs) and tools for data management, IEEE DataPort supports reproducibility, collaboration, and compliance with open science mandates in biometric research.

Our **Biometric Pioneers** feature highlights the work of **Dr. Christoph Busch**, whose contributions to biometric security, performance evaluation, and standardization have profoundly impacted the field. In our **Researcher on the Rise** section, we follow the journey of **Jeremy Speth**, the 2024 recipient of the IJCB Doctoral Dissertation Award. Additionally, we bring you **Expert Perspectives** from **Jakub Sochor**, who shares his journey in biometrics and leadership at Innovatrics. Initially entering the field by chance, he now values its impact on security. Sochor also highlights the importance of multi-layered security, integrating deepfake detection, and liveness checks.

In our **Noted in Literature** section, we highlight research on synthetic face aging and evaluate its impact on age-robust facial recognition algorithms. This study examines how synthetic aging techniques can improve recognition accuracy across different age groups, and explores the technique's potential for enhancing biometric authentication while mitigating privacy concerns. Our **Database Digest** section introduces **BehavePass**, an ongoing database capturing mobile behavioral biometrics. By focusing on user interaction patterns, including touch dynamics, device movement, and keystroke behavior, this technique aims to enhance security and authentication methods in mobile environments. In addition, the issue features an update on **Source Code** initiatives using synthetic biometric datasets, with a focus on their ability to balance data availability with privacy concerns. As these datasets facilitate the development of robust biometric models while minimizing risks associated with real biometric data exposure, they offer researchers new avenues for secure and ethical biometric research. Finally, our **COTS** section highlights **Onfido's Age Verification Solution**, a cutting-edge AI-driven technology designed to authenticate users based on facial biometrics. This solution enhances security and compliance while ensuring seamless user experiences across various digital platforms.

As always, we encourage you to engage with us by sharing your thoughts, insights, and contributions. Your participation is what makes our community thrive.

I wish you a year of innovation, collaboration, and discovery!

Warm regards,

Andrew Teoh

CONGRATULATIONS TO: *DR. ANIL JAIN*

Dr. Anil Jain, University Distinguished Professor at Michigan State University, has been chosen as one of two recipients of the 17th BBVA Foundation's Frontiers of Knowledge Award. The award, which Jain shares with Michael I. Jordan, an Emeritus Professor at the University of California, Berkeley, was given in recognition of his "core contributions in machine learning that have powered the development of biometrics and artificial intelligence" that, in turn, have "unlocked applications of far-reaching impact on society as a whole."

In its official acknowledgement of the award, the BBVA Foundation cites how Jain's research in clustering algorithms found a practical application. "In the 1990s, he received a call from a colleague in search of a civil application for an apparatus designed by the U.S. National Security Agency," the announcement reads, continuing, "Jain realised that (the application) could identify matches between two fingerprints 100 times faster than any previous method. That finding would produce six patents and, in time, Jain's group would come to lead the world in fingerprint recognition."

The award citation adds that, "this technology is now in wide use in the touch ID features of our mobile phones, and as a forensic tool in criminal investigations. Jain was also a pioneer in quantifying the slight probability that two people's fingerprints can be misidentified as the same, and providing first-time confirmation that fingerprints are persistent over time."

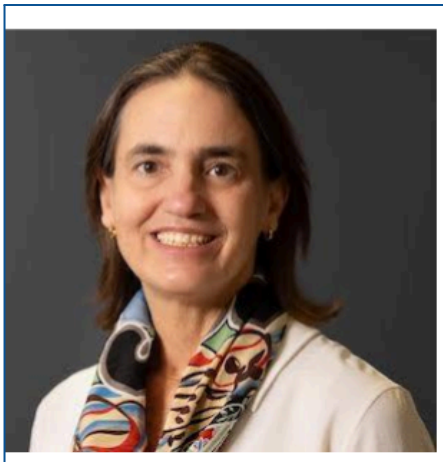
The BBVA Foundation Frontiers of Knowledge Awards acknowledge research work that "successfully enlarges the scope of our current knowledge – pushing forward the frontiers of the known world – and the meeting and overlap of disciplines." In describing the importance of the award, a "Biometrics on the Rise" column (https://ieee-biometrics.org/biometrics-on-the-rise/) on the Council website observes that "Jain's work has laid the foundation for modern biometric systems, significantly advancing technologies for fingerprint, face, and iris recognition." It adds, "The award recognizes Jain's decades-long leadership in shaping a field that is now central to global digital infrastructure."

Congratulations to Professor Jain on receipt of this prestigious honor. For more information on the award, go to https://www.frontiersofknowledgeawards-fbbva.es/galardonados/anil-k-jain-2/.

COUNCIL NEWS

Message from the 2025 IEEE Biometrics Council President

by Dr. Stephanie Schuckers, University of North Carolina-Charlotte, USA



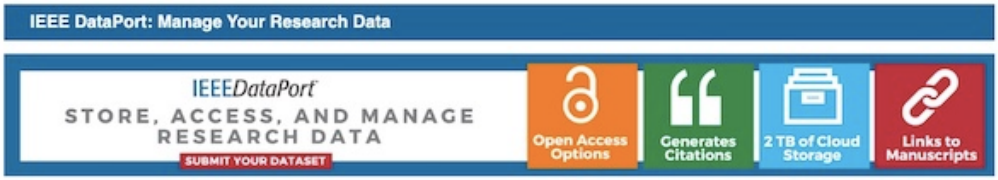
Dr. Stephanie Schuckers is the Bank of America Distinguished Professor in Computing & Informatics at UNC Charlotte, and also serves as the Director of the Center for Identification Technology Research (CITeR), a National Science Foundation Industry/University Cooperative Research Center. Her research focuses on processing and interpreting signals that arise from the human body, and has been funded by the National Science Foundation, Department of Homeland Security, and private industry. A Ph.D. graduate in Electrical Engineering from the University of Michigan, her accomplishments include starting her own business, testifying before the US Congress, and publishing 175 academic papers. Schuckers was named an IEEE Fellow in 2023, and has served on the Board of Directors for the Biometrics Institute..

I am honored to represent the IEEE Biometrics Council as President. I have worked in biometric recognition since 1998 and have seen the evolution of the technology from research to practice. In the mid-2000s, there was talk that, in five years, biometric recognition technology would have become a "solved problem," Boy, were we wrong. Now in 2025, the application of biometric recognition to commercial and government applications has brought a host of new questions to solve, including data privacy to minimize risk at all stages of the pipeline and ensure the technology works for all individuals, and protection approaches to reduce vulnerabilities from spoofing, injection of replay and deepfake videos, and other attacks. Further, the potential of biometric technology has grown from physiological biometrics to behavioral biometrics. That is, it is not useful only for matching against a prior captured reference, but can also determine other biometric information, such as stress, emotion, and health.

The IEEE Biometrics Council was created in 2008. I represented the Council as VP for Finance from 2012 to 2017, during the time of its review and approval from provisional to permanent status in 2015. I am proud of the team's work to ensure we became a permanent Council in

IEEE. Today, the Council continues to mature with the successful journal*, IEEE Transactions on Biometrics, Behavior, and Identity Science (T-BIOM)*, a newsletter with widespread readership, multiple conferences, a webinar series, Distinguished Lecturers, 6+ awards, and 20+ chapters. With compelling questions about the role of AI in society, the IEEE Biometrics Council has the potential to lead on these questions, as biometrics has shown its value in a whole host of industry applications. But, this is only the tip of the iceberg. I expect to see this technology throughout our daily lives. From mobile identity for both in-person and online identity, to physical infrastructure, such as autonomous vehicles and workplace safety strategies, biometrics and identity play a part in fully immersing the human with the technological world. The IEEE Biometrics Council has a role to play by providing leadership to ensure the technology is safe, effective, and compelling for all members of society, no matter who they are and no matter where they live, work, and play.

What can the Council do? The IEEE Biometrics Council can ensure that there are experts in the field who understand the deep technological underpinnings, as well as the socio-technical aspects. While supporting our leading conferences and publications, the IEEE Biometrics Council continues to grow the efforts of technical activities, education, and outreach efforts. We are expanding our educational offerings and ensuring these offerings are available worldwide. We seek to grow the pipeline of professionals by engaging the IEEE Biometrics chapters, expanding online engagement through hosted educational webinars (both synchronous and asynchronous), and increasing the number of lecturers. We look forward to the opportunity to work together on these and other initiatives. Having worked in biometric recognition since 1998, those in the field have eagerly awaited the “hockey stick,” i.e., an exponential adoption of biometric technology. That time has finally come, and the IEEE Biometrics Council has an important role to play by continuing to provide thought leadership, education, and outreach.



Introducing IEEE DataPort

By Melissa Handa, Program Director, Technical Activities, IEEE, Piscataway, NJ, USA

- Would you like to get more exposure for your valuable research?
- Do you have datasets that require long-term storage and accessibility?
- Do you have a need for datasets to support your research?
- Do you want to initiate or participate in data competitions?

If you answered YES to any of these questions, you are invited to experience **IEEE DataPort™,** a global research data platform enabling both individuals and institutions to perform critical data management functions, including storing and accessing research datasets. Hosting more than 7,600 datasets, IEEE DataPort is used by more than 13 million global researchers.

IEEE DataPort offers the following benefits to all researchers:

- Accepts and stores datasets of up to 2TB for individuals at no cost.
- Provides a free, persistent Digital Object Identifier (DOI) for each uploaded dataset and analysis
- Provides datasets that can support research reproducibility
- Supports government or other funder mandates for accessibility and management
- Hosts and manages data challenges/competitions
- Provides global exposure to your datasets with an opportunity for data owners to obtain citations

“IEEE DataPort is a wonderful repository of datasets and the easiest way to host datasets that are accessible worldwide,” says Haiqiang Wang, a Ph.D. student at the University of Southern California. “As a data owner, it releases me from identifying a host server, building corresponding websites, regular maintenance, payments, and other tedious work. Recently, I shared VideoSet on DataPort, and it works well no matter where a user is from. It has a user-friendly interface and excellent download speed, and supports direct feedback and response between users and owners.”

Simply login to IEEE DataPort (https://ieee-dataport.org), and start exploring the multiple dataset files available to users. Or, upload your own dataset.

9th IAPR/IEEE Winter School on Biometrics

January 12-16, 2025
Shenzhen, China

Report by Shiqi Yu, Associate Professor of Computer Science and Engineering, Southern University of Science and Technology, Shenzhen, China, and Chair, IAPR Technical Committee on Biometrics

The 9th IAPR/IEEE Winter School on Biometrics brought 77 participants from nine countries to Shenzhen, China, from 12 to 16 January 2025. The four day program, which addressed a multitude of topics, offered its attendees a number of ways to interact with an impressive group of instructors, including lectures, mentor conversations, and informal social activities.

Expert talks highlight past, present, and future of biometric technology

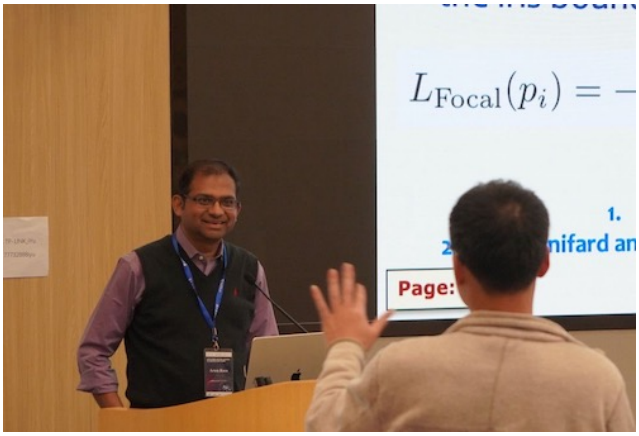
At the core of the winter school program was a series of 17 lectures on key topics in biometrics. These included overview lectures from Professor Tieniu Tan of the Chinese Academy of Sciences and Nanjing University, China, and Professor Rama Chellappa from Johns Hopkins University, USA. Tan discussed how biometrics has improved over the years, what problems still need solving, and where the technology might go next, while Chellappa explained emerging challenges in biometrics, especially in capturing face and gait characteristics.

Several professors gave lectures on the core technologies of different biometric features. Dr. Mark Nixon of the University of Southampton, UK, introduced foundational principles of gait

biometrics, while Professor Matteo Ferrara from the University of Bologna, Italy, offered a step by step demonstration of the way fingerprint recognition works. Professor Zhenan Sun of the Chinese Academy of Sciences detailed advancements in iris recognition, and Professor Ajay Kumar of the Hong Kong Polytechnic University, China, introduced the topic of secure authentication using contactless palmprint recognition systems.

