Hongyi Pan, Ph.D.

Postdoctoral Research Fellow
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Research Interests

Signal processing, machine learning, computer vision, and image processing.

Education

University of Illinois Chicago — Chicago, Illinois, USA
Ph.D. in Electrical and Computer Engineering — August 2019 – May 2023
Advisor: Ahmet Enis Cetin (IEEE Fellow)

University of Illinois Chicago — Chicago, Illinois, USA
Master in Electrical and Computer Engineering — August 2017 – May 2019

Chang'an University — Xi'an, Shaanxi, China
Bachelor in Automation — September 2014–July 2018

Work Experience

Northwestern University, Feinberg School of Medicine — Chicago, Illinois, USA
Postdoctoral Research Fellow — June 2023 – Present
Advisor: Ulas Bagci

InnoPeak Technology (OPPO US Research Center) — Bellevue, Washington, USA
Engineering Intern. Mentor: Xihua Dong — May 2022 – August 2022
Topic: Attention-based variable rate super-sampling (VRSS) for graphics rendering.

University of Illinois Chicago, College of Engineering — Chicago, Illinois, USA
Teaching Assistant and Research Assistant — August 2019 – May 2023
Advisor: Ahmet Enis Cetin

Editorial Services

Associate Editor, Signal, Image and Video Processing (SIVP), Springer — June 2023 – Present

Selected Honors and Awards

UIC Graduate Student Award for Exceptional Research Promise — May 2022
First Provincial Prize of "Renesas Cup" China Electronic Design Competition — July 2017
Second National Prize of "Shanghe Cup" China Robot Competition — October 2016
First Provincial Prize of "TI Cup" China Electronic Design Competition — July 2016
Second Provincial Prize of China Mathematics Competition — October 2015
First Provincial Prize of China Shaanxi Advanced Mathematics Contest — September 2015

Teaching Experience

Teaching assistant at University of Illinois Chicago

ECE 266: Introduction to Embedded Systems — Fall 2019
ECE 317: Digital Signal Processing I — Spring 2020, Summer 2021
ECE 407: Pattern Recognition I — Spring 2022

ECE 415: Image Analysis and Computer Vision I — Fall 2020, Fall 2021, Fall 2022
ECE 491: Digital Speech Processing — Fall 2020, Fall 2021, Fall 2022
ECE 491: Introduction to Neural Networks — Spring 2021, Spring 2022, Spring 2023

Selected Research Experience

Frequency Analysis Based Neural Network Layers — March 2021 – April 2023

We proposed a family of orthogonal-transform-based novel neural network layers to replace the convolutional layers in the convolutional neural networks. The idea is from the convolution theorem, which states that convolution in the time/spatial domain is equivalent to multiplication in the frequency domain (transform domain). Compared to the conventional convolution neural layer, our layers contain much fewer parameters and computational costs, but the image classification accuracy on the benchmark datasets such as the CIFAR-10 and the ImageNet-1k of our revised networks is comparable to or better than the conventional convolution neural networks (ResNet, etc.). Related peer-reviewed papers include [J4, C3, C5, C6, C8, C9].

L_1-Norm Kernel PCA — March 2021 – December 2021

We proposed a family of ℓ_1-norm kernel principal component analysis (PCA) methods. Compared to the conventional PCA method, our methods are computationally efficient because they are multiplication-free and more robust because they employ Mercer-type kernels that induce the ℓ_1-norm. We further proposed ℓ_1-norm kernel power iterations methods using the same kernel. Related peer-reviewed papers include [J5, C2, C4].

Neural Network Based Wildfire Detection — May 2018 – January 2021

We designed a real-time wildfire detection model using MobileNet-V3. We deployed the model on an NVIDIA Jetson Nano as a real-world application. We have tested our system on the HPWREN wildfire surveillance database and obtained satisfactory results. Related peer-reviewed papers include [J1, J3, C1].

Journal Publications

[J5] **Pan, H.**, Badawi, D., Bassi, I., Ozev, S., & Cetin, A. E. (2022). Detecting anomaly in chemical sensors via L1-kernel-based principal component analysis. *IEEE Sensors Letters*, 6(10), 1-4.

[J4] **Pan, H.**, Badawi, D., & Cetin, A. E. (2022). Block walsh–hadamard transform-based binary layers in deep neural networks. *ACM Transactions on Embedded Computing Systems*, 21(6), 1-25.

[J3] **Pan, H.**, Badawi, D., & Cetin, A. E. (2020). Computationally efficient wildfire detection method using a deep convolutional network pruned via fourier analysis. *Sensors*, 20(10), 2891.

[J2] Badawi, D., **Pan, H.**, Cetin, S. C., & Çetin, A. E. (2020). Computationally efficient spatio-temporal dynamic texture recognition for volatile organic compound (voc) leakage detection in industrial plants. *IEEE Journal of Selected Topics in Signal Processing*, 14(4), 676-687.

[J1] **Pan, H.**, Badawi, D., Zhang, X., & Cetin, A. E. (2020). Additive neural network for forest fire detection. *Signal, Image and Video Processing*, 14, 675-682.

