# CURRICULUM VITAE

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## CONTACT INFORMATION

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# **RESEARCH INTERESTS**

My research interests include human-centered intelligent perception and natural human-machine interaction, especially computer vision-based human vital sign monitoring, electromagnetic inverse scattering, and multi-source human-machine interaction.

## **EDUCATION**

- 2005.9–2010.7, Ph.D. Computational Mathematics, Department of Mathematics, Zhejiang University, China.
- 2001.9–2005.7, B.S. Computational Mathematics, College of Mathematics, Jilin University, China.

## ACADEMIC & WORK EXPERIENCE

- 2017.5-present, Associate Professor, Department of Biomedical Engineering, Hefei University of Technology, Hefei, China.
- 2013.1–2017.4, Principal Scientist, Sensor Physics, Halliburton Far East Pte Ltd, Singapore.
- 2010.7–2012.12, Research Fellow, Department of Electrical and Computer Engineering, National University of Singapore, Singapore.

## PUBLICATIONS

### *Journal Articles (\*Corresponding author):*

A: Vision-based human vital sign monitoring (sort by date):

- 1. **Song, R.**, H. Wang, H. Xia, J. Cheng, C. Li, and X. Chen, Uncertainty quantification for deep learningbased remote photoplethysmography. IEEE Transactions on Instrumentation and Measurement, 2023, accepted.
- 2. Song, R., C. Ren, J. Cheng, C. Li, and X. Yang, Non-contact human respiratory rate measurement based on two-level fusions of video and fmcw radar information. Measurement, 2023: p. 113604.
- 3. Han, X., X. Yang, S. Fang, **R. Song**, L. Li, and J. Zhang, Non-contact blood pressure estimation using BP-related cardiovascular knowledge: an uncalibrated method based on consumer-level camera. IEEE Transactions on Instrumentation and Measurement, 2023.

- Cheng, J., B. Yue, R. Song\*, Y. Liu, C. Li, and X. Chen, Motion-robust anteriorposterior imaging ballistocardiography for non-contact heart rate measurements. Biomedical Signal Processing and Control, 2023. 86: p. 105307.
- Cheng, J., R. Liu, J. Li, R. Song\*, Y. Liu, and X. Chen, Motion-Robust Respiratory Rate Estimation from Camera Videos via Fusing Pixel Movement and Pixel Intensity Information. IEEE Transactions on Instrumentation and Measurement, 2023.
- Song, R., X. Sun, J. Cheng, X. Yang, and X. Chen, Video-Based Heart Rate Measurement Against Uneven Illuminations Using Multivariate Singular Spectrum Analysis. IEEE Signal Processing Letters, 2022. 29: p. 2223-2227.
- 7. Liu, X., X. Yang, **R. Song**, J. Zhang, and L. Li, VideoCAD: an uncertainty-driven neural network for coronary artery disease screening from facial videos. IEEE Transactions on Instrumentation and Measurement, 2022. 72: p. 1-12.
- Liu, X., X. Yang, R. Song, D. Wang, and L. Li, PFDNet: A Pulse Feature Disentanglement Network for Atrial Fibrillation Screening From Facial Videos. IEEE Journal of Biomedical and Health Informatics, 2022(10.1109/JBHI.2022.3220656): p. 1 - 12.
- 9. Xie, Y., **R. Song**<sup>\*</sup>, D. Yang, H. Yu, C. Sun, Q. Xie, and R.X. Xu, Motion robust ICG measurements using a two-step spectrum denoising method. Physiological measurement, 2021. 42(9): p. 095004.
- Song, R., G. Wang, J. Cheng, A. Liu, C. Li, and X. Chen, Constrained independent vector extraction of quasi-periodic signals from multiple data sets. Signal Processing, 2021. 189: p. 108296.
- Song, R., J. Li, M. Wang, J. Cheng, C. Li, and X. Chen, Remote photoplethysmography with an EEMD-MCCA method robust against spatially uneven illuminations. IEEE Sensors Journal, 2021. 21(12): p. 13484-13494.
- Song, R., H. Chen, J. Cheng, C. Li, Y. Liu, and X. Chen, PulseGAN: Learning to generate realistic pulse waveforms in remote photoplethysmography. IEEE Journal of Biomedical and Health Informatics, 2021. 25(5): p. 1373-1384.
- Cheng, J., Y. Xu, R. Song\*, Y. Liu, C. Li, and X. Chen, Prediction of arterial blood pressure waveforms from photoplethysmogram signals via fully convolutional neural networks. Computers in Biology and Medicine, 2021. 138: p. 104877.
- Song, R., S. Zhang, C. Li, Y. Zhang, J. Cheng, and X. Chen, Heart rate estimation from facial videos using a spatiotemporal representation with convolutional neural networks. IEEE Transactions on Instrumentation and Measurement, 2020. 69(10): p. 7411-7421.
- Song, R., S. Zhang, J. Cheng, C. Li, and X. Chen, New insights on super-high resolution for videobased heart rate estimation with a semi-blind source separation method. Computers in biology and medicine, 2020. 116: p. 103535.
- 16. Song, R., J. Li, J. Cheng, C. Li, Y. Liu, and X. Chen, Motion robust imaging ballistocardiography through a two-step canonical correlation analysis. IEEE Transactions on Instrumentation and Measurement, 2020. 70: p. 1-10.
- Cheng, J., X. Wang, R. Song\*, Y. Liu, C. Li, and X. Chen, Exploring the feasibility of seamless remote heart rate measurement using multiple synchronized cameras. Multimedia Tools and Applications, 2020.
- Cheng, J., P. Wang, R. Song\*, Y. Liu, C. Li, Y. Liu, and X. Chen, Remote heart rate measurement from near-infrared videos based on joint blind source separation with delay-coordinate transformation. IEEE Transactions on Instrumentation and Measurement, 2020. 70: p. 1-13.