Specific attention at this year's school was focused on the emerging technologies of generative artificial intelligence and the use of foundation models for biometrics. Professor Xiaoming Liu of Michigan State University, USA, addressed the latter topic with an analysis of biometric systems in the era of foundation models. Professor Chen Change Loy of Nanyang Technological University, Singapore, offered insights on the former with a talk on methods for harnessing generative priors for visual content restoration. In related talks on these topics, Professor Kaiyang Zhou of Hong Kong Baptist University, China, introduced technical roadmaps for vision-language models, Professor Josef Kittler of the University of Surrey, UK, deconstructed self-supervised learning paradigms for limited-data scenarios, and Professor Vishal Patel of Johns Hopkins University, USA, explored generative AI and large vision-language models for biometrics.

Professor Arun Ross of Michigan State University, USA, (photo at left) was one of several speakers to tackle issues of privacy and security in biometrics with an analysis of privacy-preserving biometric frameworks. Professor Sébastien Marcel of Idiap Research Institute, Switzerland, shared cutting-edge methods for face presentation attack detection, and for addressing vulnerabilities in biometric authentication. Professor Karthik Nandakumar of Mohamed bin Zayed University of Artificial Intelligence, UAE, introduced encrypted-domain biometric matching techniques. And, Professor Pong C. Yuen of Hong Kong Baptist, China, introduced a method for presentation attack detection using remote photoplethysmography for 3D facial mask attacks.

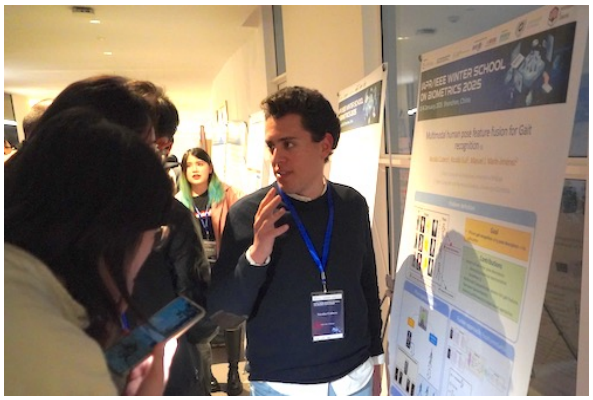


Complementing the academic perspectives of the lectures, Dr. Shouhong Ding, Director of Tencent Youtu Labs in Shanghai, China, highlighted the integration challenges of industrial-scale deployments of palmprint e-payment systems And, OpenCV developers, Wanli

Zhong and Yuantao Feng gave participants a hands-on experience in building face recognition tools using OpenCV and Python. Most students finished their projects, and four teams received prizes for their creative solutions.

Multidimensional Knowledge Exchange

Beyond the formal lectures, the Winter School also offered opportunities for less structured and more interactive exchanges between students and faculty. The program included one such event on each day of the workshop. The first of these opportunities was a mentoring



session held on the program's opening day. Participants were divided into seven groups, and each group was paired with one of seven mentors, all drawn from the workshop's lecturers: Professors Nixon, Loy, Marcel, Kumar, Kittler, Zhou, and Yuen. The mentors shared stories from their own careers, while participants were welcome to query them about their research and their life journeys.

On the second day, it was the students' turn to share part of their research journeys. Fourteen student attendees presented posters of their current work, which addressed topics in biometrics data from generative AI, privacy protection, and more. The last event was an afternoon social outing on a cruise ship on the third day. The cruise took participants through the Hong Kong-Zhuhai-Macao Bridge, one of the world's longest sea-spanning bridges. As the ship sailed under the bridge, students admired the 55-kilometer structure, which connects three cities across the Pearl River Delta. The blue sea and distant city skylines created a perfect backdrop for learning and sharing with the eight professors that joined students for the program: the aforementioned Nixon, Kittler, Liu, Ross, Patel, and Ferrara, along with Professors Zhihui Lai of Shenzhen University, China, and Shiqi Yu, of Southern University of Science and Technology.

The Winter School on Biometrics was co-sponsored by the IAPR TC4 and IEEE Biometrics Council, and jointly organized by the Department of Computer Science at Hong Kong Baptist University; the Institute of Automation of the Chinese Academy of Sciences; and the Department of Computer Science and Engineering at Southern University of Science and Technology. The program attracted participants from China, Somalia, India, Spain, Portugal, and Chile. Of the total group of participants, 73% were masters students,14% were undergraduate students and others, and 13% were doctoral researchers or industry engineers.

Winter School Reflections

By Zhilin Chen, Yulin University, China

The five-day Winter School on Biometrics in Shenzhen has successfully ended. This short yet fulfilling journey brought many benefits! ✨

Outstanding students and professors from around the globe gathered for the event, and It was not only an academic feast but also a collision of ideas. I was fortunate to make many friends from various universities and to have in-depth discussions with professors about research directions. This inspired new inspirations and thoughts.

The cruise tour on the third day left me with an unforgettable memory. Seeing the magnificent sight of the Hong Kong-Zhaui-Macao Bridge under the setting sun up close was truly breathtaking.

I was honored to be a volunteer on the media team for the school. By recording and sharing the wonderful moments of each day, I truly felt the joy of research.

On the last day, the efforts of our group members were recognized, and our project was honored with an award (see photo above) . This is the greatest affirmation of our teamwork and innovative spirit! I'm grateful to Prof. Tieniu Tan for presenting the award to us. All of these will become precious memories that I will cherish for a lifetime.

Although the five days were short, they made me more determined in my love and yearning for research. I want to thank my supervisor Prof. Hanye Liu and the organizer, Professor Shiqi Yu, for giving me this opportunity to broaden my horizons. In addition, I acknowledge all the professors and friends who accompanied me along the way.

May we all continue to shine brightly on the path of research in the future.

IN THE NEWS...

Compiled by Emanuele Maiorana, Assistant Professor, Roma Tre University, Rome, Italy

Biometric recognition systems have now become an integral part of our daily lives, largely due to their use as authentication methods for mobile devices. As more and more applications use these systems, interest in the functioning and implications of biometrics in everyday life has also grown. Numerous articles on these topics now appear in publications that are not strictly scientific in nature. As media can play a significant role in forming and directing people's perception of a particular topic, it is important to know how these technologies are being presented to the public. The following is a selection of articles that appeared from July to December 2024 on some of the most popular English-language news websites, such as *The Financial Times*, *Forbes*, *The Guardian, The New York Times*, or the *BBC*.

Meta agrees to $1.4 billion settlement in Texas biometric data lawsuit over Facebook images (July 30, 2024)
https://www.cnbc.com/2024/07/30/meta-agrees-to-1point4-billion-settlement-in-texas-biometric-data-lawsuit.html
Meta agreed to pay $1.4 billion to settle a facial recognition data lawsuit brought by the state of Texas. The lawsuit related to the Facebook owner's unauthorized use of the personal biometric data extracted from uploaded photos and videos on the social media site. Texas

Attorney General Ken Paxton, who sued Meta in 2022, is continuing to press a similar lawsuit involving biometric data against Google owner Alphabet.

Beyond Passwords: How Biometrics Revolutionize the Payments Landscape (September 13, 2024)
https://www.forbes.com/councils/forbestechcouncil/2024/09/13/beyond-passwords-how-biometrics-revolutionize-the-payments-landscape/
With the increasing use of Iris, fingerprint, voice and facial scans, what used to be the realm of sci-fi thrillers is now part of our daily lives. People use fingerprint scans to open their phones and unlock their front doors. Companies and governments use biometric authentication to restrict access to sensitive areas. Now, biometric authentication is on its way to changing how we make payments to better secure these transactions.

Plan to fingerprint passengers on entry to EU to be delayed again (October 9, 2024)
https://www.theguardian.com/world/2024/oct/09/plan-to-fingerprint-passengers-on-entry-to-eu-to-be-delayed-again
https://www.bbc.com/news/articles/cgey0vvxxw7o
Plans to fingerprint passengers entering the EU, which was scheduled to begin November 10, have been delayed for a third time after concerns were raised by France, Germany and the Netherlands. The introduction of the entry-exit system (EES), which requires non-EU citizens to have their fingerprints or photos taken before entering the Schengen area, has already been delayed twice. It was rescheduled for 6 October this year, then pushed back again until November amid concerns about disruption to school trips into the EU.

NY Mets used facial recognition to profit from unsuspecting Citi Field fans: suit (October 12, 2024)
https://nypost.com/2024/10/12/us-news/mets-used-facial-recognition-to-profit-on-unsuspecting-citi-field-fans-suit/
In a new class-action lawsuit, a Citi Field patron named Chris Dowling claims that facial recognition technology is being used to collect information on unsuspecting attendees. The suit, filed in Brooklyn Federal Court, claims that cameras “at the main fan entrance” collect “facial identifiers” from patrons as they enter the stadium, and that the Mets have third parties processing the data to find people on the team’s “black list.”

Meta to use facial recognition technology in fight against celebrity investment scam ads (October 22, 2024)
https://www.theguardian.com/technology/2024/oct/22/meta-to-use-facial-recognition-technology-in-fight-against-celebrity-investment-scam-ads
Meta is fighting the scourge of celebrity investment scam ads by using facial recognition technology to detect those whose image is used most often. The parent company of Facebook and Instagram announced it would begin using facial recognition technology on a limited

basis. The application began in December for a select pool of 50,000 celebrities or public figures worldwide on an opt-out basis. If Meta's existing systems suspect an ad may be a scam, it would compare the images in the ad against the public figure's Facebook and Instagram profile pictures. If it's a match and the ad is a scam, it will be deleted.

Now AI Can Bypass Biometric Banking Security, Experts Warn (December 4, 2024)
https://www.forbes.com/sites/daveywinder/2024/12/04/ai-bypasses-biometric-security-in-1385-million-financial-fraud-risk/
A fraud investigation team was asked to look into an unnamed but "prominent" Indonesian financial institution following a spate of more than 1,100 attempts to bypass its loan application security processes using deepfakes. More than 1,000 fraudulent accounts were detected, and 45 specific mobile devices were identified as part of the fraud campaign. Most of the devices run on Android systems, but a number also used the iOS app. The team was able to analyze the techniques used to bypass the "Know Your Customer" and biometric verification systems in place. The investigators cite a number of discoveries from the study, including that AI deepfake fraud has a potentially large financial and societal impact, and have introduced unprecedented security challenges for financial institutions.

Dark Web Facial ID Farm Warning—Hackers Build Identity Fraud Database (December 27, 2024)
https://www.forbes.com/sites/daveywinder/2024/12/27/dark-web-face-id-farm-warning-as-hackers-build-identity-fraud-database/

Researchers from iProov's biometric threat intelligence unit have uncovered what appears to be a simple, yet simultaneously sophisticated, identity protection bypass operation being implemented on the dark web. The operation is described as "compromising identity verification systems through the systematic collection of genuine identity documents and images." The iProov analysts note the by-pass demonstrates how the nature of identity fraud is evolving.

BIOMETRIC PIONEERS: *Christoph Busch*

Interview conducted by Andrew Teoh Beng Jin, Yonsei University, Korea, and Editor-in-Chief of the IEEE Biometrics Council Newsletter

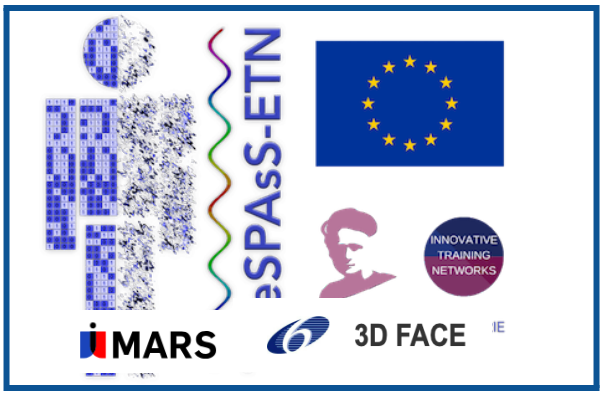
Christoph Busch holds a joint appointment as a Professor at both the Norwegian University of Science and Technology (NTNU) in Norway, and Hochschule Darmstadt (HDA) in Germany, and has also lectured on biometric systems at the Technical University of Denmark since 2007. On behalf of the German Federal Office for Information Security (BSI), he has served as coordinator for a number of project series dealing with biometric applications, specifically with performance and security testing. A current or former partner of the EU projects 3D-Face, FIDELITY, TURBINE, SOTAMD, RESPECT, TReSPAsS, iMARS, EINSTEIN and others, he is also principal investigator in the German National Research Center for Applied Cybersecurity (ATHENE), and co-founder of the European Association for Biometrics (EAB). Busch has co-authored more than 700 technical papers and been a featured speaker at many international conferences.

TEOH: You have played a leading role in various biometric research initiatives, both at the national and European levels. Can you share key insights from these projects and their impact on the advancement of biometric security and performance evaluation?

