

# Qiang Zhu

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## EDUCATION

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**Ph.D. Electrical & Computer Engineering**, University of Maryland, College Park College Park, MD  
Advised by *Prof. Min Wu*, GPA: 3.8/4.0 December 2019 (Expected)  
Selected Courses: *Machine Learning, Adaptive Signal Processing*, Digital Image Processing, Linear Model, Real Analysis, Digital Communication.  
**M.S. Electrical Engineering**, Shanghai Jiaotong University Shanghai, China  
Advised by *Prof. Jianxun Li*, GPA: 3.7/4.0 March 2014  
**B.S. Electrical Engineering**, Zhejiang University Hangzhou, China  
*Top 10%*, GPA: 3.7/4.0 July 2010

## PROFESSIONAL EXPERIENCE

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**Entrepreneurial Lead**, NSF National I-Corps Program Detroit, MI  
Received \$50,000 on market analysis and commercialization potential (*remote cardiac sensing*). August–December, 2018  
**Video & Image Research Intern**, Dolby Laboratories Sunnyvale, CA  
Developed a patent pending HDR image enhancement algorithm (*integrated to DoVi encoder SDK in 2018*). May–August, 2017

## TEACHING EXPERIENCE AT UMD

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ENEE 630 (Advanced Digital Signal Processing); ENEE 631 (Digital Image and Video Processing).  
ENEE 322 (Signal and System Theory); ENEE 324 (Engineering Probability).  
ENEE 222 (Elements of Discrete Signal Analysis); ENEE 245 (Digital Circuits and Systems Laboratory).

## COMPUTING SKILLS

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**Languages:** Python, MATLAB, C/C++, SQL.  
**Tools:** L<sup>A</sup>T<sub>E</sub>X, Git, Scikit-learn, Tensorflow, Spark, Adobe Illustrator/Photoshop.

## RESEARCH PROJECTS AT MEDIA AND SECURITY TEAM (MAST), UMD

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**Remote Vital Signs Monitoring Using Regular RGB Camera** From July 2016  
— Proposed a dense optical-flow based motion estimation scheme for fine-grained human face registration and enabled highly-accurate remote extraction of human vital signs (e.g., heart rate, heart rate variability, and breathing rate) in realtime using regular RGB camera in exercise or driving scenarios.  
— Designed and built a Python prototype with ResNet-based face detector/tracker and adaptive cardiovascular signal processing units and achieved the state-of-the-art performance of less than 1 bpm in estimation error.  
— Proposed an unsupervised online learning scheme for efficient subject-specific and scene-tailored skin detection and improved the overall accuracy of heart rate estimation by 20%.  
— Proposed a novel adaptive filtering algorithm and achieved more than 40% improvement in estimation accuracy of the heart rate variability.

**Electrocardiogram (ECG) Reconstruction From Photoplethysmogram (PPG)** From June 2018  
— Carried out a detailed statistical modeling of the two related cardiovascular measurement (ECG and PPG) with deep bio-insights and high model interpretability.  
— Devised a novel semi-couple dictionary learning algorithm for inversely reconstruct the ECG signals from the more easily obtainable PPG signals and improved the diagnostic capability of the PPG signals by more than 50%.  
— Verified the efficacy of the proposed model using both public-available and self-collected databases with 147 subjects with a variety of age, weight, and disease types.

**Robust Frequency Tracking Weak Signal Traces Under Severe Noise and Distortions** May 2017–September 2018  
— Proposed an iterative dynamic programming algorithm and enabled the tracking of multiple frequency components in a highly corrupted signal of less than  $-10$  dB at a error rate of less than 4%.  
— Extensive experiment results on real-world digital forensic data demonstrate more than double of the estimation accuracy with no additional computational cost compared with the state-of-the-art methods.  
— Implemented and evaluated the state-of-the-art approaches such as Factorial HMM, particle filter, and spectral clustering based algorithms.

**Electrical Network Frequency (ENF) Estimation From Multimedia Data** May–December 2016  
— Assisted in building and testing an ENF estimation prototype for extracting the subtle ENF signals from the multimedia contents.