 Chen, X., J. Cheng, R. Song, Y. Liu, R. Ward, and Z.J. Wang, Video-based heart rate measurement: Recent advances and future prospects. IEEE Transactions on Instrumentation and Measurement, 2018. 68(10): p. 3600-3615.

#### **B**: EM modeling and inverse scattering (sort by date):

- Xu, K., Z. Qian, R. Song\*, X. Ye, N. Xu, X.-M. Pan, P. Zhao, S. Chen, G. Wang, and W. Li, Physically Unrolling Network under Contraction Integral Equation for Limited-Aperture Inverse Scattering Problem. IEEE Transactions on Antennas and Propagation, 2023.
- Wang, Y., Z. Zong, S. He, R. Song, and Z. Wei, Push the Generalization Limitation of Learning Approaches by Multi-Domain Weight-Sharing for Full-Wave Inverse Scattering. IEEE Transactions on Geoscience and Remote Sensing, 2023.
- Wang, J., N. Du, T. Yin, R. Song, K. Xu, S. Sun, and X. Ye, A Machine Learning-Assisted Inversion Method for Solving Biomedical Imaging Based on Semi-Experimental Data. Electronics, 2023. 12(12): p. 2623.
- Ye, X., N. Du, D. Yang, X. Yuan, R. Song, S. Sun, and D. Fang, Application of generative adversarial network-based inversion algorithm in imaging 2-D lossy biaxial anisotropic scatterer. IEEE Transactions on Antennas and Propagation, 2022. 70(9): p. 8262-8275.
- 5. **R. Song**, M. Li, K. Xu, C. Li, and X. Chen, Electromagnetic Inverse Scattering With an Untrained SOM-Net. IEEE Transactions on Microwave Theory and Techniques, 2022. 70(11): p. 4980-4990.
- R. Song, Y. Huang, X. Ye, K. Xu, C. Li, and X. Chen, Learning-based inversion method for solving electromagnetic inverse scattering with mixed boundary conditions. IEEE Transactions on Antennas and Propagation, 2022. 70(8): p. 6218-6228.
- Liu, Y., H. Zhao, R. Song\*, X. Chen, C. Li, and X. Chen, SOM-net: Unrolling the subspace-based optimization for solving full-wave inverse scattering problems. IEEE Transactions on Geoscience and Remote Sensing, 2022. 60: p. 1-15.
- 8. Li, C., J. Li, C. Sui, **R. Song**, and X. Chen, Spatial-spectral nonlinear hyperspectral unmixing under complex noise. IEEE Sensors Journal, 2022. 22(5): p. 4338-4346.
- 9. Xu, K., C. Zhang, X. Ye, and **R. Song**<sup>\*</sup>, Fast full-wave electromagnetic inverse scattering based on scalable cascaded convolutional neural networks. IEEE Transactions on Geoscience and Remote Sensing, 2021. 60: p. 1-11.
- R. Song, Q. Zhou, Y. Liu, C. Li, and X. Chen, A Convolutional Sparsity Regularization for Solving Inverse Scattering Problems. IEEE Antennas and Wireless Propagation Letters, 2021. 20(12): p. 2285-2289.
- R. Song, Y. Huang, K. Xu, X. Ye, C. Li, and X. Chen, Electromagnetic inverse scattering with perceptual generative adversarial networks. IEEE Transactions on Computational Imaging, 2021. 7: p. 689-699.
- Li, C., C. Sui, R. Song, J. Cheng, Y. Liu, and X. Chen, Superpixel-Based Noise-Robust Sparse Unmixing of Hyperspectral Image. IEEE Geoscience and Remote Sensing Letters, 2021. 19: p. 1-5.
- 13. Zhang, L., K. Xu, **R. Song**, X. Ye, G. Wang, and X. Chen, Learning-based quantitative microwave imaging with a hybrid input scheme. IEEE Sensors Journal, 2020. 20(24): p. 15007-15013.

