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 – August 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 — Chicago, Illinois, USA
Postdoctoral Research Fellow — June 2023 – Present
Advisor: Ulas Bagci
Topic: Federated learning, domain generalization, eye-tracking-based medical image analysis.

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

University of Illinois Chicago — Chicago, Illinois, USA
Teaching Assistant and Research Assistant — August 2019 – May 2023
Advisor: Ahmet Enis Cetin
Topic: Wildfire detection, $\ell 1$-norm kernel PCA, orthogonal-transform-based neural network layer.

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

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 Projects

Federated Domain Generalization for Medical Image Analysis — June 2023 – Present

The goal of this effort is to develop a Federated domain generalization for medical image analysis tasks. We improved the main-steam Fourier-transform-based domain generalization using a soft-thresholding function. The innovative nature of the soft thresholding fused with Fourier-transform-based domain generalization improves neural network models' performance by reducing the target images' background interference. Preliminary work is presented in [A8].

Eye-Tracking-Based Medical Image Analysis. — February 2023 – Present

The goal of this effort is to develop an AI system to integrate computer-aided detection and diagnosis systems with radiologists' perceptive knowledge and patterns via eye-tracking. In [C10], we use eye gaze as a novel interactive prompt by leveraging the real-time interactive prompting feature of META's Segment Anything Model (SAM) for image segmentation. We present the GazeSAM system to enable users to collect target segmentation masks by simply looking at the region of interest. In [C11], we proposed a novel gaze-guided graph neural network (GazeGNN) for chest X-ray image classification.

Orthogonal Transform 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]. Specially, in [C9], we present the relationship between the Hadamard-transform-based layer with the quantum computation.

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 iteration 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

[J9] Xin Zhu, Daoguang Yang, **Hongyi Pan**, Hamid Reza Karimi, Didem Ozevin, and Ahmet Enis Cetin. "A novel asymmetrical autoencoder with a sparsifying discrete cosine Stockwell transform layer for gearbox sensor data compression." ***Engineering Applications of Artificial Intelligence*** 127 (2024): 107322.

[J8] Tong Wah Lim, **Hongyi Pan**, Mi Pan, Michael Francis Burrow, and Colman McGrath. "Agreement in quantification of removable prosthesis plaque area coverage using a semi-automated planimetric assessment method." ***Journal of Dentistry*** (2023): 104721.

[J7] Minye Yang, Zhilu Ye, **Hongyi Pan**, Mohamed Farhat, Ahmet Enis Cetin, and Pai-Yen Chen. "Electromagnetically unclonable functions generated by non-Hermitian absorber-emitter." ***Science Advances*** 9, no. 36 (2023): eadg7481.

[J6] Ziliang Hong, Emadeldeen Hamdan, Yifei Zhao, Tianxiao Ye, **Hongyi Pan**, and Ahmet Enis Cetin. "Wildfire detection via transfer learning: a survey." ***Signal, Image and Video Processing*** (2023): 1-8.

[J5] **Hongyi Pan**, Diaa Badawi, Ishaan Bassi, Sule Ozev, and Ahmet Enis Cetin. "Detecting anomaly in chemical sensors via L1-kernel-based principal component analysis." ***IEEE Sensors Letters*** 6, no. 10 (2022): 1-4.
[J4] **Hongyi Pan**, Diaa Badawi, and Ahmet Enis Cetin. "Block walsh–hadamard transform-based binary layers in deep neural networks." ***ACM Transactions on Embedded Computing Systems*** 21, no. 6 (2022): 1-25.
[J3] **Hongyi Pan**, Diaa Badawi, and Ahmet Enis Cetin. "Computationally efficient wildfire detection method using a deep convolutional network pruned via fourier analysis." ***Sensors*** 20, no. 10 (2020): 2891.
[J2] Diaa Badawi, **Hongyi Pan**, Sinan Cem Cetin, and A. Enis Çetin. "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, no. 4 (2020): 676-687.
[J1] **Hongyi Pan**, Diaa Badawi, Xi Zhang, and Ahmet Enis Cetin. "Additive neural network for forest fire detection." ***Signal, Image and Video Processing*** 14 (2020): 675-682.