Busch: For biometric systems, both operators and the data subjects expect good performance. Thus, algorithms must be validated in technology testing to achieve low error rates in performance evaluations. Likewise integrated systems should be analysed in operational testing as this is crucial for performance in the field. Beyond that, we need to ensure that performance is balanced for various demographic groups to satisfy expectations of algorithmic fairness. As operators require that systems defend against attacks on enrollment procedures and capture devices, the ability to detect presentation and morphing attacks is another required attribute. Finally, privacy regulations, such as the GDPR, motivate us to research biometric template protection (BTP). The research projects in which I had the honor and pleasure to be involved have contributed towards achieving all of these objectives.[1]

TEOH: As the convener of WG3 in ISO/IEC JTC1 SC37 on Biometrics, you have significantly contributed to the

standardization of biometric technologies. What do you see as the most critical challenges in developing international biometric standards, and how can they be addressed?



A few of the EU Biometric projects to which Dr. Busch has contributed.

Busch: Biometric systems are, in general, open and often designed as distributed systems. This means sub-systems at different locations must be able to communicate and read data captured and stored by another entity, often one using a different capture device technology. Our passports, which contain face and fingerprint images, are a prime example. Without standards that define how to store data in compliance with extensible data interchange formats, a border control gate in one country would not be able to read and interpret the data stored in the passport by the issuing country.

Moreover, assessing sample quality requires a uniform perspective to ensure that a sample accepted or discarded for a biometric process (and for storage in a reference database) is based on a common definition. Such definitions have been achieved through standardised sample quality assessments for both fingerprint images (ISO/IEC 29794-4)[2] and its reference implementation (NFIQ2),[3] and for face images (ISO/IEC 29794-5) [4] and its reference implementation (OFIQ)[5]. For operators, it is important to rely on standards and to avoid a vendor lock-in situation, as potentially they want to be able to change recognition algorithms in support of new, innovative technologies.

TEOH: Your research spans multiple biometric modalities, including 3D face recognition, fingerprint authentication, and iris recognition. How do you assess the evolving role of multimodal biometrics in ensuring more secure and reliable identity verification systems?

Busch: Using multiple biometric modalities has two fundamental motivations: a) reducing errors in biometric recognition, and compensating for the inability to present certain biometric characteristics (e.g. missing eye, missing finger), which will lead to a more inclusive system; and b) taking one step forward in reducing the risk of presentation attacks.

Starting almost 20 years ago with the European 3D Face project, we researched 3D face recognition to increase recognition performance by combining face texture and face geometry. This proved especially reliable when the pose of a probe sample diverted from the frontal pose and could be

corrected based on the 3D model. Another objective was to provide a robust approach that can be operated in unsupervised access control scenarios with a 3D capture device. As we anticipated back then, we now have unsupervised 3D access control in smartphones. Moreover, usability has improved significantly. Nowadays, multimodal biometrics can be implemented with one capture attempt that simultaneously collects complementary biometric data from different sensors, such as RGB, NIR, and 3D.

TEOH: With the rise of AI-driven deepfake technologies and adversarial attacks, what do you foresee is the future of biometric security? What countermeasures do you believe will be most effective in mitigating these emerging threats?

Busch: This question raises two thoughts. First, what biometric data that I see / hear can be trusted? And, second, should we trust biometric algorithms that are based on AI-algorithms?

On the first question: The quality of deepfake technologies and the threat of adversarial attacks are getting more and more serious. I expect that, in the longer term, neither human observers nor algorithms will manage to reliably detect attacks. The consequence is that, despite their inconvenience and costs, we must have trusted and supervised capture situations. In addition, consumers of biometric data must be enabled to verify the authenticity and integrity of biometric data by means of digital signatures. This concept is old, yet has not yet been deployed.

As for the second question, now that we have the computational power, we see that in many areas of signal processing pattern recognition AI-driven approaches outperform hand-crafted ones. We have observed over time that “performance wins,”and that perspective will also be instrumental in the selection process for best biometric algorithms. However, we, as a society, including developers and operators of biometric systems, have formulated very well justified expectations of AI-driven algorithms as they comply with the following objectives:

1) treatment of various demographic groups in a fair manner
2) transparency of the data which was used for training
3) acquisition of the training data in a respectful manner, meaning with consent of the data subjects
4) explainability of the AI-based decision.

In our discussions, we should not forget that we often formulate expectations on AI-driven algorithms which neither a human expert / observer nor a hand-crafted algorithm can fulfill. Just as an example, think of a forensic identity parade. Human experts operate based on experience, which includes bias. Moreover, it is challenging for them to explain their decision. Having said this, we should continue to reach the requirements and never fail to address the hard tasks ahead.

As a concluding thought on the cat and mouse race in the field of AI-based applications, we shall align our research and

development with the legal framework, but stay in communication with legal experts. Though we work with regulations on AI-driven development and operation as formulated in the European AI-Act, we still implicitly promote solutions developed outside Europe. I have doubts that this is serving the best interests of data subjects.

TEOH: As a founding member of the European Association for Biometrics (EAB) and the CAST-Forum, you have helped foster collaboration between academia, industry, and government agencies. How do you envision the role of such organizations in shaping the future of biometric innovation and policy-making?

Busch: Both the European Association for Biometrics (EAB) [6] and the Competence Center for Applied Security Technology (CAST)[7] were established to transfer knowledge and to promote the responsible use of IT-security, digital identity systems, and biometrics. I have invested a lot of my life energy in these associations and remain an active member of both. I am convinced of their positive impact in building crucial Interactions between operators, industry, and academic members to initiate innovation and develop research ideas.

Bringing together these parties will remain a source of inspiration for new research. Workshops and conferences provide a platform where end-users/operators can express their needs to researchers ready to listen and respond. These associations will remain successful because they focus on up-to-date unbiased content. Moreover, annual awards help motivate young researchers to achieve tangible innovations.

TEOH: Given your extensive experience in cybersecurity and biometrics, what key research directions do you believe the community should prioritize to address privacy, ethical concerns, and bias in biometric systems?

Busch: Biometric template protection (BTP) will remain important. One example that highlights the relevance of BTP is the exit of NATO troops from Afghanistan in the summer of 2021, when biometric data (iris-, face- and fingerprint images) were left behind and fell under control of the Taliban. If BTP had been integrated in regional systems, severe consequences like those could have been prevented. We must always remember to interact with other disciplines and learn from them. Through interaction,

we learn to understand that BTP approaches must also be post quantum secure.

With regards to privacy and ethical concerns, which include potential biases in biometric algorithms, I think it is fundamental to consider this factor in the design of our systems. Privacy-by-design is already an adopted concept. In a similar manner, I hope Fairness-by-design also takes hold. Such a design concept will reduce bias in systems that constitute a digital device.

TEOH: Having worked across leading institutions, such as NTNU, Hochschule Darmstadt, and DTU, how do you approach educating and mentoring the next generation of biometric researchers? What skills and knowledge do you believe are essential for students entering the field today?

Busch: Students should be trained to become (self-) critical thinkers, and learn to interact with neighboring disciplines. They need fundamental training to obtain skills in signal processing, and IT security, as well as machine learning (ML). Within the field of ML, techniques to provide explainability in the sense of "why a decision is taken" and not "where the attention is strongest" will be important to students. Further, students should be trained to consider energy consumption during training. Along this line we need to make clear that not every problem should be solved with ML. On an organisational level, I think that exchange between different institutions via internships or remote thesis projects is very helpful. I am grateful for the funding options, such as the Erasmus program, that support such internships.

Endnotes

1) "Project Examples," https://christoph-busch.de/projects.html.
2) I*SO/IEC 29794-4:2024. Information Technology — Biometric Sample Quality, Part 4: Finger Image Data.* https://www.iso.org/standard/83827.html
3) "NFIQ 2: Fingerprint Image Quality." https://christoph-busch.de/projects-nfiq2.html.
4) *ISO/IEC* 29794-5 *Information Technology — Biometric Sample Quality, Part 5: Face Image Data.* https://www.iso.org/standard/81005.html
5) "Face Image Quality Assessment." https://christoph-busch.de/projects-ofiq.html
6) "Welcome to 3Dface.org." https://christoph-busch.de/3dface/
7) "Welcome to the Competence Center for Applied Security Technology." https://cast-forum.de/

EXPERT PERSPECTIVES: *Jakub Sochor*

Interview conducted by* Dr. João C. Neves, *Associate Professor, University of Beira Interior, Portugal

Jakub Sochor is the Chief Technology Officer at Innovatrics, a world-class provider of biometric technology and solutions that is consistently ranked in top positions by the National Institute for Standards and Technology. Before joining Innovatrics, Sochor worked at Google in Switzerland, contributing to the development of Google Assistant. He holds a Ph.D. from Brno University of Technology in the Czech Republic, where he also completed his bachelors and master's degree work. With research accomplishments that include an improved design for convolution neural networks, and automatic camera calibration methods, Sochor's dissertation focused on fine-grained recognition of vehicles and automatic speed measurement using automatic traffic video surveillance.

NEVES: Your career spans computer vision and biometrics, with roles in both academia and in industry posts with Google and Innovatrics. What attracted you to the field of biometrics, and how has your perspective on biometric technology evolved over the years?

Sochor: When I first joined Innovatrics, my move into biometrics was more a matter of timing and opportunity than a lifelong passion. At that point, I was looking for a fresh machine learning challenge as I transitioned from Switzerland back to the Czech Republic, and Innovatrics caught my eye for its leading role in fingerprint recognition.

Over time, however, my perspective on biometrics has evolved. I've come to truly appreciate how this technology makes a tangible impact on everyday life by enhancing security and convenience for millions of users. Working in this competitive field pushes us to continuously innovate and refine our core algorithms, which is both challenging and deeply rewarding. It's inspiring to see our algorithms and solutions improve over the years.

NEVES: As the CTO of Innovatrics, you are responsible for driving biometric innovation. Can you share some of the advancements your team is currently working on, and how they are pushing the boundaries of biometric authentication?

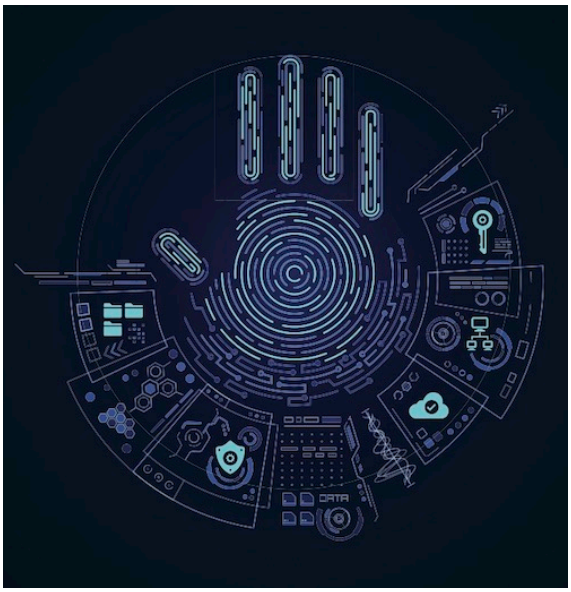
Sochor: At Innovatrics, we're focused on practical improvements across both our algorithms and our product offerings.

We continue to refine our core algorithms, as demonstrated by our performance on various NIST benchmarks. While these improvements may not be immediately visible, they translate into better accuracy for our clients. For example, our latent fingerprint technology now leads in accuracy, and our face identification system recently secured a top 10 ranking in FRTE 1:N evaluations.

On the product side, we are expanding our biometric modalities. We've introduced palm recognition capture via mobile phones, and are actively developing contactless fingerprint capture for mobile devices. Additionally, we're preparing to launch a deepfake detection feature to further strengthen our identity verification process. We see palm recognition as having significant future potential—not only for straightforward access control, but also as a reliable second modality for remote identity verification, in uses such as mobile payments.

NEVES: Biometric recognition systems must balance accuracy and fairness. What are some of the biggest challenges Innovatrics faces in ensuring that biometric technologies are unbiased? And, how is Innovatrics addressing the issue?

Sochor: Our company's research has found that the primary challenge isn't so much racial or gender bias, but rather domain



shifts. While ensuring fairness across all demographic groups remains a top priority, our real-world experience has shown that variations in environmental conditions—such as lighting, sensor quality, and background differences—can significantly impact the performance of our biometric systems. To tackle this, we're employing a two-pronged strategy:

Enhanced Data Collection: We're actively expanding our datasets to include a broad spectrum of real-world scenarios. This approach ensures that our training data reflects the diverse conditions under which our systems operate, thereby reducing the impact of domain-specific variations.

Advanced Training Approaches: Our training methods now incorporate state-of-the-art techniques like domain adaptation and transfer learning. These methods help our models adjust to new or varied conditions, mitigating biases that might otherwise emerge due to domain shift. By focusing on these strategies, we're reinforcing our commitment to creating

biometric technologies that are both highly accurate and fair for all users.