- Ye, X., Y. Bai, R. Song, K. Xu, and J. An, An inhomogeneous background imaging method based on generative adversarial network. IEEE Transactions on Microwave Theory and Techniques, 2020. 68(11): p. 4684-4693.
- Ma, Z., K. Xu, R. Song\*, C.-F. Wang, and X. Chen, Learning-based fast electromagnetic scattering solver through generative adversarial network. IEEE Transactions on Antennas and Propagation, 2020. 69(4): p. 2194-2208.
- 16. Li, C., Y. Liu, J. Cheng, **R. Song**, J. Ma, C. Sui, and X. Chen, Sparse unmixing of hyperspectral data with bandwise model. Information sciences, 2020. 512: p. 1424-1441.
- 17. Huang, Y., **R. Song**<sup>\*</sup>, K. Xu, X. Ye, C. Li, and X. Chen, Deep learning-based inverse scattering with structural similarity loss functions. IEEE Sensors Journal, 2020. 21(4): p. 4900-4907.
- 18. Li, C., Y. Liu, J. Cheng, **R. Song**, H. Peng, Q. Chen, and X. Chen, Hyperspectral unmixing with bandwise generalized bilinear model. Remote Sensing, 2018. 10(10): p. 1600.
- 19. **R. Song**, X. Ye, and X. Chen, Reconstruction of scatterers with four different boundary conditions by T-matrix method. Inverse Problems in Science and Engineering, 2015. 23(4): p. 601-616.
- Ye, X., R. Song, and X. Chen, Application of T-matrix method in solving mixed boundary separable obstacle problem. Optics Express, 2014. 22(13): p. 1627316281.
- Xu, K., Y. Zhong, R. Song, X. Chen, and L. Ran, Multiplicative-Regularized FFT Twofold Subspace-Based Optimization Method for Inverse Scattering Problems. IEEE Transactions on Geoscience and Remote Sensing, 2014(99): p. 1-10.
- Ye, X., X. Chen, Y. Zhong, and R. Song, Simultaneous reconstruction of dielectric and perfectly conducting scatterers via T-matrix method. IEEE Transactions on Antennas and Propagation, 2013(99): p. 1-1.
- Agarwal, K., R. Song, M. D'Urso, and X. Chen, Improving the Performances of the Contrast Source Extended Born Inversion Method by Subspace Techniques. IEEE Geoscience and Remote Sensing Letters, 2013(99): p. 1-5.
- 24. Ye, X., **R. Song**, K. Agarwal, and X. Chen, Electromagnetic imaging of separable obstacle problem. Optics express, 2012. 20(3): p. 2206-2219.
- 25. **R. Song**, Y. Zhong, and X. Chen, A multi-dimensional sampling method for locating small scatterers. Inverse problems, 2012. 28(11): p. 115004.
- R. Song, X. Chen, and Y. Zhong, Imaging small three-dimensional elastic inclusions by an enhanced multiple signal classification method. The Journal of the Acoustical Society of America, 2012. 132(4): p. 2420-2426.
- R. Song and X. Chen, Analysis of cutoff wavelength of elliptical waveguide by regularized meshless method. International Journal of Numerical Modelling: Electronic Networks, Devices and Fields, 2012. 25(5-6): p. 417-427.
- R. Song, R. Chen, and X. Chen, Imaging three-dimensional anisotropic scatterers in multilayered medium by multiple signal classification method with enhanced resolution. Journal of the Optical Society of America A, 2012. 29(9): p. 1900-1905.
- Zhu, J., X. Zhang, and R. Song, A unified mode solver for optical waveguides based on mapped barycentric rational chebyshev differentiation matrix. Journal of lightwave technology, 2010. 28(12): p. 1802-1810.

