



Exploiting Micro-Signals for Physiological Forensics

Min Wu

University of Maryland, College Park, USA
minwu@umd.edu

ABSTRACT

A variety of nearly invisible “micro-signals” have played important roles in media security and forensics. These noise-like micro-signals are ubiquitous and typically an order of magnitude lower in strength or scale than the dominant ones. They are traditionally removed or ignored as nuances outside the forensic domain.

This talk discusses the recent research harnessing micro-signals to infer a person’s physiological conditions. One type of such signals is the subtle changes in facial skin color in accordance with the heartbeat. Video analysis of this repeating change provides a contact-free way to capture photo-plethysmogram (PPG). While heart rate can be tracked from videos of resting cases, it is challenging to do so for cases involving substantial motion, such as when a person is walking around, running on a treadmill, or driving on a bumpy road. It will be shown in this talk how the expertise with micro-signals from media forensics has enabled the exploration of new opportunities in physiological forensics and a broad range of applications.

CCS Concepts/ACM Classifiers

Security and privacy -- security services; Computing methodologies -- Machine learning -- Machine learning algorithms; Computing methodologies -- Computer graphics

Keywords

Physiological forensics; micro signals; photo-plethysmogram; remote PPG; vital signs.

BIOGRAPHY

Min Wu is a Professor of Electrical and Computer Engineering and a Distinguished Scholar-Teacher at the University of Maryland, College Park. She is currently serving as Associate Dean for Graduate Affairs for the University’s Clark School of Engineering. She received her Ph.D. degree in electrical engineering from Princeton University in 2001. At UMD, she leads the Media and Security Team (MAST), with main research interests on information security and forensics, multimedia signal processing, and application of data science and machine learning. Her research and education have been recognized by a U.S. NSF CAREER award, a TR100 Young Innovator Award from the MIT Technology Review, an U.S. ONR Young Investigator Award, a Computer World “40 Under 40” IT Innovator Award, an

IEEE Harriett B. Rigas Education Award, an IEEE Distinguished Lecturer recognition, and several paper awards from IEEE SPS, ACM, and EURASIP. She was elected as IEEE Fellow, AAAS Fellow, and Fellow of the National Academy of Inventors for contributions to multimedia security, forensics, and signal processing. Dr. Wu chaired the IEEE Technical Committee on Information Forensics and Security (2012-2013), and has served as Vice President - Finance of the IEEE Signal Processing Society (2010-2012), and Editor-in-Chief of the IEEE Signal Processing Magazine (2015-2017). [URL: www.ece.umd.edu/~minwu/bio.html]



REFERENCES

- [1] Q. Zhu, C.-W. Wong, C.-H. Fu, and M. Wu, “Fitness Heart Rate Measurement Using Face Videos,” *Proc. of IEEE Int. Conf. on Image Processing (ICIP 2017)*, Sept. 2017.
- [2] Q. Zhu, M. Chen, C.-W. Wong, and M. Wu, “Adaptive Multi-Trace Carving Based on Dynamic Programming,” *Asilomar Conference on Signals, Systems and Computers (Asilomar 2018)*, Pacific Grove, CA, Oct. 2018.
- [3] Q. Zhu, M. Chen, C.-W. Wong, and M. Wu: “Adaptive Multi-Trace Carving for Robust Frequency Tracking in Forensic Applications,” under review.
- [4] Q. Zhu, X. Tian, C.-W. Wong, and M. Wu: “ECG Reconstruction via PPG: A Pilot Study,” *IEEE International Conf. on Biomedical and Health Informatics (BHI’19)*, Chicago, IL, May 2019.
- [5] M. Chen, Q. Zhu, H. Zhang, M. Wu, and Q. Wang: “Respiratory Rate Estimation from Face Videos,” *IEEE International Conf. on Biomedical and Health Informatics (BHI’19)*, Chicago, IL, May 2019.
- [6] X. Tian, Q. Zhu, Y. Li, and M. Wu: “Cross-Domain Joint Dictionary Learning for ECG Reconstruction from PPG,” *Proc. of IEEE Int. Conf. on Acoustics, Speech, and Signal Processing (ICASSP)*, Barcelona, Spain, May 2020.
- [7] F. Zhang, C. Wu, B. Wang, M. Wu, D. Bugos, H. Zhang, K.J. Liu: “SMARS: Sleep Monitoring via Ambient Radio Signal,” *IEEE Trans. on Mobile Computing*, to appear 2020.

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the Owner/Author.

IH&MMSec '20, June 22–24, 2020, Denver, CO, USA

© 2020 Copyright is held by the owner/author(s).

ACM ISBN 978-1-4503-7050-9/20/06.

<https://doi.org/10.1145/3369412.3396882>