Conference Publications

[C9] **Pan, H.**, Zhu, X., Atici, S. F., & Cetin, A. (2023, July). A Hybrid Quantum-Classical Approach based on the Hadamard Transform for the Convolutional Layer. In *International Conference on Machine Learning* (pp. 26891-26903). PMLR.

[C8] **Pan, H.**, Zhu, X., Ye, Z., Chen, P. Y., & Cetin, A. E. (2023, June). Real-time wireless ecg-derived respiration rate estimation using an autoencoder with a dct layer. In *ICASSP 2023-2023 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)* (pp. 1-5). IEEE.

[C7] Atici, S., **Pan, H.**, Elnagar, M. H., Allareddy, V., Suhaym, O., Ansari, R., & Cetin, A. E. (2023, June). Classification of the Cervical Vertebrae Maturation (CVM) Stages Using the Tripod Network. In *ICASSP 2023-2023 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)* (pp. 1-5). IEEE.

[C6] Cetin, A. E., & **Pan, H.** (2023, April). Hybrid Binary Neural Networks: A Tutorial Review. In *2023 IEEE 41st VLSI Test Symposium (VTS)* (pp. 1-12). IEEE.

[C5] **Pan, H.**, Badawi, D., Chen, C., Watts, A., Koyuncu, E., & Cetin, A. E. (2022). Deep neural network with

walsh-hadamard transform layer for ember detection during a wildfire. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition* (pp. 257-266).
[C4] **Pan, H.**, Badawi, D., Miao, R., Koyuncu, E., & Cetin, A. E. (2022, May). Multiplication-avoiding variant of power iteration with applications. In *ICASSP 2022-2022 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP) (pp. 5608-5612)*. IEEE.
[C3] **Pan, H.**, Badawi, D., & Cetin, A. E. (2021). Fast walsh-hadamard transform and smooth-thresholding based binary layers in deep neural networks. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition* (pp. 4650-4659).
[C2] **Pan, H.**, Badawi, D., Koyuncu, E., & Cetin, A. E. (2021, August). Robust Principal Component Analysis Using a Novel Kernel Related with the L_1-Norm. In *2021 29th European Signal Processing Conference (EUSIPCO)* (pp. 2189-2193). IEEE.
[C1] **Pan, H.**, Badawi, D., & Cetin, A. E. (2021, January). Fourier domain pruning of mobilenet-v2 with application to video based wildfire detection. In *2020 25th International Conference on Pattern Recognition (ICPR)* (pp. 1015-1022). IEEE.

ArXiv Publications

[A6] Hong, Z., Hamdan, E., Zhao, Y., Ye, T., **Pan, H.**, & Cetin, A. E. (2023). Wildfire Detection Via Transfer Learning: A Survey. *arXiv preprint arXiv:2306.12276*.
[A5] Wang, B., **Pan, H.**, Aboah, A., Zhang, Z., Cetin, A., Torigian, D., ... & Bagci, U. (2023). GazeGNN: A Gaze-Guided Graph Neural Network for Disease Classification. *arXiv preprint arXiv:2305.18221*.
[A4] **Pan, H.**, Zhu, X., Atici, S., & Cetin, A. E. (2023). Orthogonal transform domain approaches for the convolutional layer. *arXiv preprint arXiv:2303.06797*.
[A3] **Pan, H.**, Zhu, X., Atici, S., & Cetin, A. E. (2022). DCT Perceptron Layer: A Transform Domain Approach for Convolution Layer. *arXiv preprint arXiv:2211.08577*.
[A2] **Pan, H.**, Atici, S., & Cetin, A. E. (2022). Multipod convolutional network. *arXiv preprint arXiv:2210.00689*.
[A1] Atici, S., **Pan, H.**, & Cetin, A. E. (2022). Normalized Stochastic Gradient Descent Training of Deep Neural Networks. *arXiv preprint arXiv:2212.09921*.

Reviewer Services

Journals: Signal, Image and Video Processing (SIVP); Fire Technology; IEEE Sensors Journal; IEEE Transactions on Neural Networks and Learning Systems (TNNLS); IEEE Transactions on Medical Imaging (TMI); ACM Transactions on Embedded Computing Systems (TECS); Plos Ones; Medical Image Analysis;
Conferences: IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), ICML workshop on Machine Learning for Multimodal Healthcare Data.

Skills

Programming Languages: Python3, MATLAB, C, C++, LaTex.
Scientific Tools/Software: PyTorch, TensorFlow, MATLAB, Octave, Altium Designer, Multisim, Proteus, SolidWorks, Onshape, Photoshop, LTSpice, Microsoft Office, ...
Operating Systems: Windows, Linux (Ubuntu, Raspbian), Mac OS.
Microcontrollers: Raspberry Pi, Nvidia Jetson Nano, Arduino, STM32, MSP430, 80C51.
Musical Instruments: Piano.

Language

Mandarin Chinese (native), English (fluent).