- R. Song, J. Zhu, and X. Zhang, Full-vectorial modal analysis for circular optical waveguides based on the multidomain Chebyshev pseudospectral method. Journal of the Optical Society of America B: Optical Physics, 2010. 27(9): p. 1722-1730.
- Chen, W. and R. Song, Analytical diagonal elements of regularized meshless method for regular domains of 2D Dirichlet Laplace problems. Engineering analysis with boundary elements, 2010. 34(1): p. 2-8.
- 32. Zhu, J. and **R. Song**, Fast and stable computation of optical propagation in micro-waveguides with loss. Microelectronics Reliability, 2009. 49(12): p. 1529-1536.
- 33. R. Song and W. Chen, An investigation on the regularized meshless method for irregular domain problems. Computer Modeling in Engineering and Sciences (CMES), 2009. 42(1): p. 59.
- *C*: Human-machine interaction (sort by date):
  - Zhao, Y., S. Feng, C. Li, R. Song, D. Liang, and X. Chen, Source-Free Domain Adaptation for Privacy-Preserving Seizure Prediction. IEEE Transactions on Industrial Informatics, 2023.
  - 2. Wei, Y., Y. Liu, C. Li, J. Cheng, **R. Song**, and X. Chen, TC-Net: A Transformer Capsule Network for EEG-based emotion recognition. Computers in Biology and Medicine, 2023. 152: p. 106463.
  - Mao, T., C. Li, Y. Zhao, R. Song, and X. Chen, Online Test-Time Adaptation for Patient-Independent Seizure Prediction. IEEE Sensors Journal, 2023.
  - Li, C., C. Shao, R. Song, G. Xu, X. Liu, R. Qian, and X. Chen, Spatio-temporal MLP network for seizure prediction using EEG signals. Measurement, 2023. 206: p. 112278.
  - Deng, Z., C. Li, R. Song, X. Liu, R. Qian, and X. Chen, EEG-based seizure prediction via hybrid vision transformer and data uncertainty learning. Engineering Applications of Artificial Intelligence, 2023. 123: p. 106401.
  - Zhao, Y., C. Li, X. Liu, R. Qian, R. Song, and X. Chen, Patient-specific seizure prediction via adder network and supervised contrastive learning. IEEE Transactions on Neural Systems and Rehabilitation Engineering, 2022. 30: p. 1536-1547.
  - Liu, Y., Y. Wei, C. Li, J. Cheng, R. Song, and X. Chen, Bi-CapsNet: A Binary Capsule Network for EEG-Based Emotion Recognition. IEEE Journal of Biomedical and Health Informatics, 2022. 27(3): p. 1319-1330.
  - Li, C., Y. Zhao, R. Song, X. Liu, R. Qian, and X. Chen, Patient-specific seizure prediction from electroencephalogram signal via multi-channel feedback capsule network. IEEE Transactions on Cognitive and Developmental Systems, 2022.
  - Li, C., B. Wang, S. Zhang, Y. Liu, R. Song, J. Cheng, and X. Chen, Emotion recognition from EEG based on multi-task learning with capsule network and attention mechanism. Computers in Biology and Medicine, 2022. 143: p. 105303.
  - Li, C., X. Lin, Y. Liu, R. Song, J. Cheng, and X. Chen, EEG-based emotion recognition via efficient convolutional neural network and contrastive learning. IEEE Sensors Journal, 2022. 22(20): p. 19608-19619.
  - Li, C., X. Huang, R. Song, R. Qian, X. Liu, and X. Chen, EEG-based seizure prediction via Transformer guided CNN. Measurement, 2022. 203: p. 111948.