NEVES: With increasing threats, such as deepfakes and presentation attacks, how do authentication systems ensure resilience against spoofing and fraud?

Sochor: Modern authentication systems, including those at Innovatrics and other leading vendors, tackle spoofing and fraud using a robust, multi-layered approach:

- *Deepfake Detection:* We employ advanced algorithms designed to recognize deepfakes, ensuring that any manipulated images or videos are flagged immediately.
- *Prevention of Media Injection:* Instead of solely relying on detection after the fact, we also implement measures to prevent the injection of fraudulent photos or videos from entering the system in the first place.
- *Liveness Checks:* Our strategy integrates both passive and active liveness detection techniques. We ask the person being authenticated to perform an action and at the same time, we are making sure that the video/photo is not a spoof. Therefore, we are combining passive and active approaches.

By combining these layers, we create a resilient system that not only *detects* sophisticated spoofing attempts but also actively *prevents* them. This enables us to maintain a high level of security and user trust.

NEVES: You are also a Board Member of the prestigious European Association for Biometrics (EAB). Can you summarize the major initiatives of this association, and how these initiatives are contributing to the responsible use of biometric recognition in digital identity systems?

Sochor: EAB's initiatives promote technical excellence and ethical standards in biometric recognition. The association hosts workshops, seminars, and conferences on topics like detecting fingerprint presentation attacks and morphing. Recently, EAB has prioritized guiding the industry through the regulatory challenges of the AI Act, ensuring that digital identity systems are secure, compliant, and responsibly implemented.

NEVES: Having worked across academia and industry, what insights can you share about transferring biometric research into real-world applications?

Sochor: My academic work focused on anonymous traffic surveillance rather than traditional biometrics, but I observed that research can struggle with real-world adoption due to challenges like scalability and usability. Bridging the gap between academic findings and practical applications requires balancing theoretical rigor with an understanding of real-world constraints.

NEVES: What advice would you give to young researchers and engineers looking to make an impact in the field of biometrics?

Sochor: For young researchers and engineers, it's crucial to build a strong foundation. While deep learning is very popular, mastering fundamental concepts remains essential, as these basics deepen your understanding and often complement modern techniques. Moreover, maintain a spirit of curiosity—question assumptions and dig deep in the exploration, as these can lead to innovative improvements. Your fresh perspective is valuable, so don't hesitate to engage with more experienced colleagues and challenge established ideas.

RESEARCHER ON THE RISE: *Jeremy Speth*

Interview conducted by* Dr. Ruben Tolosana, *Assistant Professor of Biometrics and Data Pattern Analytics - BiDA Lab at the Universidad Autonoma de Madrid, Spain

Jeremy Speth, who was honored with the IJCB 2024 Doctoral Dissertation Award for his work on "Remote Vitals Estimation in an Open World," recently joined Apple as a research scientist in computer vision and machine learning. Previously, he worked as a research scientist at Presage Technologies, a startup focused on extracting a suite of health measurements from any camera. Speth obtained his Bachelor's degree in Computer Science at the University of Nevada, Reno in 2019, and his Ph.D. in the Computer Vision Research Lab at the University of Notre Dame. His research has focused on measuring physiological biomarkers from video, and his work on unsupervised learning of periodic signals from video was selected as a highlight paper at CVPR 2023, Speth has applied his camera-based physiology research during internships at Philips and Samsung Research America, and aims to achieve continuous sensing for detecting health anomalies.

TOLOSANA: You have worked on many different topics in the field of physiological biomarkers. What is your advice for young Ph.D. students on how to get quickly acquainted with, and contribute scientifically to, new research fields.

Speth: Starting a new research project in an area where you don't have much experience can be daunting. If you feel overwhelmed by the amount of background literature on the topic, I think you're doing it right. It's so important to read as many research papers as possible early in the process. Ultimately, the set of existing research should help form the boundaries for the research questions you should ask. Early in your research career, I think it's beneficial to start with lower risk research projects. This should give you the chance to quickly gain experience running experiments from start to finish, writing about your findings, and submitting a paper for review. You'll probably learn just as much about the general research process as your actual topic. This should build up your confidence to take on higher risk projects later and explore some more creative research ideas.

TOLOSANA: You have also published quite a bit in top conferences and journals during your research career and have received several awards. What are the strategies and key factors that have encouraged this level of productivity?

Speth: The first thing to point out is that I was fortunate to be a part of an excellent research group in the computer vision research lab at Notre Dame. All of the papers you mentioned were touched by advisors and grad student peers that spent considerable time on these projects. The biggest factor in research productivity for me was how interesting I found a particular project. You'll always do your best work on the projects that take most of your attention. My most successful papers were the ones that excited me the most. Everyone's work style is different, but I didn't have much success by banging my head against the wall and pushing myself into a stressed state. Sometimes stepping away from your problem can be more useful than hours of grinding away at it from the wrong direction.

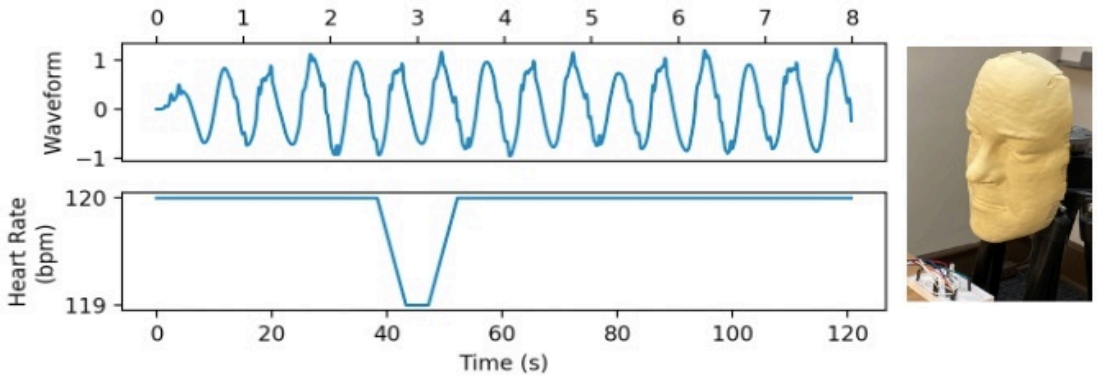


Figure 1: Illustration from Speth's award-winning dissertation, showing RPNet's pulse predictions from a 3D-printed face mask https://curate.nd.edu/articles/thesis/Remote_Physiological_Measurement_in_an_Open_World/24884337?file=43780902.

TOLOSANA: You did your B.Sc. degree at the University of Nevada, Reno, and your Ph.D. in the Computer Vision Research Lab at the University of Notre Dame, before working awhile as a Research Scientist at Presage Technologies. What was your motivation to move from one place to other? Was it difficult for you? What can you suggest to young aspiring researchers about handling transitions?

Speth: I think a useful guide for young researchers is to hop on any opportunities where you'll have to learn new skills. The move from my undergraduate work to the Ph.D. program at Notre Dame was a jump towards learning how to be a researcher in computer vision

Speth receiving the 2024 Dissertation Award at the IJCB meeting in Buffalo, NY. From l to r: Then President-Elect Stephanie Schuckers, Speth, and 2024 President Nasir Memon.

Also, after learning how to contribute to the scientific community through writing research papers, I realized that I didn't necessarily know how to translate my technical skills into actual products. So, I joined Presage Technologies after graduation to see how startups could quickly move new technologies into the hands of users. After years focused on writing papers and working with prototypes in the lab, we tend to think we're further along towards a product than we actually are. In reality, building systems that any person in the world can use is extremely challenging. I'd recommend taking these leaps into unknown territory when the opportunities come up. You'll learn quickly and figure out what's most important to you.

TOLOSANA: What is the most valuable expertise you have gained during your Ph.D.? What would you change if you could go back in time?

Speth: One particular skill that was somewhat unique to the lab at Notre Dame was the expectation that we would collect the data for our experiments ourselves. The lab has a solid background in biometrics and they've collected massive datasets in the past. I'm thankful that they've kept this tradition. Many machine learning Ph.D.'s can make their way through programs using benchmark datasets for all of their research, and for many postgrad jobs this is fine. But, starting a project with data collection and working all the way up to the analysis of the research results is extremely informative. I've gained a lot of experience working with cameras/sensors, and organizing large data collections, and I think such experience will be useful for the rest of my career.

One thing I'd improve upon is branching out for collaborations earlier on in the program. Notre Dame had experts in biomedical optics that could have been excellent collaborators if I'd made those connections in my first couple of years. We were also collecting more data than we could analyze, so I wish I would have found other graduate students interested in video processing to team up with. Overall, I think I could have learned even more if I interacted with a bigger set of researchers!

TOLOSANA: As mentioned before, your research has focused on using video to measure physiological biomarkers, such as cardiac pulse, respiration, and blood pressure. What inspired you to explore this intersection of computer vision and health applications? What has been your biggest challenge in this area?

Speth: I've been interested in AI for a while, and health is a perfect application in my opinion. There are so many variables that affect our health, and the human body is dynamic and complicated. The health assessments we get in clinical settings have always struck me as somewhat crude. We might answer a couple questions from the nurses and take a measurement of pulse rate, blood oxygenation and blood pressure. But this is really just a single noisy sample from an instant in time. We make critical decisions about our health with very limited data. And usually that data is collected after the symptoms have started to occur.

The goal we're working towards with AI and health sensing is preemptive care. If we had continuous physiological measurements, maybe we could find warning signs and intervene before the damage has been done. Cameras are surprisingly effective sensors for collecting multiple different types of biomarkers in a cheap and seamless way. They're also already in smartphones, so a software update could theoretically give new health sensing capabilities to billions of people on the planet for free.

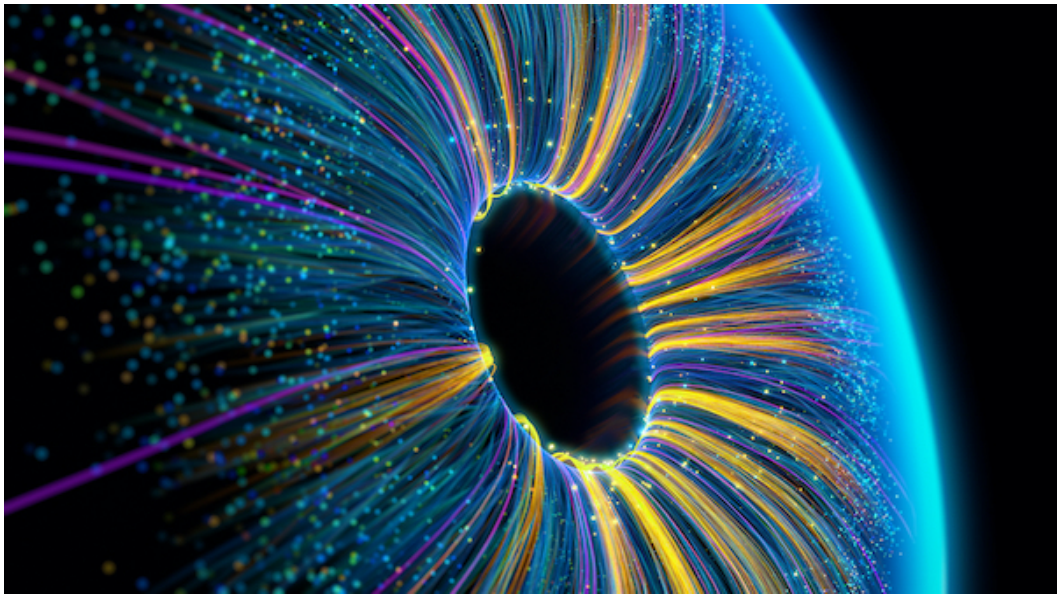
I'd argue that the biggest challenge in this area is translating biomarker measurements to actual outcomes in people's lives. Some people are just inherently interested in health tracking and more conscientious about changes in their body. How do you convince other people

to adopt this technology? We need comprehensive studies that can show examples of early diagnosis and recommendations for how practitioners can use this information to make medical decisions. Passing the advances in sensing methods all the way up to direct impact on patients is very hard!

TOLOSANA: If you had extra time and funds, what topic would you be interested in pursuing?

Speth: A big challenge in biomarker research is running longitudinal studies to see how measurements change for an individual over time. Recruiting participants that are willing to be tested more than once is expensive, and you usually can't get a large sample size. One experiment in particular comes to mind. We observed that the perfusion pattern over the face was quite subject-dependent. Everyone's pattern was different. For some people, the pulse signal was much stronger on the forehead than the cheeks, while for others it was the opposite.

It would be quite interesting to see if this pattern is consistent for each person, or if it changes as a function of temperature, blood pressure, facial expression, or stress. I think there are a ton of undiscovered biomarkers that require personalization and measurements over longer periods of time than we typically take in the lab. Effective longitudinal studies require time, funds, and a coordinated team. I'm hoping to work on projects like this in the future!



