

# Kai-Chieh (Kevin) Hsu

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## Research Interests

<b>Signal Processing</b>	sparse signal processing, array signal processing and compressed sensing
<b>Machine Learning</b>	healthcare applications, privacy and security issues
<b>VLSI Design</b>	low-power architecture design and ASIC implementation

## Education

### Princeton University

Ph.D. in Electrical Engineering

Princeton, NJ

Sept. 2019 - PRESENT

### National Taiwan University (NTU)

B.S. in Electrical Engineering

Taipei, Taiwan

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 Experiences

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

## [1] DOA Estimation of Quasi-Stationary Signals Using a Partly-Calibrated Uniform Linear Array with Fewer Sensors Than Sources |

Jan. 2018

K.-C. Hsu and J.-F. Kiang

*Progress In Electromagnetics Research M*, Vol. 63, pp. 185-193

### 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

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**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
- Implemented an electromagnetic structure longer than 2.5 m with only stationery and achieved -7.8 dB insertion loss at 3 GHz | 

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, STA and cell library

Nov. 2018

**Graduate Representative** in NTUEE 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** ×2

Dept. of EE, NTU, Taiwan

- Given to top ten students of that semester

second semester of 2014 and 2016

## Selected Course Projects

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**Survey of Dictionary Learning** | 

Mathematical Principles of Machine Learning

team project

June 2018

- Contribution: served as the **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 the **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

**Different Handover Policies in Different Environments** | 

Intro. to Wireless and Mobile Networking

Matlab, team project

June 2017

- Contribution: served as the **project speaker**, conducted simulations and analyzed results
- Proposed four different handover policies and compared performances among different environments
- Provide two different channel models and different mobility pattern of mobile stations

**Pipelined MIPS CPU** | 

Computer Architecture

Verilog, team project

June 2017

- Contribution: served as the **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 hazard and branch hazard
- Implemented a synthesizable pipelined MIPS CPU overcoming data hazard, load-use hazard and branch hazard
- Advanced with branch prediction, L2 cache and support of multiply and divide instructions

## Working Experiences

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**Research Assistant**

NTU, Taiwan

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

Feb. 2018 - Dec. 2018

**Teaching Assistant**

NTU, Taiwan

Digital System Design

Feb. 2018 - June 2018