- 12. Li, C., Y. Hou, **R. Song**, J. Cheng, Y. Liu, and X. Chen, Multi-channel EEG-based emotion recognition in the presence of noisy labels. Science China Information Sciences, 2022. 65(4): p. 140405.
- Li, C., Z. Deng, R. Song, X. Liu, R. Qian, and X. Chen, EEG-based seizure prediction via model uncertainty learning. IEEE Transactions on Neural Systems and Rehabilitation Engineering, 2022. 31: p. 180-191.
- 14. Li, C., Z. Zhang, **R. Song**, J. Cheng, Y. Liu, and X. Chen, EEG-based emotion recognition via neural architecture search. IEEE Transactions on Affective Computing, 2021.
- 15. Tao, W., C. Li, **R. Song**, J. Cheng, Y. Liu, F. Wan, and X. Chen, EEG-based emotion recognition via channel-wise attention and self attention. IEEE Transactions on Affective Computing, 2020.
- Liu, Y., Y. Ding, C. Li, J. Cheng, R. Song, F. Wan, and X. Chen, Multi-channel EEG-based emotion recognition via a multi-level features guided capsule network. Computers in Biology and Medicine, 2020. 123: p. 103927.
- Cheng, J., M. Chen, C. Li, Y. Liu, R. Song, A. Liu, and X. Chen, Emotion recognition from multichannel EEG via deep forest. IEEE Journal of Biomedical and Health Informatics, 2020. 25(2): p. 453-464.

*Patents (sort by date):* 

- 1. Wu, H.-H., **R. Song**, and L. Pan, Distance-to-bed-boundary inversion solution pixelation. 2023, US Patent 11,574,459.
- 2. Wu, H.-H., G.A. Wilson, and **R. Song**, Inversion processing of well log data. 2022, US Patent 11,467,318.
- 3. **R. Song**, L. Pan, and H.-H. Wu, System and methods for evaluating a formation using pixelated solutions of formation data. 2022, US Patent 11,525,353.
- R. Song, L. Pan, and H.-H. Wu, Multi-layer distance to bed boundary (DTBB) inversion with multiple initial guesses. 2022, US Patent 11,299,978.
- 5. Wilson, G.A., B. Donderici, and **R. Song**, Quality factors for appraising resistivity LWD inversion performance. 2021, US Patent 11,098,578.
- 6. Ma, J., **R. Song**, and G.A. Wilson, Optimized geosteering using real-time geological models. 2021, US Patent 11,118,441.
- 7. **R. Song**, G.A. Wilson, and B. Donderici, Methods of selecting an earth model from a plurality of earth models. 2020, US Patent 10,788,602.
- 8. Pan, L., C.-F. Wang, **R. Song**, and J. Ma, Bi-mode high frequency dielectric tool. 2020, US Patent 10,725,196.
- 9. Pan, L., C.-F. Wang, W.H. Huang, and **R. Song**, Modifying magnetic tilt angle using a magnetically anisotropic material. 2020, US Patent 10,620,334.
- Pan, L., Y. Fan, and R. Song, Skin effect correction for focused electrode devices based on analytical model. 2020, US Patent 10,690,801.
- 11. Ewe, W.-B., **R. Song**, and G.A. Wilson, Dielectric logging tool comprising high-impedance metamaterials. 2020, US Patent 10,656,302.

- Pan, L., C.-F. Wang, R. Song, and J. Ma, Electromagnetic sensor for a downhole dielectric tool. 2019, US Patent 10,436,931.
- 13. Pan, L., L.E. San Martin, and **R. Song**, Downhole logging tool using resonant cavity antennas with real-time impedance matching. 2019, US Patent 10,483,939.
- Donderici, B., R. Song, G.A. Wilson, and P.F. Rodney, Frequency ratiometric processing of resistivity logging tool data. 2019, US Patent 10,317,563.
- 15. Kuo, C.-h. and **R. Song**, Acousto-electromagnetic measurement through use of Doppler spectrum for casing corrosion evaluation. 2018, US Patent 10,054,713.

