TBIOM Special Issue on "Best Reviewed Papers From IJCB 2020—Editorial"

I. Best of IJCB 2020—Editorial

Recent years have seen considerable advances in biometric recognition techniques leading to a widespread deployment of biometric technology across a number of application domains, ranging from security, border control, and criminal investigations to entertainment, social media, autonomous driving and even health services. To highlight some of these advancements and present the latest research achievements related to biometrics, the 4th IEEE/IAPR International Joint Conference on Biometrics (IJCB) was organized in 2020. IJCB combines two major biometrics research conferences, the IEEE International Conference on 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. Because IJCB has (so far) only been organized every three years, it represents a particularly prestigious and selective event, where only the highest-quality research is presented.

This Special Issue was organized to give the authors of the best reviewed papers from IJCB 2020 the opportunity to extend their work and present it in a more comprehensive manner. From the 221 submissions received for IJCB 2020 across three submission rounds, 13 papers were invited for the special issue. Out of the 13 invited papers, 10 were eventually submitted by the suggested deadline and after a rigorous reviewing procedure 7 were finally accepted for publication. This meticulous selection procedure ensured that only the most excellent work that significantly extends on the research initially presented at IJCB 2020 is included in this special issue. The accepted papers cover a broad range of research topics from recognition techniques, inverse biometrics and novel tracking methodologies to presentation attack detection solutions and exploratory studies investigating the information content of biometric templates.

In [A1], Mostofa *et al.* address the problem of matching irises acquired in different spectral bands and under different resolutions. The authors propose two distinct solutions for this problem, both based on conditional generative adversarial networks (cGANs). The first utilizes an image-to-image translation approach to reduce the resolution and modality gaps and facilitate comparisons between iris images in a common (image) domain. The second solution projects iris images onto a common latent space that allows for cross-spectral and cross-resolution iris matching. Experiments are presented on the PolyU Bi-Spectral, WVU face and iris and Cross-eyedcross-spectral datasets demonstrating the feasibility of both proposed solutions.

In [A2], Kauba *et al.* investigate the possibility of generating grayscale images of finger and hand vein patterns from their corresponding binary templates. The authors design a *pix2pix*-based convolutional neural network to invert templates and show that their network is able to successfully reconstruct vascular images from a diverse set of input features. Several interesting findings are reported based on experiments with five finger vein and three hand vein datasets, all pointing to the considerable security threads originating from template inversion techniques.

In [A3], Xu *et al.* study the task of age estimation from (appearance-based) gait features. Specifically, the authors propose a convolutional neural network trained within a label-distribution learning framework that ensures highly accurate age estimation results during inference. Experimental results show that the proposed network not only ensures state-of-the-art age estimation performance on the OULP-Age dataset, but also that the predicted label distribution can be utilized to improve the performance of different applications, such as person search through age queries and age-specific people counting.

In [A4], Barquero *et al.* introduce a long-term (multi-face) tracking approach based on the tracking-by-detection paradigm. The proposed approach combines a fast shortterm tracker with a novel online tracklet reconnection strategy relying on rank-based face verification and is specifically designed to be robust against motion artifacts and occlusions. The presented tracking approach is rigorously evaluated and demonstrated to significantly outperform state-of-the-art deep learning trackers.

In [A5], Makowski *et al.* examine the usefulness of involuntary micro-movements of the eyes in addition to the saccadic macro-movements for biometric applications. The authors develop a convolutional neural network capable of verifying the viewers identity given a binocular eye-tracking signal. Additionally, a presentation attack detection (PAD) mechanism is designed based on the ocular response to randomized stimuli. Experimental results on multiple datasets show that the proposed PAD mechanism reliably detect replay attacks, while the verification performance significantly outperforms competing solutions.

In [A6], Terhörst *et al.* study what kind of information (beyond identity) is stored in biometric templates generated by modern (deep) face recognition models. Particularly, the authors explore the predictability of 73 different attributes, including demographic factors, image characteristics and social traits. Experimental results using three popular face recognition models and two publicly available datasets show

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that many of the considered attributes are still encoded in the facial templates and can be predicted to a certain extent despite the fact that the models were trained to be invariant to many of these attributes.

In [A7], Ebihara *et al.* propose a novel approach to presentation attack detection for face biometrics. The presented approach utilizes a monocular visible-light camera to capture images of the face with and without flash. A dedicated descriptor is then constructed based on these images and used to determine whether the input face corresponds to a presentation attack or not. The developed approach is evaluated in rigorous experiments on the NUAA, Replay-Attack, Spoofing in the Wild, and OULU-NPU datasets yielding highly competitive results.

We would like to thank all authors, reviewers, the TBIOM support staff, and everyone else involved in the production of this special issue for their support and valuable contribution. We are confident that the papers included in the special issues will make for an interesting read, provide researchers with new ideas and inspire novel research endeavors in the field of biometrics.

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APPENDIX: RELATED ARTICLES

[A1] M. Mostofa, S. Mohamadi, J. Dawson, and N. M. Nasrabadi, "Deep GAN-based cross-spectral cross-resolution iris recognition," 2021, *arXiv:2108.01569*.

[A2] C. Kauba, S. Kirchgasser, V. Mirjalili, A. Uhl, and A. Ross, "Inverse biometrics: Generating vascular images from binary templates," *IEEE Trans. Biom., Behav., Ident. Sci.*, early access, Apr. 19, 2021, doi: 10.1109/TBIOM.2021.3073666.

[A3] C. Xu *et al.*, "Uncertainty-aware gait-based age estimation and its applications," *IEEE Trans. Biom., Behav., Ident. Sci.*, early access, May 14, 2021, doi: 10.1109/TBIOM.2021.3080300.

[A4] G. Barquero, I. Hupont, and C. Fernández, "Rank-based verification for long-term face tracking in crowded scenes," 2021, *arXiv:2107.13273*.

[A5] S. Makowski, P. Prasse, D. R. Reich, D. Krakowczyk, L. A. Jäger, and T. Scheffer, "DeepEyedentificationLive: Oculomotoric biometric identification and presentation-attack detection using deep neural networks," *IEEE Trans. Biom., Behav., Ident. Sci.*, early access, Oct. 1, 2021, doi: 10.1109/TBIOM.2021.3116875.

[A6] P. Terhörst, D. Fährmann, N. Damer, F. Kirchbuchner, and A. Kuijper, "On soft-biometric information stored in biometric face embeddings," *IEEE Trans. Biom., Behav., Ident. Sci.*, early access, Jul. 1, 2021, doi: 10.1109/TBIOM.2021.3093920.

[A7] A. F. Ebihara, K. Sakurai, and H. Imaoka, "Efficient face spoofing detection with flash," *IEEE Trans. Biom., Behav., Ident. Sci.*, early access, Apr. 30, 2021, doi: 10.1109/TBIOM.2021.3076816.