NOTED IN THE LITERATURE

Synthetic Face Ageing: Evaluation, Analysis and Facilitation of Age-Robust Facial Recognition Algorithms

A summary of an article that appeared in* IEEE Transactions on Biometrics, Behavior, and Identity Science*, January 2025, as prepared by its authors W. Yao, M.A. Farooq, J. Lemley and P. Corcoran

INTRODUCTION

Face recognition technology is now commonly used in our daily lives, from unlocking smartphones to passport verification. However, as this technology becomes more widely used for identity verification and security purposes, several challenges have emerged, especially when it comes to age-related changes in facial characteristics. Research has shown that the accuracy of face recognition systems can be significantly affected by human ageing factors. For example, the system tends to be less accurate when recognizing children and teenagers, while it performs better with older adults [1]. Additionally, as people grow older, their facial features change, which can further impact the system's effectiveness and require periodic re-enrollment.

Developing a system that can recognize faces consistently across different ages has become a research challenge of growing importance. In this study, we provide new insights into solving this problem. After evaluating the potential of synthetic ageing data, we adopt synthetic data to enhance state-of-the-art face recognition systems to better overcome this challenge.

FRAMEWORK

This study uses three advanced methods including Style-based Age Manipulation (SAM) [2], CUstom Structure Preservation (CUSP) [3] and AgeTransGAN [4] to generate synthetic ageing samples. We designed experiments to assess these samples in terms of how well they preserve identity, how accurately they represent ageing, and the overall quality of the image. Then the synthetic ageing data are compared against the effects of real-world ageing over time. We also explored how we can help improve performance in face recognition systems, especially in scenarios involving significant age gaps between individuals.

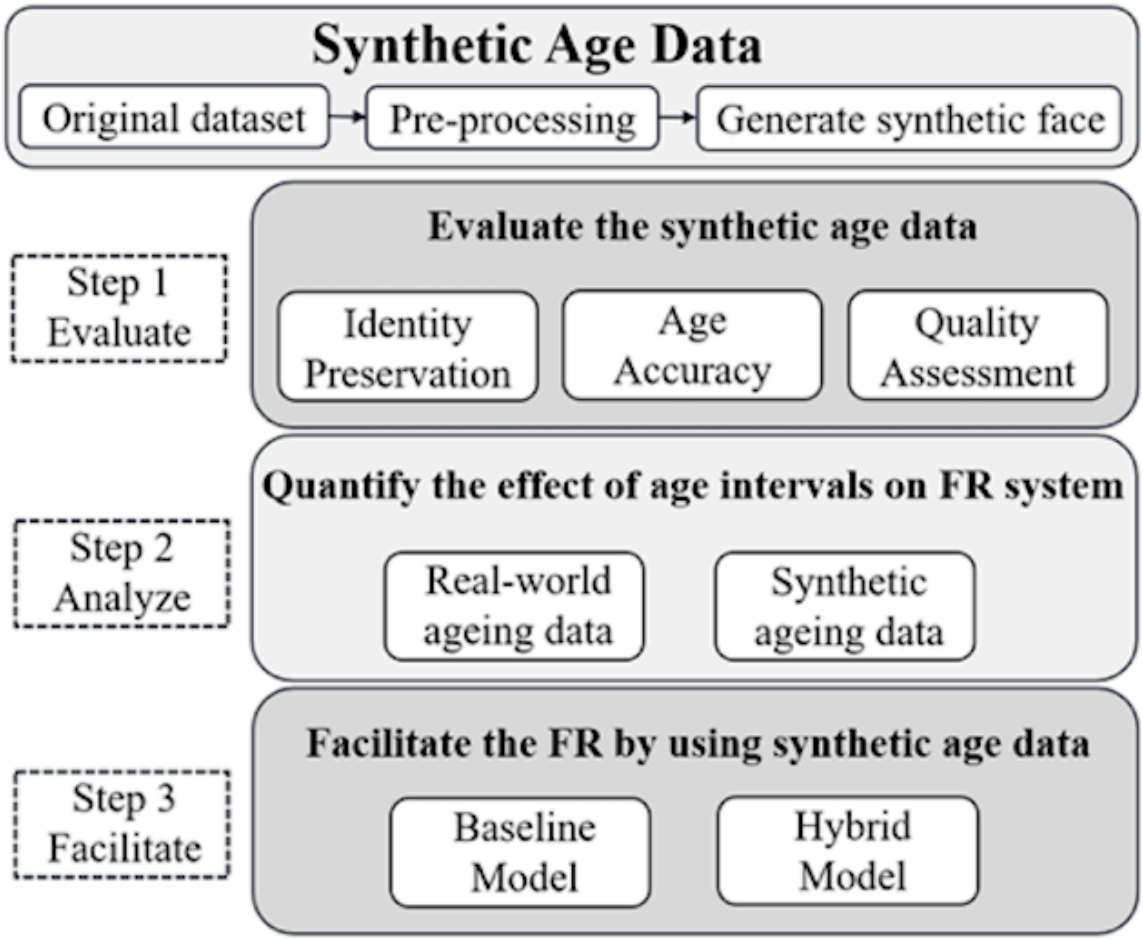


Figure 1: The pipeline of the experimental process.

The complete processing framework, as shown in Figure 1, involves these stages. First, we employ various methods to generate synthetic ageing samples. These samples are then used to evaluate how well they maintain identity, accuracy in ageing, and image quality. To test their effectiveness, we apply these samples to face recognition systems. Finally, we discuss how using these synthetic ageing samples as a data augmentation technique can help improve the performance and reliability of face recognition algorithms.

RESULTS

In this study, we evaluated the synthetic ageing samples based on age accuracy, identity preservation, and image quality—key factors in analyzing synthetic ageing faces. We introduced two age estimators and used box plots to visually compare the target age with the

estimated age. For identity preservation, we designed turn-old and reverse-back experiments to analyze changes in identity in two different ways. By adding backtracking experiments, we could track how consistently identity is preserved when using synthetic data to generate faces at various ages.

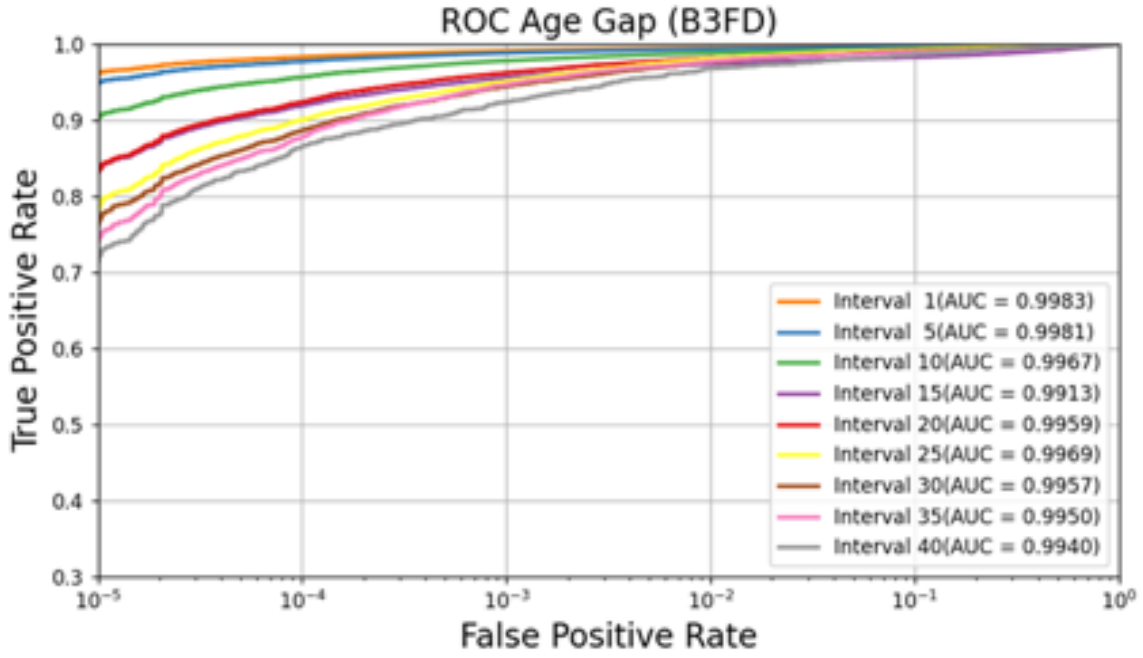


Figure 2: The ROC curves of real-world ageing data.

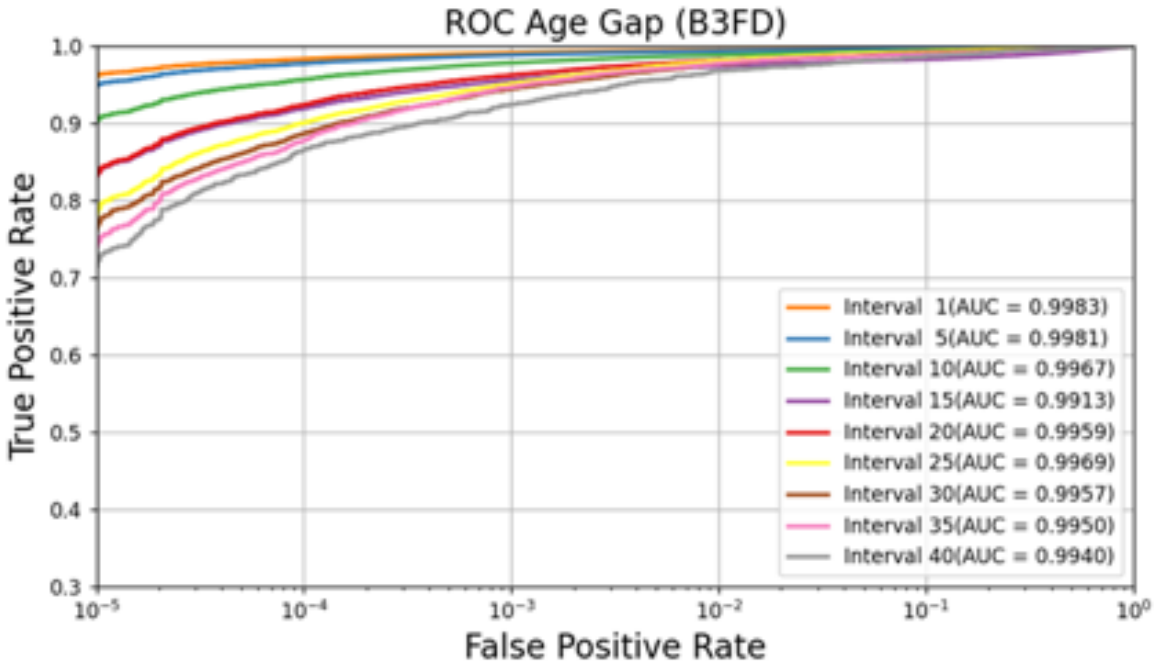


Figure 3: The ROC curves of synthetic ageing data.

Additionally, we used several image quality assessment methods to evaluate the synthetic ageing data.

Model	Age Gap 1	Age Gap 5	Age Gap 10	Age Gap 20	Age Gap 30	Age Gap 40
Baseline	98.34	97.21	94.86	94.15	90.54	88.88
CelebA-Syn-25	98.76	97.86	96.46	94.68	91.98	90.82
CelebA-Syn-35	98.87	98.20	96.77	95.47	93.02	91.21
CelebA-Syn-45	98.87	98.12	96.58	95.22	92.77	90.49
CelebA-Syn-55	99.06	98.42	97.27	95.90	93.29	92.21
CelebA-Syn-65	98.95	98.24	97.02	95.55	92.48	90.99

Table 1: True positive rates (%) with a false match rate of 10^{-3} on the original B3FD dataset.

This study also compares the impact of real-world ageing and synthetic ageing on the performance of face recognition systems. The results show that, in both cases, the system's performance decreases as the age gap grows. However, synthetic ageing images posed a greater challenge, likely due to limitations in how well synthetic data preserves identity, maintains image quality, and accurately represents ageing.

In addition, this research explores how synthetic ageing data can improve the accuracy and reliability of face recognition models. To investigate this, we have trained multiple models using different datasets to examine whether synthetic ageing data helps develop age-invariant face recognition, and whether certain types of synthetic samples lead to better results.

The models were trained on the CelebA-HQ dataset and synthetic ageing data, and then evaluated on a real-world dataset. The results showed that, in comparison to the baseline model, models trained with synthetic ageing data performed significantly better in recognizing faces across large age gaps.

CONCLUSION

In this study, we devised an experimental framework to assess the effectiveness of synthetic ageing samples and their impact on a large-scale, real-world face ageing dataset. We also explored how synthetic ageing data can be used to improve the performance of face recognition systems, especially when dealing with large age gaps. The results show that using synthetic ageing images for training significantly improves the robustness of face recognition algorithms in handling these age gaps.