## PUBLICATION

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- J1 A. Hajj-Ahmad, C.-W. Wong, . Gambino, **Q. Zhu**, M. Yu, and M. Wu, “Factors Affecting ENF Capture in Audio”, IEEE Trans. on Info. Forensics and Security (TIFS), Vol. 14, No. 2, pp. 277-288, Feb. 2019.
- J2 S. Han, **Q. Zhu**, J. Li, and Y. Zhou, “Generalized Rough Set-based Information Filling Technique for Failure Analysis of Thruster Experimental Data”, Chinese Journal of Aeronautics, Vol. 26, No. 5, pp. 1182-1194, Oct. 2017.
- J3 J. Wu, Z. Mou, **Q. Zhu**, J. Li, and Y. Zhou, “Decoupled Target Tracking with Bearing-only Measurements”, Optical Engineering, Vol. 51, No. 12, pp. 126401, Dec. 2012.
- J4 **Q. Zhu**, X. Tian, C.-W. Wong and M. Wu, “Learning Your Heart Actions: ECG Waveform Reconstruction From PPG”, submitted to IEEE Journal of Biomedical and Health Informatics (JBHI).
- J5 **Q. Zhu**, M. Chen, C.-W. Wong and M. Wu, “Adaptive Multi-Trace Carving for Robust Frequency Tracking in Forensic Applications”, under preparation for journal submission.
- J6 **Q. Zhu**, C.-W. Wong and M. Wu, “Robust Fitness Pulse Rate and Pulse Rate Variability Measurement From Face Videos”, under preparation for journal submission.
- J7 M. Chen, **Q. Zhu**, M. Wu and Q. Wang, “Amplitude and Frequency Modulation for Vital Signs Extraction From Photoplethysmography Signal”, under preparation for journal submission
- C1 **Q. Zhu**, X. Tian, C.-W. Wong, and M. Wu, “ECG Reconstruction via PPG: A Pilot Study”, IEEE International Conf. on Bio. and Health Informatics, 2019. [43/394=**10% acceptance rate** for oral presentation of regular paper]
- C2 M. Chen, **Q. Zhu**, H. Zhang, M. Wu, and Q. Wang, “Respiratory Rate Estimation From Face Videos”, IEEE International Conf. on Bio. and Health Informatics, 2019. [123/394=**31% acceptance rate** for regular paper]
- C3 **Q. Zhu**, M. Chen, C.-W. Wong, and M. Wu, “Adaptive Multi-Trace Carving Based on Dynamic Programming”, Asilomar Conf. on Signals, Systems, and Computers, 2018.
- C4 **Q. Zhu**, C.-W. Wong, C.-H. Fu and M. Wu, “Fitness Heart Rate Measurement Using Face Videos”, IEEE International Conf. on Image Proc. (ICIP), 2017.
- C5 Y. Wang, S. Zhao, J. Li, J. Kuang, and **Q. Zhu**, “Recurrent Neural Network for Spectral Mapping in Speech Bandwidth Extension”, IEEE Global Conf. on Sig. and Info. Proc. (GlobalSIP), 2016.
- C6 **Q. Zhu** and J. Li, “Joint Estimation of State and Parameter for Tracking System Using EM-UKF”, IASTED International Sympo. on Power and Energy, 2013.
- C7 Z. Zhang, J. Li, S. Han, and **Q. Zhu**, “Multi-Target Tracking Using the Sign of Innovations in Wireless Sensor Networks”, 2012 Chinese Control and Decision Conf. (CCDC), 2012.
- C8 X. Tian, **Q. Zhu**, Y. Li, and M. Wu, “Cross-domain Joint Dictionary Learning for ECG Reconstruction From PPG”, submitted for conference publication.

## PATENT

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- P1 **Q. Zhu**, X. Tian, C.-W. Wong, and M. Wu, “Reconstruction of ECG from PPG Signals for Continuous Monitoring and Analytics”, provisional patent filing Mar. 2019.
- P2 **Q. Zhu**, M. Chen, C.-W. Wong, and M. Wu, “Methods for Tracking Weak Signal Traces Under Severe Noise and Distortions”, provisional patent filing Sept. 2018, formal filing Sept. 2019.
- P3 N. Gadgil, G. Su, **Q. Zhu**, and Q. Song, “Reducing Banding Artifacts in HDR Imaging via Adaptive SDR-to-HDR Reshaping Functions”, provisional patent filing Aug. 2018.
- P4 M. Wu, C.-W. Wong, **Q. Zhu**, C.-H. Fu, and J. Su, “Heart Rate Measurement for Fitness Exercises Using Facial Video”, provisional patent filing Sept. 2017, formal filing Sept. 2018.

## HONORS AND AWARDS

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<b>Jacob K. Goldhaber Travel Award</b> , University of Maryland, College Park	2018-2019
<b>Teaching Assistant Training Development Fellow Mentor</b> , University of Maryland, College Park	2017-2018
<b>ECE Distinguished Teaching Assistant</b> , University of Maryland, College Park	2015
<b>2nd Prize of Excellent Student Scholarship</b> , Shanghai Jiaotong University, Shanghai, China	2011-2014
<b>1st Prize and 2nd Prize of Excellent Student Scholarship</b> , Zhejiang University, Hangzhou, China	2007-2008