

Special Issue on Face Presentation Attack Detection

FACE presentation attack detection, also termed Face Anti-Spoofing (FAS) [item 1), 2) in the Appendix), is a hot and challenging research topic that has received much attention from the computer vision and pattern recognition communities in the past. Owing to the development of deep learning and big data, recent advances in this and related fields has increased considerably. However, there are still several challenging tasks that deserve attention from the community, for instance robust techniques to unknown spoofing attacks, cross-domain generalization, and multi-modal fusion in images and video sequences. We edited this special issue with the goal of compiling the latest progress in the field and identifying promising research opportunities on FAS.

The guest editors invited paper submissions for the special issue on face anti-spoofing to be published in IEEE TRANSACTIONS ON BIOMETRICS, BEHAVIOR, AND IDENTITY SCIENCE (TBIOM). The call for submissions was open from December 18th, 2020 to May 20st, 2021. A dozen submissions were received, and every submission was subject to the standard TBIOM rigorous peer-review process. This led to the set of four papers appearing in this special issue. In the remainder of this note, we briefly summarize the contributions of the articles included in the issue.

The first article of this issue, “Revisiting Pixel-Wise Supervision for Face Anti-Spoofing” [item 3) in the Appendix), first provides a comprehensive review and analysis of existing pixel-wise supervision methods for FAS. Then, it proposes a novel pyramid supervision to learn local and global semantics from multi-scale spatial contexts. The proposed pyramid supervision is able to not only improve the FAS performances beyond the existing pixel-wise supervision frameworks but also enhances the model’s interpretability. Moreover, this paper also studies the efficacy of different architecture configurations with two kinds of pixel-wise supervision, such as binary mask and depth map supervisions.

The second article of this issue, “Attention-Based Spatial-Temporal Multi-Scale Network for Face Anti-Spoofing” [item 4) in the Appendix), proposes a two-stream spatial-temporal network to explore the potential depth information and multi-scale information, respectively. It first introduces a temporal shift module to extract temporal information and a scale-level attention module based on the estimated depth map to extract essential discriminative features. Finally, a fully-connected network is used to judge the face as fake or real. Extensive

experiments show the performance of proposed methods on five face anti-spoofing datasets.

The third article of this issue, “Inconsistency-Aware Wavelet Dual-Branch Network for Face Forgery Detection” [item 5) in the Appendix), presents an inconsistency-aware wavelet dual-branch network for face forgery detection. This model utilizes two kinds of forgery clues: inter-image and intra-image inconsistencies. The authors firstly enhance the forgery features by using additional inputs based on stationary wavelet decomposition (SWD) and then design a dual-branch network to predict image-level and pixel-level forgery labels, respectively. The segmentation branch aims to recognize real and fake local regions, which is crucial for discovering intra-image inconsistency. The classification branch learns to discriminate the real and fake images globally, thus it can extract inter-image inconsistency. Finally, bilinear pooling is employed to fuse the features from the two branches. Experiments show the proposed method surpasses the state-of-the-art face forgery detection methods.

The fourth article of this issue, “Fighting Fake News: Two Stream Network for Deepfake Detection via Learnable SRM” [item 6) in the Appendix), first analyzes the drawbacks of Deepfake detection (rarely considering temporal information, rapidly decrease of low-quality data). To address these problems, the authors propose a two-stream network to detect Deepfake at the video level with the capability of handling low-quality data. The proposed architecture firstly divides the input video into segments and then feeds selected frames of each segment into two streams. The first stream takes RGB information as input and tries to learn the semantic inconsistency. In parallel, the second stream leverages noise features extracted by spatial rich model (learnable SRM) filters. The proposed method is evaluated on the largest Deepfake dataset up to date, FaceForensics++, and the experimental results show that the proposed model obtains state-of-the-art performance.

We thank the authors for submitting their work to TBIOM, and we thank the reviewers for their comments and suggestions during the review process. We hope the readers will find useful the insights in these papers, all of them at the cutting edge of face anti-spoofing.

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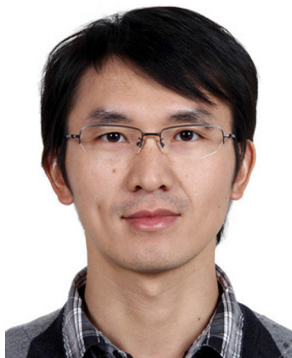
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APPENDIX RELATED WORK

- 1) Z. Yu, J. Wan, Y. Qin, X. Li, S. Z. Li, and G. Zhao, "NAS-FAS: Static-dynamic central difference network search for face anti-spoofing," *IEEE Trans. Pattern Anal. Mach. Intell.*, early access, Nov. 9, 2020, doi: [10.1109/TPAMI.2020.3036338](https://doi.org/10.1109/TPAMI.2020.3036338).
- 2) A. Liu *et al.*, "Cross-ethnicity face anti-spoofing recognition challenge: A review," *IET Biometr.*, vol. 10, no. 1, pp. 24–43, 2021.
- 3) Z. Yu, X. Li, J. Shi, Z. Xia, and G. Zhao, "Revisiting pixel-wise supervision for face anti-spoofing," *IEEE Trans. Biom., Behav., Ident. Sci.*, early access, Mar. 11, 2021, doi: [10.1109/TBIOM.2021.3065526](https://doi.org/10.1109/TBIOM.2021.3065526).
- 4) W. Zheng, M. Yue, S. Zhao, and S. Liu, "Attention-based spatial-temporal multi-scale network for face anti-spoofing," *IEEE Trans. Biom., Behav., Ident. Sci.*, early access, Mar. 22, 2021, doi: [10.1109/TBIOM.2021.3066983](https://doi.org/10.1109/TBIOM.2021.3066983).
- 5) G. Jia *et al.*, "Inconsistency-aware wavelet dual-branch network for face forgery detection," *IEEE Trans. Biom., Behav., Ident. Sci.*, early access, Jun. 7, 2021, doi: [10.1109/TBIOM.2021.3086109](https://doi.org/10.1109/TBIOM.2021.3086109).
- 6) B. Han, X. Han, H. Zhang, J. Li, and X. Cao, "Fighting fake news: Two stream network for deepfake detection via learnable SRM," *IEEE Trans. Biom., Behav., Ident. Sci.*, early access, Mar. 12, 2021, doi: [10.1109/TBIOM.2021.3065735](https://doi.org/10.1109/TBIOM.2021.3065735).



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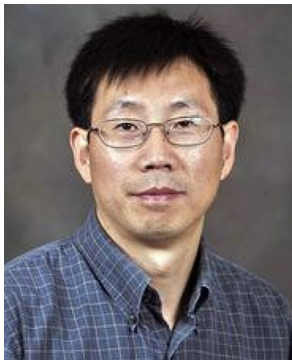


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