This study highlights the promising potential of synthetic ageing technology in the field of face recognition, and suggests new directions for future research. As face recognition technology continues to evolve, we believe synthetic ageing can help overcome challenges

related to age-related changes, leading to more accurate and reliable systems. Moving forward, we plan to develop more advanced synthetic ageing algorithms, such as training vision language models (diffusion models) [5] to enhance image quality and identity preservation, and explore their potential for real-world applications.

REFERENCES

1) W. Yao, M.A. Farooq, J. Lemley, and P. Corcoran, “A study on the effect of ageing in facial authentication and the utility of data augmentation to reduce performance bias across age groups,” *IEEE Access*, vol. 11, pp. 97118–97134, 2023.
2) Y. Alaluf, O. Patashnik, and D. Cohen-Or, “Only a matter of style: Age transformation using a style-based regression model,” *ACM Transactions on Graphics*, vol. 40, no. 4, July 2021.
3) G. Gomez-Trenado, S. Lathuilière, P. Mesejo, and Ó. Cordón, “Custom structure preservation in face aging,” in *Computer Vision – ECCV 2022*, S. Avidan, G. Brostow, M. Cisse, G.M. Farinella, and T. Hassner, Eds. Cham: Springer Nature, Switzerland, pp. 565–580, 2022.
4) G-S. Hsu, R-C. Xie, Z-T. Chen, and Y-H. Lin, “AgeTransGan for facial age transformation with rectified performance metrics,” in *Computer Vision – ECCV 2022*, S. Avidan, G. Brostow, M. Cisse, G.M. Farinella, and T. Hassner, Eds. Cham: Springer Nature, Switzerland, 2022, pp. 580–595.
5) M.A. Farooq, W. Yao, and P. Corcoran, "ChildDiffusion: Unlocking the Potential of Generative AI and Controllable Augmentations for Child Facial Data using Stable Diffusion and Large Language Models," *arXiv preprint,* 2024. https://arxiv.org/abs/2406.11592.

W. Yao, M.A. Farooq, J. Lemley and P. Corcoran, "Synthetic Face Ageing: Evaluation, Analysis and Facilitation of Age-Robust Facial Recognition Algorithms," *IEEE Transactions on Biometrics, Behavior, and Identity Science*, pp. 1-1, January 2025. doi: 10.1109/TBIOM.2025.3536622.

DATABASE DIGEST

BehavePass: An On-going Capturing Database for Mobile Behavioral Biometrics

by Ruben Vera-Rodriguez, Associate Professor, Biometrics and Data Pattern Analytics Lab, Universidad Autónoma de Madrid, Madrid, Spain

BehavePass is an ambitious initiative to advance development of innovative biometric authentication systems by creating the largest public database of mobile behavioral biometrics. The dataset captures real-world user interactions with mobile devices, focusing on tasks like:

- **Typing:** Free-text input and structured typing tasks.
- **Swiping:** Gesture interactions like scrolling through the gallery and a text (horizontal and vertical swipe).
- **Signing:** Drawing a signature directly on the screen.
- **Air-signing:** Reproducing the signature in the air using the mobile device.
- **Walking:** Gait-based biometric data collection while carrying the device.
- **Daily Device Interaction:** Common tasks during daily use of the device, covering a wide range of actions and gestures.

The interactions cited above capture detailed touchscreen interactions, alongside sensor data from the device's accelerometer, gyroscope, gravity, or magnetometer and other apps. Thus, these actions offer a multimodal perspective to study user-device interactions in real-world settings.

Expanding BehavePass: The first version of the BehavePass database—together with an experimental analysis of the biometric recognition performance of some of the included tasks (keystroke, swiping and tapping dynamics)—was made publicly available in 2022 [1]. This dataset was also the centerpiece of the Mobile Behavioral Biometrics Competition (MobileB2C) held at IJCB 2022 [2], where participants benchmarked mobile authentication systems for the tasks mentioned above.

For the specific tasks cited above, the dataset captures both detailed touchscreen interactions, alongside sensor data from the device's accelerometer, gyroscope, gravity, or magnetometer among others. Thus, these interactions offer a multimodal perspective to study user-device interactions in real-world settings.

Instant Feedback on Cognitive Abilities to Encourage Participation: The researchers at UAM have created a platform that provides participants with instant feedback on their performance

after finishing each capturing session. This feedback includes the reaction speed to visual stimuli, visual memory through interactive tasks, the security and consistency of the signature, and an estimation of the participant's age, among other things. These insights are meant to motivate users to complete the four capturing sessions and share the app with their contacts.

Additionally, the research team at UAM rewarded participants who shared the app by giving them extra entries into the periodic raffles they hold for technology devices (smartphones, smartwatches or iPads). This provides an extra incentive to engage with the project.

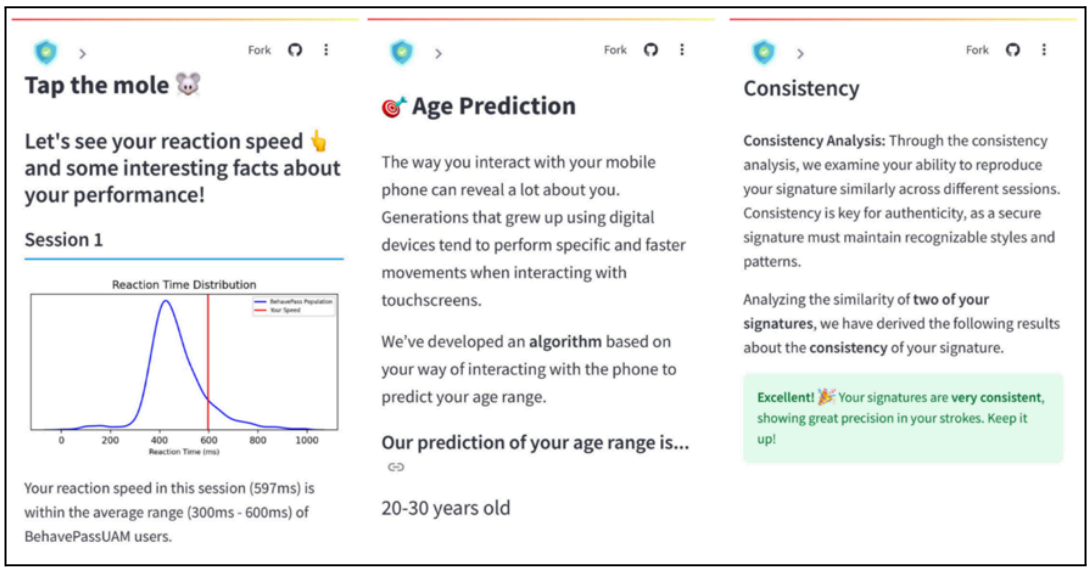


Figure 1. Example of the feedback provided after completing each capturing session.

Join the BehavePass Initiative: The acquisition process for the new version of the BehavePass database is taking place right now, and it will be an on-going process. Researchers, students and tech enthusiasts are invited to help grow BehavePass and, in doing so, will contribute to advancing mobile security and behavioral biometrics research. The process involves completing tasks through the Android app **BehavePassUAM**, which is available on Google Play (https://play.google.com/store/search?q=behavepassuam&c=apps&hl=en). All data will be anonymized before the database is made publicly available.

To get involved or learn more, visit https://behavepassuam.humanairesearch.com or contact the researchers at behavepass@uam.es.

REFERENCES

1) D. Ye, C. Fan, G. Stragapede, R. Vera-Rodriguez, R. Tolosana, A. Morales, "BehavePassDB: Public Database for Mobile Behavioral Biometrics and Benchmark Evaluation." *Pattern Recognition*, v. 134, February 2023. https://doi.org/10.1016/j.patcog.2022.109089.
2) G. Stragapede et al., "IJCB 2022 Mobile Behavioral Biometrics Competition (MobileB2C)," *6th IEEE International Joint Conference on Biometrics (IJCB)*, pp. 1-7, Abu Dhabi, United Arab Emirates, 2022.

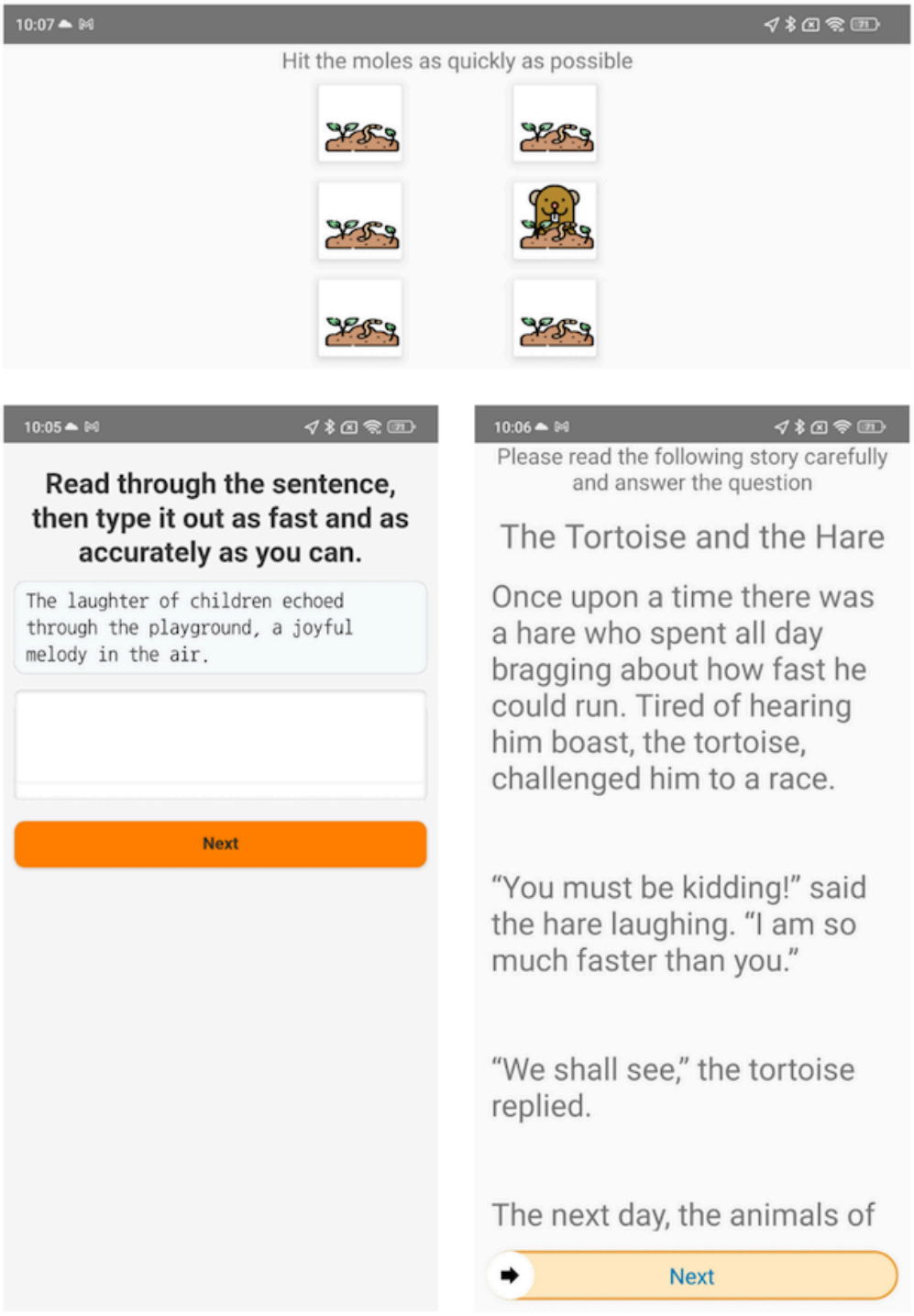


Figure 2. Example of some of the tasks of the acquisition.

SOURCE CODE

Synthetic Biometric Datasets for Balancing Data Availability and Privacy

By Chiara Galdi, Assistant Professor, EURECOM, Biot, France

Data availability is crucial for training AI models, especially today when increasingly deep architectures and complex models require vast, diverse, and high-quality datasets that can generalize effectively, reduce biases, and achieve state-of-the-art performance across various tasks. For AI biometric models to be fair and effective, data must not only be abundant, but also representative of all demographic groups. This will ensure diversity and inclusivity and prevent biases that could lead to unfair or inaccurate outcomes. But collecting data that accurately represents the target population and ensures equal representation of all demographic groups is a challenging task.

The rapid advancement of face recognition technology has been driven not only by the development of more powerful neural networks, but also by the availability of large-scale face databases that provide the necessary training data. Without access to extensive and representative face databases, even the most sophisticated neural networks would struggle to achieve high performance. However, the way such large datasets have been collected often did not comply with current privacy protection laws. In many cases, vast amounts of facial images were scraped from the internet without people's consent, raising ethical and legal concerns about data usage and individual rights.

