

Kai-Chieh (Kevin) Hsu

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Research Interests

Signal Processing sparse signal processing, array signal processing and compressed sensing

Machine Learning healthcare applications, privacy and security issues

VLSI Design low-power architecture design and ASIC implementation

Education

Princeton University

Princeton, NJ

Ph.D. in Electrical Engineering

Sept. 2019 - PRESENT

- Advisor: Prof. Niraj Jha

National Taiwan University (NTU)

Taipei, Taiwan

B.S. in Electrical Engineering

Sept. 2014 - Jan. 2019

- Achieved 4.19/4.30 overall GPA and 4.19/4.30 major GPA.
- Ranked in top 5% by cumulative GPA
- Research Advisor: Prof. An-Yeu (Andy) Wu and Prof. Jean-Fu Kiang

Research Projects

ECG Real-Time Telemonitoring with Compressed Analysis

NTU, Taiwan

Access IC Lab (Prof. An-Yeu (Andy) Wu, IEEE Fellow)

Aug. 2017 - Mar. 2019

- **Edge Classification:** Incorporated compressed sensing (CS), task-driven dictionary learning (predictive sparse coding) and PCA to render light-weighted classifier and overcome limited labeled data challenge
- **On-Demand Recovery:** Design a two-stage algorithm to classify and then reconstruct only problematic signals, utilizing the information from classification stage to speed up the reconstruction algorithm
- **Hardware Design and Chip Implementation:** Propose a hardware architecture for on-demand recovery to allow hardware sharing between classification and reconstruction algorithms

Direction-of-Arrival (DOA) Estimation

NTU, Taiwan

Group of Electromagnetic Applications (Prof. Jean-Fu Kiang)


Feb. 2017 - Mar. 2019

- **Antenna Uncertainty:** Utilized special matrix structure with Khatri-Rao subspace-based MULTiple Signal Classification (MUSIC) to improve immunity to uncertainties and detect DOAs with sensors half the number of sources
- **More Sources Than Sensors:** Proposed a new antenna array structure to increase the detectable number of sources based on fourth-order statistics and compressive sensing approach
- **Mixed Carrier Frequency (CF) Known and Unknown Sources:** Proposed a two-step algorithm to first estimate DOA of known sources and then joint estimate the DOA and CF of unknown sources
- **Near Sea Surface Environment:** Consider the influence of multipath propagation (coherent signal) and sea clutter (backscattered signal from the sea surface)

Publications

Accepted


- [6] **K.-C. Hsu** and J.-F. Kiang, "Joint Estimation of DOA and Frequency From A Mixture of Frequency Known and Unknown Sources with Orthogonal Coprime Arrays," *Sensors*, 19(2), 335, Jan. 2019. | [📄](#)
- [5] **K.-C. Hsu**, B.-H. Cho, C.-Y. Chou and A.-Y. (Andy) Wu, "Low-Complexity Compressed Analysis in Eigenspace with Limited Labeled Data for Real-Time Electrocardiography Telemonitoring," *IEEE Global Conference on Signal and Information Processing (GlobalSIP)*, Anaheim, USA, Nov. 2018. | [📄](#)
- [4] **K.-C. Hsu** and J.-F. Kiang, "Joint Estimation of DOA and Carrier Frequency Based on Coprime Arrays," *Progress In Electromagnetics Research Symposium (PIER S)*, Toyama, Japan, Aug. 2018.
- [3] **K.-C. Hsu** and J.-F. Kiang, "DOA Estimation With Triply Primed Arrays Based on Fourth-Order Statistics," *IEEE AP-S Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting*, Boston, USA, July 2018. | [📄](#)
- [2] **K.-C. Hsu** and J.-F. Kiang, "DOA Estimation Using Triply Primed Arrays Based on Fourth-Order Statistics," *Progress In Electromagnetics Research M*, Vol. 67, pp. 55-64, Mar. 2018. | [📄](#)

[1] **K.-C. Hsu** and J.-F. Kiang, "DOA Estimation of Quasi-Stationary Signals Using a Partly-Calibrated Uniform Linear Array with Fewer Sensors Than Sources," *Progress In Electromagnetics Research M*, Vol. 63, pp. 185-193, Jan. 2018. | 

Under Review

- C.-Y. Chou, **K.-C. Hsu**, B.-H. Cho, K.-C. Chen and A.-Y. (Andy) Wu, "Low-Complexity On-demand Reconstruction for Compressively Sensed Problematic Signals," submitted to *IEEE Trans. Signal Process.*, Apr. 2019.

Honors & Awards

- 3rd Prize** in Integrated Circuit Design Contest Ministry of Education, Taiwan
- Out of about 300 teams July 2018
- 2nd Prize** in Taiwan Creative Electromagnetic Implementation Competition High-speed RF and mm-Wave Tech. Center, Taiwan
- Under the supervision of Prof. Tzong-Lin Wu, IEEE Fellow |  Aug. 2017
- 8th place** in Data Structure and Programming Contest Cadence, Taiwan
- Out of about 250 students Mar. 2017
- Digital IC Design Certificate** National Chip Implementation Center, Taiwan
- Familiar with Verilog, logic synthesis, simulation and STA Nov. 2018
- Graduate Representative** in NTU EE graduate ceremony Dept. of EE, NTU, Taiwan
- Given to top ten students of four years June 2018
- Professor Chun-Hsiung Chen Scholarship** Electromagnetic Industry-Academia Consortium, Taiwan
- Rewarded outstanding performances in electromagnetic fields Jan. 2018
- Presidential Awards** $\times 2$ Dept. of EE, NTU, Taiwan
- Given to top ten students of that semester second semester of 2014 and 2016




Research & Teaching Experiences

- Research Assistant** NTU, Taiwan
Access IC Lab (Prof. An-Yeu (Andy) Wu, IEEE Fellow) Feb. 2018 - Mar. 2019
- Undergraduate Researcher** NTU, Taiwan
Group of Electromagnetic Applications (Prof. Jean-Fu Kiang) Feb. 2017 - Mar. 2019
- Teaching Assistant** NTU, Taiwan
Digital System Design Feb. 2018 - June 2018

Professional Activities

Reviewer IEEE Transactions on Vehicular Technology, IETE Technical Review

Selected Course Projects

- Survey of Dictionary Learning** |  Mathematical Principles of Machine Learning
team project June 2018
- Contribution: served as **project speaker** and surveyed predictive dictionary learning and sparse coding optimization
 - Studied generalization bound of reconstructive and predictive dictionary learning
 - Studied optimization algorithm of dictionary learning, including MOD, ODL, K-SVD and TDD
 - Studied sparse coding optimization algorithm, including sub-gradient descent, ISTA and FISTA
- An Analysis of Deep Neural Networks in Hardware Perspective** |  Advanced Integrated Circuit Design
Python, team project Jan. 2018
- Contribution: served as **leader** to distribute work and surveyed the structure of residual net, Inception v4 and Xception
 - Reviewed many state-of-the-art very deep CNNs, including AlexNet, VGG net, Inception, ResNet and Xception
 - Analyzed with estimation accuracy and resource consumption and provided insight of hardware-friendly designs
- Pipelined MIPS CPU** |  Computer Architecture
Verilog, team project June 2017
- Contribution: served as **leader** to distribute work, design whole structure and implement basic function of CPU
 - Implemented a pipelined MIPS CPU with support of multiplication and division and overcame data and branch hazard