Conference Publications

[C11] Bin Wang, **Hongyi Pan**, Armstrong Aboah, Zheyuan Zhang, Elif Keles, Drew Torigian, Baris Turkbey, Elizabeth Krupinski, Jayaram Udupa, and Ulas Bagci. "GazeGNN: A Gaze-Guided Graph Neural Network for Disease Classification." ***IEEE CVF Winter Conference on Applications of Computer Vision*** 2024.
[C10] Bin Wang, Armstrong Aboah, Zheyuan Zhang, **Hongyi Pan**, and Ulas Bagci. "GazeSAM: Interactive Image Segmentation with Eye Gaze and Segment Anything Model." *In* ***NeurIPS 2023 Workshop*** *on Gaze Meets ML*. 2023.
[C9] **Hongyi Pan**, Xin Zhu, Salih Furkan Atici, and Ahmet Cetin. "A hybrid quantum-classical approach based on the Hadamard transform for the convolutional layer." In ***International Conference on Machine Learning***, pp. 26891-26903. PMLR, 2023.
[C8] **Hongyi Pan**, Xin Zhu, Zhilu Ye, Pai-Yen Chen, and Ahmet Enis Cetin. "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***, pp. 1-5. IEEE, 2023.
[C7] Salih Atici, **Hongyi Pan**, Mohammed H. Elnagar, Veerasathpurush Allareddy, Omar Suhaym, Rashid Ansari, and Ahmet Enis Cetin. "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***, pp. 1-5. IEEE, 2023.
[C6] Ahmet Enis Cetin and **Hongyi Pan**. "Hybrid Binary Neural Networks: A Tutorial Review." In ***2023 IEEE 41st VLSI Test Symposium***, pp. 1-12. IEEE, 2023.
[C5] **Hongyi Pan**, Diaa Badawi, Chang Chen, Adam Watts, Erdem Koyuncu, and Ahmet Enis Cetin. "Deep Neural Network with Walsh-Hadamard Transform Layer For Ember Detection during a Wildfire." In ***2022 IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops***, pp. 256-265. IEEE, 2022.
[C4] **Hongyi Pan**, Diaa Badawi, Runxuan Miao, Erdem Koyuncu, and Ahmet Enis Cetin. "Multiplication-avoiding variant of power iteration with applications." In ***ICASSP 2022-2022 IEEE International Conference on Acoustics, Speech and Signal Processing***, pp. 5608-5612. IEEE, 2022.
[C3] **Hongyi Pan**, Diaa Badawi, and Ahmet Enis Cetin. "Fast Walsh-Hadamard Transform and Smooth-Thresholding Based Binary Layers in Deep Neural Networks." In ***2021 IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops***, pp. 4645-4654. IEEE, 2021.
[C2] **Hongyi Pan**, Diaa Badawi, Erdem Koyuncu, and A. Enis Cetin. "Robust Principal Component Analysis Using a Novel Kernel Related with the L_1-Norm." In ***2021 29th European Signal Processing Conference***, pp. 2189-2193. IEEE, 2021.
[C1] **Hongyi Pan**, Diaa Badawi, and Ahmet Enis Cetin. "Fourier domain pruning of mobilenet-v2 with application to video based wildfire detection." In ***2020 25th International Conference on Pattern Recognition***, pp. 1015-1022. IEEE, 2021.

ArXiv Publications

[A8] **Hongyi Pan**, Bin Wang, Zheyuan Zhang, Xin Zhu, Debesh Jha, Ahmet Enis Cetin, Concetto Spampinato, and Ulas Bagci. "Domain Generalization with Fourier Transform and Soft Thresholding." *arXiv preprint arXiv:2309.09866* (2023).

[A7] Xin Zhu, **Hongyi Pan**, Shuaiang Rong, and Ahmet Enis Cetin. "Electroencephalogram Sensor Data Compression Using An Asymmetrical Sparse Autoencoder With A Discrete Cosine Transform Layer." *arXiv preprint arXiv:2309.12201* (2023).
[A6] Xin Zhu, **Hongyi Pan**, Salih Atici, and Ahmet Enis Cetin. "Stein Variational Gradient Descent-based Detection For Random Access With Preambles In MTC." *arXiv preprint arXiv:2309.08782* (2023).
[A5] Nastaran Darabi, Maeesha Binte Hashem, **Hongyi Pan**, Ahmet Cetin, Wilfred Gomes, and Amit Ranjan Trivedi. "ADC/DAC-Free Analog Acceleration of Deep Neural Networks with Frequency Transformation." *arXiv preprint arXiv:2309.01771* (2023).
[A4] **Hongyi Pan**, Xin Zhu, Salih Atici, and Ahmet Enis Cetin. "Orthogonal transform domain approaches for the convolutional layer." *arXiv preprint arXiv:2303.06797* (2023).
[A3] **Hongyi Pan**, Xin Zhu, Salih Atici, and Ahmet Enis Cetin. "DCT Perceptron Layer: A Transform Domain Approach for Convolution Layer." *arXiv preprint arXiv:2211.08577* (2022).
[A2] **Hongyi Pan**, Salih Atici, and Ahmet Enis Cetin. "Multipod convolutional network." *arXiv preprint arXiv:2210.00689* (2022).
[A1] Salih Atici, **Hongyi Pan**, and Ahmet Enis Cetin. "Normalized Stochastic Gradient Descent Training of Deep Neural Networks." *arXiv preprint arXiv:2212.09921* (2022).

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); IEEE Journal of Biomedical and Health Informatics (JBHI); ACM Transactions on Embedded Computing Systems (TECS); Plos Ones; Medical Image Analysis.

Conferences: IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP); International Conference on Machine Learning (ICML).

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).