Because of the ethical and legal concerns surrounding data collection, research has increasingly focused on the creation of synthetic biometric datasets. Generative AI can produce highly realistic facial images that retain the diversity and complexity needed for training AI models. This approach allows researchers to develop and refine face recognition systems while ensuring compliance with privacy regulations and eliminating the risks associated with unauthorized data collection.

The work “On the use of automatically generated synthetic image datasets for benchmarking face recognition,” by Colbois et al. from the Idiap Research Institute provides a face generator based on the StyleGAN2. The model, which is pretrained on high quality face images, consists of a mapping network and a synthesis network. The mapping network transforms Gaussian-sampled latent vectors into a new latent space, which the synthesis network then uses to generate face images. While random sampling can produce diverse independent faces, face recognition applications require multiple images of the same identity with variations in

illumination, pose, and expression. To achieve this, the method leverages the linear separability property of StyleGAN2's latent space, which identifies hyperplanes that separate different characteristics to allow controlled modifications of facial attributes.

Together with the research paper, the authors provide a set of tools to reproduce the experiments described in the article. The tools allow users to perform the following operations:

1. Projection of a face dataset into StyleGAN2's latent space;
2. Computation of semantic editing latent directions from those projections;
3. Generation of a synthetic dataset using the precomputed latent directions.

The code and detailed instructions for using it [2] are available on the Idiap GitLab repository. The repository link can be found on the Idiap website [3], along with other open source code useful for biometrics researchers.

REFERENCES

1. L. Colbois, T. de Freitas Pereira, and S. Marcel. "On the use of automatically generated synthetic image datasets for benchmarking face recognition," *International Joint Conference on Biometrics*, Shenzhen, China, 2021, pp. 1-8, doi: 10.1109/IJCB52358.2021. Also available at https://arxiv.org/pdf/2106.04215.
2. "Synthetic image datasets for benchmarking face recognition," idiap.ch. https://technology.idiap.ch/technologies/biometrics/genface/.
3. "Technologies," idiap.ch. https://technology.idiap.ch/technologies/.

COMMERCIAL OFF-THE-SHELF SYSTEMS

Onfido's Age Verification Solution

By Chiara Galdi, Assistant Professor, EURECOM, Biot, France

In this issue, we will explore a Commercial Off-The-Shelf (COTS) solution for age verification. In biometrics, age verification refers to the use of biometric technologies to determine a user's age based on their physical characteristics. Automated age verification is crucial for businesses that offer age-restricted services, such as gaming, e-commerce, and financial services. As it ensures compliance with legal regulations, it can protect businesses from fines and

reputational damage, while preventing underage users from accessing inappropriate content or services.

The *Children's Online Privacy Protection Act* (COPPA) [1] is a U.S. federal law enacted in 1998 to protect the online privacy of children under 13. It requires websites, apps, and online services that collect personal information from children to obtain verifiable parental consent before doing so. In the UK, the *Online Safety Bill* [2] is a legislative framework designed to regulate online content and protect users, particularly children, from harmful material. It places legal responsibilities on social media platforms, search engines, and other online services to prevent the posting of illegal content, such as child exploitation, hate speech, and fraud, while ensuring strong age verification measures for age-restricted content. Finally, the European Commission's *Better Internet for Kids* (BIK+) strategy, adopted on May 11, 2022, aims to create a safer and more empowering digital environment for children. BIK+ also encourages the development of standardized *age verification methods* across Europe.
As a consequence of violating data protection laws like these, TikTok was fined £12.7 million In April 2023 by the UK's Information Commissioner Office (ICO) for allowing up to 1.4 million children under 13 to use its platform in 2020 without parental consent. The ICO's investigation revealed that TikTok failed to implement adequate age verification measures to prevent underage users from accessing the platform [4,5].

Onfido's age verification solution [6] enables businesses to comply with evolving regulations, such as COPPA and the UK Online Safety Bill, by offering flexible, no-code workflows through Onfido Studio. Built with data security and algorithmic fairness in mind, Onfido's solution supports more than 2,500 identity documents worldwide, providing fast and accurate verification to protect brands and users alike. It enhances security by detecting tampered IDs and spoofed biometrics, thus preventing underage access to restricted services. The platform ensures a seamless user experience with Smart Capture technology, guiding customers through the verification process with real-time feedback.

REFERENCES

1) Federal Trade Commission, "Children's Online Privacy Protection Act." https://www.ftc.gov/legal-library/browse/rules/childrens-online-privacy-protection-rule-coppa
2) UK Parliament, "Online Safety Bill." https://bills.parliament.uk/bills/3137
3) European Commission, "A European Strategy for a Better Internet for Kids (BIK+)." https://digital-strategy.ec.europa.eu/en/policies/strategy-better-internet-kids

4) A. Hern and A. Adu, "TikTok fined £12.7m for illegally processing children's data," *The Guardian,* April 4, 2023. https://www.theguardian.com/technology/2023/apr/04/tiktok-fined-uk-data-protection-law-breaches.
5) K. Chan, "TikTok fined $15.9M by UK watchdog over misuse of kids' data," *AP News.com*, April 4, 2023. https://apnews.com/article/tiktok-data-privacy-britain-fine-china-2a94fcb6b74619ea7d04fdfc2ffe4e33
6) "Age Verification," Onfido.com. https://onfido.com/use-cases/age-verification.

BIOMETRIC ALERT

February 2025

By Dr. Carmen Bisogni, *Research Fellow, Biometric and Image Processing Laboratory, University of Salerno, Salerno, Italy, and* ***Dr. David Freire-Obregón,*** *Associate Professor, University of Las Palmas de Gran Canaria, Gran Canaria Island, Spain*

Below is a list of the latest papers addressing topics in biometrics that have been accepted (via early access) or published in various IEEE journals over the past few months.

BEHAVIORAL BIOMETRICS

1. B. Bera, S. Nandi, A.K. Das and B. Sikdar, "Healthcare Security: Post-Quantum Continuous Authentication with Behavioral Biometrics using Vector Similarity Search," in *IEEE Transactions on Information Forensics and Security*. DOI: 10.1109/TIFS.2025.3531197

2. Z. Hong, Y. He, L. Cao and L. Liu, ”A Wrist-Rolling Motion Recognition Method for Mobile Phone Unlocking,” in *IEEE Internet of Things Journal*, December 2024. DOI: 10.1109/JIOT.2024.3510395

BIOMETRICS DATASETS AND SURVEYS

1. P. Zhang, Y. Liu, S. Lai, H. Li and L. Jin, ”Privacy-Preserving Biometric Verification with Handwritten Random Digit String,” in *IEEE Transactions on Pattern Analysis and Machine Intelligence*. DOI: 10.1109/TPAMI.2025.3529022
2. S.V. Kulkarni and S. Pal, ”A Review on Language-Independent Search on Speech and its Applications,” in *IEEE Access*, vol. 12, pp. 194182-194202, 2024. DOI: 10.1109/ACCESS.2024.3520394
3. A. Leschanowsky, C. Rusti, C. Quinlan, M. Pnacek, L. Gorce and W. Hutiri, ”A Data Perspective on Ethical Challenges in Voice Biometrics Research,” in *IEEE Transactions on Biometrics, Behavior, and Identity Science*, vol. 7, no. 1, pp. 118-131, January 2025. DOI: 10.1109/TBIOM.2024.3446846

CONTEXT-AWARE BIOMETRICS

1. R.Y-Y. Chan, ”EEG Transformer for Classifying Students’ Epistemic Cognition States in Educational Contexts,” in *IEEE Access*. DOI: 10.1109/ACCESS.2025.3538036
2. C. Selvan, H. Anwar Basha, K. Meenakshi and S. Naveen, ”A Review on Person ReIdentification Techniques and Its Analysis,” in *IEEE Access*. DOI: 10.1109/ACCESS.2025.3536478
3. M. Guan, B. Yang, Z. Wang, C. Li and K. Nakano, ”An Experimental Study on Drivers’ Eye Movement Behavior When Using an Automated Lane Change System,” in *IEEE Transactions on Intelligent Transportation Systems*. DOI: 10.1109/TITS.2025.3534233
4. J.A. Abbasi, A. Parsi, N. Ringelsthttps://ieeexplore.ieee.org/document/10870574ein, P. Reilhac, E. Jones and M. Glavin, ”Enhancing Cyclist Safety Through Driver Gaze Analysis at Intersections With Cycle Lanes,” in *IEEE Transactions on Intelligent Transportation Systems*. DOI: 10.1109/TITS.2025.3530872
5. Y. Han, Y. Miao, J. Wang, H. Sha, Y. Xiao and Y. Liu, ”Utilizing Gaze-Contingent Rendering to Maintain Visual Attention in Educational VR,” in *IEEE Transactions on Visualization and Computer Graphics*. DOI: 10.1109/TVCG.2024.3520359

FACE RECOGNITION AND ANALYSIS

1. B. Huang, J. Ma, G. Wang and H. Wang, ”HDL: Hybrid and Dynamic Learning for Fake Face Recognition,” in *IEEE Transactions on Artificial Intelligence*. DOI: 10.1109/TAI.2025.3537963
2. A. Zarei, A. Hassanpour and K. Raja, ”On Privacy, Accuracy, and Fairness Trade-offs in Facial Recognition,” in *IEEE Access*. DOI: 10.1109/ACCESS.2025.3536784

3. R. Zhang et al., ”Facial 3D Regional Structural Motion Representation Using Lightweight Point Cloud Networks for Micro-Expression Recognition,” in *IEEE Transactions on Affective Computing*. DOI: 10.1109/TAFFC.2025.3535569
4. Y. Yu, C. Guo, L. Fan, J. Zhang, L. Yu and P. Li, ”Face Recognition Method for Underground Engineering Based on Dual-Target Domain Adaptation and Discriminative Feature Learning,” in *IEEE Access*. DOI: 10.1109/ACCESS.2025.3529698

GENERATIVE BIOMETRICS

1. C. Kang, ”Are Synthetic Datasets Reliable for Benchmarking Generalizable Person Re-Identification?” in *IEEE Transactions on Biometrics, Behavior, and Identity Science*, vol. 7, no. 1, pp. 146-155, January 2025. DOI: 10.1109/TBIOM.2024.3459828
2. M-H. Hsu, Y-C. Hsu and C-T. Chiu, ”Inpainting Diffusion Synthetic and Data Augment with Feature Keypoints for Tiny Partial Fingerprints,” in *IEEE Transactions on Biometrics, Behavior, and Identity Science*. DOI: 10.1109/TBIOM.2024.3517330
3. W. Yao, M.A. Farooq, J. Lemley and P. Corcoran, ”Synthetic Face Ageing: Evaluation, Analysis and Facilitation of Age-Robust Facial Recognition Algorithms,” in *IEEE Transactions on Biometrics, Behavior, and Identity Science*. DOI: 10.1109/TBIOM.2025.3536622
4. T. Eglynas, D. Lizdenis, A. Raudys, S. Jakovlev and M. Voznak, ”Exploring Generative Adversarial Networks: Comparative Analysis of Facial Image Synthesis and the Extension of Creative Capacities in Artificial Intelligence,” in *IEEE Access*, vol. 13, pp. 19588-19597, 2025. DOI: 10.1109/ACCESS.2025.3531726
5. H. Duan et al., ”Adversarial Samples Generated by Self-Forgery for Face Forgery Detection,” in *IEEE Transactions on Biometrics, Behavior, and Identity Science*. DOI: 10.1109/TBIOM.2025.3529026
6. M.V. Perera and V.M. Patel, ”Unbiased-Diff: Analyzing and Mitigating Biases in Diffusion Model-Based Face Image Generation,” in *IEEE Transactions on Biometrics, Behavior, and Identity Science*. DOI: 10.1109/TBIOM.2024.3525037

IRIS AND PERIOCULAR RECOGNITION AND ANALYSIS

1. X. Sun, C. Wang, Y. Wang, J. Wei and Z. Sun, ”IrisFormer: A Dedicated Transformer Framework for Iris Recognition,” in *IEEE Signal Processing Letters*, vol. 32, pp. 431-435, 2025. DOI: 10.1109/LSP.2024.3522856

MULTI-MODAL BIOMETRICS

1. S. Vatchala et al., ”Multi-modal biometric authentication: Leveraging shared layer architectures for enhanced security,” in *IEEE Access.* DOI: 10.1109/ACCESS.2025.3534223