#### Conference:

- H. Wang, R. Song\*. "Uncertainty quantification for deep learning-based remote photoplethysmography", 2023 China Biomedical Engineering Conference & Medical Innovation Summit, Suzhou, 2023, Oral Presentation
- C. Ren, R. Song\*. "Non-contact human respiration rate measurement based on video and FMCW radar information fusion", 2023 China Biomedical Engineering Conference & Medical Innovation Summit, Suzhou, 2023, Oral Presentation
- 3. Y. Wang, X. Yang, X. Liu, **R. Song**, and J. Zhang. "Remote assessment of physiological parameters by non-contact methods to detect mental stress". SPIE Eighth International Conference on Electronic Technology and Information Science (ICETIS 2023), Dalian, 2023.
- Z. Qian, X. Zhang, K. Xu, and R. Song, "Physically Inspired Learning-based Microwave Imaging under Limited Aperture". 2023 Progress in Electromagnetic Research Symposium (PIERS 2023), Prague, 2023
- X. Liu, Z. Sun, X. Li, R. Song, and X. Yang, "VidBP: Detecting Blood Pressure from Facial Videos with Personalized Calibration". 45th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, EMBC 2023, Sydney, 2023
- 6. M Li, **R Song**<sup>\*</sup>, "Physics-inspired SOM-Net for Solving Full-wave Inverse Scattering Problems," 2022 International Applied Computational Electromagnetics Society(ACES-China), Xuzhou, 2022, oral presentation
- H Zhao, Y Liu, R Song\*, "Physical-Based Deep Unrolling Network for Solving Full-Wave Inverse Scattering Problems," 2021-2022 IEEE MTT-S International Microwave Biomedical Conference (IM-BioC), Suzhou, 2022, oral presentation
- 8. M Li, **R Song**<sup>\*</sup>, "Electromagnetic Inverse Scattering With an Untrained Neural Network," 2022 IEEE MTT-S International Microwave Biomedical Conference (IMBioC), Suzhou, 2022, oral presentation
- 9. Y Huang, **R Song**\*, "Learning-based Electromagnetic Inverse Scattering with Mixed Boundaries," 2021-2022 Progress in Electromagnetic Research Symposium (PIERS 2021-2022), Hangzhou, 2022, oral presentation
- textbfR. Song\*, X. Sun, J. Cheng, X. Chen, "Remote Photoplethysmography Methods Robust Against Spatially Uneven Illuminations", 2021-2022 China Biomedical Engineering Conference & Medical Innovation Summit, Shenzhen, 2022, Oral Presentation
- Y Huang, R Song\*, "Structural similarity loss functions for deep learning based inverse scattering methods," 2020 IEEE MTT-S International Conference on Numerical Electromagnetic and Multiphysics Modeling and Optimization (NEMO 2020), Hangzhou, 2020, oral presentation

- 12. **R Song**, Y Huang, "Electromagnetic inverse scattering with perceptual adversarial networks," 2020 IEEE MTT-S International Conference on Numerical Electromagnetic and Multiphysics Modeling and Optimization (NEMO 2020)Hangzhou, 2020, oral presentation
- 13. S Zhang, R Song\*, J Cheng, Y Zhang, X Chen, "A feasibility study of a video-based heart rate estimation method with convolutional neural networks," 2019 IEEE International Conference on Computational Intelligence and Virtual Environments for Measurement Systems and Applications (CIVEMSA), Tianjin, 2019, oral presentation

## **RECENT GRANTS**

- Research on personalized monitoring and reference-free evaluations of long-term video-based pulsatile information, National Natural Science Foundation of China, 2023.1-2026.12, PI.
- Intelligent interrogation assistance system based on non-contact physiological abnormality monitoring, Anhui Key Project of Research and Development Plan, 2021.1-2023.12, Pl.
- Research on fast imaging method of inhomogeneous-background electromagnetic inverse scattering based on physics-driven learning, Anhui Provincial Natural Science Foundation, 2021.1-2023.12, PI.

## PROFESSIONAL SERVICE

- International Conference on Numerical Electromagnetic Modeling and Optimization for RF, Microwave, and Terahertz Applications (NEMO), NEMO2020, TPC member & Session Chair.
- Progress in Electromagnetic Research Symposium, PIERS2024, Session Chair
- Guest Editorial Special Issue on Sensors: Sensor Based Pattern Recognition and Signal Processing
- Reviewers for more than thirty journals including IEEE TIM, IEEE TAP, and IEEE SPL etc.

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