2. G.K. Kyeremeh, M. Abdul-Al, R. Qahwaji, N.T. Ali and R.A. Abd-Alhameed, ”Fusion of Hand Biometrics for Border Control Involving Fingerprint and Finger Vein,” in *IEEE Access*. DOI: 10.1109/ACCESS.2025.3538591
3. X. Shi, W. Zhao, H. Pei, H. Zhai and Y. Gao, ”Research on Gait Recognition Based on GaitSet and Multimodal Fusion,” in *IEEE Access,* vol. 13, pp. 20017-20024, 2025. DOI: 10.1109/ACCESS.2025.3533571
4. S. Vatchala et al., ”Multi-modal biometric authentication: Leveraging shared layer architectures for enhanced security,” in *IEEE Access*. DOI: 10.1109/ACCESS.2025.3534223

PHYSIOLOGICAL SIGNAL-BASED BIOMETRICS

1. S. Dai et al., ”Contrastive Learning of EEG Representation of Brain Area for Emotion Recognition,” in *IEEE Transactions on Instrumentation and Measurement.* DOI: 10.1109/TIM.2025.3533618
2. H. Ye, X. Zhang, Y. Hu, H. Fu and J. Liu, ”VSR-Net: Vessel-like Structure Rehabilitation Network with Graph Clustering,” in *IEEE Transactions on Image Processing*. DOI: 10.1109/TIP.2025.3526061
3. K. Das and R.B. Pachori, ”Automated Mental Fatigue Detection from Electroencephalogram using Joint Time-Frequency Representation Based on Multivariate Iterative Filtering,” in *IEEE Transactions on Cognitive and Developmental Systems*. DOI: 10.1109/TCDS.2025.3538947
4. S-Y. Lee, M-Y. Ku, S-Y. Pan and C-C. Lin, ”Reconfigurable and Scalable Artificial Intelligence Acceleration Hardware Architecture with RISC-V CNN Coprocessor for Real-time Seizure Detection,” in *IEEE Access*. DOI: 10.1109/ACCESS.2025.3538781
5. H. Rong, W. Ji, T. Ma, W. Ding and V.S. Sheng, ”CogLign: Interpretable Text Sentiment Determination by Aligning Cognition between EEG-Derived Brain Graph and Text-Derived Knowledge Graph,” in *IEEE Transactions on Knowledge and Data Engineering.* DOI: 10.1109/TKDE.2025.3538618
6. H.R.A. Alameer, P. Salehpour, S.H. Aghdasi and M-R. Feizi-Derakhshi, ”Integrating Deep Metric Learning, Semi Supervised Learning, and Domain Adaptation for CrossDataset EEG-based Emotion Recognition,” in *IEEE Access*. DOI: 10.1109/ACCESS.2025.3536549
7. J. Chang, Z. Zhang, Y. Qian and P. Lin, ”Multi-Scale Hyperbolic Contrastive Learning for Cross-Subject EEG Emotion Recognition,” in *IEEE Transactions on Affective Computing.* DOI: 10.1109/TAFFC.2025.3535542
8. C. Ahuja and D. Sethia, ”TRANSIT-EEG — A Framework for Cross-Subject Classification with Subject Specific Adaptation,” in *IEEE Transactions on Cognitive and Developmental Systems.* DOI: 10.1109/TCDS.2025.3529669

SECURITY AND ANTI-SPOOFING IN BIOMETRICS

1. H. Kunt, Z. Yetgin, F. Gozukara and T. Celik, ”Letter and Person Recognition in Freeform Air-Writing using Machine Learning Algorithms,” in *IEEE Access*. DOI: 10.1109/ACCESS.2025.3536609
2. P. Zhang, Y. Liu, S. Lai, H. Li and L. Jin, ”Privacy-Preserving Biometric Verification with Handwritten Random Digit String,” in *IEEE Transactions on Pattern Analysis and Machine Intelligence.* DOI: 10.1109/TPAMI.2025.3529022
3. A. Keresh and P. Shamoi, ”Liveness Detection in Computer Vision: Transformer-Based Self-Supervised Learning for Face Anti-Spoofing,” in *IEEE Access*, vol. 12, pp. 185673185685, 2024. DOI: 10.1109/ACCESS.2024.3513795
4. J-w. Jung et al., ”SpoofCeleb: Speech Deepfake Detection and SASV In The Wild,” in *IEEE Open Journal of Signal Processing*. DOI: 10.1109/OJSP.2025.3529377

SPEECH BIOMETRICS AND ACOUSTIC ANALYSIS

1. Y. Liu, X. Yang, J. Zhang, Y. Xi and D. Qu, ”TAML-Adapter: Enhancing Adapter Tuning Through Task-Agnostic Meta-Learning for Low-Resource Automatic Speech Recognition,” in *IEEE Signal Processing Letters*, vol. 32, pp. 636-640, 2025. DOI: 10.1109/LSP.2024.3525399
2. M.M.U. Rathore, E. Bentafat and S. Bakiras, ”Towards a Scalable and Privacy-Preserving Audio Surveillance System,” in *IEEE Transactions on Audio, Speech and Language Processing*, vol. 33, pp. 186-198, 2025. DOI: 10.1109/TASLP.2024.3516521
3. S. Cho and K. Wee, ”Multi-Noise Representation Learning for Robust Speaker Recognition,” in *IEEE Signal Processing Letters*, vol. 32, pp. 681-685, 2025. DOI: 10.1109/LSP.2025.3530879

IEEE TRANSACTIONS ON BIOMETRICS, BEHAVIOR AND IDENTITY SCIENCE

January 2025

Posture and Body Movement Effects on Behavioral Biometrics for Continuous Smartphone Authentication

Nicholas Cariello;Robert Eslinger;Rosemary Gallagher;Isaac Kurtzer;Paolo Gasti;Kiran S. Balagani

Publication Year: 2025,Page(s):3 - 15

Toward Deep Face Spoofing: Taxonomy, Recent Advances, and Open Challenges

Dhimas Arief Dharmawan;Anto Satriyo Nugroho

Publication Year: 2025,Page(s):16 - 32

***DensePoseGait*: Dense Human Pose Part-Guided for Gait Recognition**

Rijun Liao;Zhu Li;Shuvra S. Bhattacharyya;George York

Publication Year: 2025,Page(s):33 - 46

GaitAGE: Gait Age and Gender Estimation Based on an Age- and Gender-Specific 3D Human Model

Xiang Li;Yasushi Makihara;Chi Xu;Yasushi Yagi

Publication Year: 2025,Page(s): 47- 60

WASD: A Wilder Active Speaker Detection Dataset

Tiago Roxo;Joana Cabral Costa;Pedro R. M. Inácio;Hugo Proença

Publication Year: 2025,Page(s):61- 70

Non-Motorized Lane Target Behavior Classification Based on Millimeter Wave Radar With P-Mrca Convolutional Neural Network

Jiaqing He;Yihan Zhu;Bing Hua;Zhihuo Xu;Yongwei Zhang;Liu Chu;Quan Shi;Robin Braun;Jiajia Shi

Publication Year: 2025,Page(s):71 - 81

TriGait: Hybrid Fusion Strategy for Multimodal Alignment and Integration in Gait Recognition

Yan Sun;Xueling Feng;Xiaolei Liu;Liyan Ma;Long Hu;Mark S. Nixon

Publication Year: 2025,Page(s):82 - 94

Diving Into Sample Selection for Facial Expression Recognition With Noisy Annotations

Wei Nie;Zhiyong Wang;Xinming Wang;Bowen Chen;Hanlin Zhang;Honghai Liu

Publication Year: 2025,Page(s):95 - 107

Facial Biometrics in the Social Media Era: An In-Depth Analysis of the Challenge Posed by Beautification Filters

Nelida Mirabet-Herranz;Chiara Galdi;Jean-Luc Dugelay

Publication Year: 2025,Page(s):108 - 117

A Data Perspective on Ethical Challenges in Voice Biometrics Research

Anna Leschanowsky;Casandra Rusti;Carolyn Quinlan;Michaela Pnacek;Lauriane Gorce;Wiebke Hutiri

Publication Year: 2025,Page(s):117 - 131

DeePhyNet: Toward Detecting Phylogeny in Deepfakes

Kartik Thakral;Harsh Agarwal;Kartik Narayan;Surbhi Mittal;Mayank Vatsa;Richa Singh

Publication Year: 2025,Page(s):132 - 145

Are Synthetic Datasets Reliable for Benchmarking Generalizable Person Re-Identification?

Cuicui Kang

Publication Year: 2025,Page(s):146 - 155

CALL FOR PAPERS

IEEE INTERNATIONAL JOINT CONFERENCE ON BIOMETRICS (IJCB 2025)

OSAKA, JAPAN
8-11 SEPTEMBER 2025

The IEEE International Joint Conference on Biometrics (IJCB) is the premier international forum for research in biometrics and related technologies. It combines two major biometrics conferences, the IEEE Biometrics Theory, Applications, and Systems (BTAS) conference and the International Conference on Biometrics (ICB), and is made possible through a special agreement between the IEEE Biometrics Council and the IAPR TC-4. IJCB 2025 is the 9th iteration of this joint event, and will be held in Osaka, Japan, between 8-11 September 2025 as an in-person conference.

IMPORTANT DATES

- Abstract and Paper Submission Deadline: **April 11, 2025** (11:59pm Pacific)
- Review comments to authors: **TBA**
- Rebuttal deadline: **TBA**
- Decisions to authors: **July 3, 2025**
- Camera-ready submission: **July 25, 2025**

Call for Contributions

IJCB 2025 invites papers that advance biometric technologies, sensor design, feature extraction and matching algorithms, security and privacy, and the social impact of biometrics technology. Topics of interest include:

- Face, Iris, Fingerprint, Palmprint
- Periocular, Ear, Vein, Speech
- Gait, Gesture and Action Recognition
- Multi-modal and Multi-spectral Biometrics
- Mobile-based Biometrics
- Template Protection and Cryptosystems
- Privacy, Demographic Bias, Fairness
- Biometrics Explainability and Interpretability
- Template Design, Selection and Update
- Datasets, Evaluation, Benchmarking
- Performance Modelling and Prediction
- Large-scale ID Management
- Anti-spoofing, Presentation Attack Detection
- Biometric DeepFakes, Digital Data Forensics
- Biometric-related Law Enforcement and Forensics
- Biometrics in Healthcare, Banking, IoT
- Biometric-related Synthetic Realities
- Ethical, Social and Legal Issues

Paper Submission

Submitted papers may be up to eight pages, plus additional references, in the conference format, and may not be accepted or under review elsewhere. For additional details on formatting, please go to https://ijcb2025.ieee-biometrics.org/paper-submission/. Accepted papers will be submitted for inclusion into IEEE Xplore, subject to meeting its scope and quality requirements. Submission is through CMT at https://cmt3.research.microsoft.com/IJCB2025.

Awards and TBIOM Special Issue

Several awards for best papers will be given out, including (1) the best paper award, (2) the best student paper award, (3) daily best poster awards. The awards will consist of a commemorative plaque and a stipend. Additionally, authors of the best-reviewed papers will be invited to submit an extended version to a special issue of the *IEEE Transactions on Biometrics, Behavior, and Identity Science* (IEEE-TBIOM). Contact PC: ijcb2025pcs@googlegroups.com.

IBCN EDITORIAL REVIEW BOARD

Many thanks to those who contributed articles to this issue:

Dr. Fernando Alonso-Fernandez, who curated the paper selected for this issue's ***Noted in the Literature*** section.

Dr. Carmen Bisogni and **Dr. David Freire-Obregón,** who compiled the items in the ***Biometric Alert*** column.

Zhilin Chen of Yulin University, China, who shared an attendee's perspective on the **2025 Winter School on Biometrics**.

Dr.Chiara Galdi who prepared both the ***Source Code*** and ***Commercial Off-the-Shelf Systems*** biometric products columns.

Melissa Handa, Program Director, Technical Activities for IEEE, who shared an introduction to the **IEEE DataPort™,** a global research data platform.

Dr. Andrew Teoh Beng Jin, who interviewed **Dr. Christoph Busch** of the Norwegian University of Science and Technology and Hochschule Darmstadt for the ***Biometric Pioneers*** section.

Dr. Emanuele Maiorana, who curated the items for the ***In the News…*** section.

Dr. Emanuela Marasco, who wrote a description of the **FIUBENCH** Dataset for our ***Database Digest*** section.

Dr. João C. Neves, who interviewed **Jakub Sochor** of Innovatrics for our ***Expert Perspectives*** section.

Dr. Ruben Tolosana, who interviewed Jeremy Speth, the IJCB 2024 Doctoral Dissertation Award winner for the ***Researcher on the Rise*** section.

Dr. Ruben Vera-Rodriguez, Associate Professor in the Biometrics and Data Pattern Analytics Lab of Universidad Autónoma de Madrid, Spain, who prepared the ***Database Digest*** report on BehavePass.

Dr. Shiqi Yu, Associate Professor of Computer Science and Engineering at Southern University of Science and Technology, Shenzhen, China, and Chair of the IAPR Technical Committee on Biometrics, who shared a report on the **9th IAPR/IEEE Winter School on Biometrics.**