

# Kai-Chieh (Kevin) Hsu

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## Research Interests

<b>Signal Processing</b>	biomedical signal processing, array signal processing and compressed sensing
<b>Machine Learning</b>	low-complexity algorithms and sparsity-based algorithms
<b>VLSI design</b>	co-optimization with software and low-power design

## Education

### National Taiwan University (NTU)

Taipei, Taiwan

B.S. in Department of Electrical Engineering

Sept. 2014 - Jan. 2019 (Expected)

- Achieved 4.19/4.30 (3.98/4.00) overall GPA and 4.19/4.30 (3.98/4.00) major GPA.
- Ranked in top 5% by cumulative GPA

## Research Experiences

### ECG Real-Time Telemonitoring

NTU, Taiwan

Access Lab (Prof. An-Yeu (Andy) Wu)

Aug. 2017 - PRESENT

Proposed compressed analysis (CA) to conduct real-time ECG telemonitoring and considered following improvements

- **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** (ongoing): 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** (ongoing): Propose a hardware architecture for on-demand recovery to allow hardware sharing between classification and reconstruction algorithms

### Direction-Of-Arrival Estimation

NTU, Taiwan

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

Feb. 2017 - PRESENT

Applied signal processing to address entailed problems of Direction-Of-Arrival (DOA) estimation

- **Antenna Uncertainty:** Utilized special matrix structure with Khatri-Rao subspace-based MULTiple Signal Classification algorithm 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** (ongoing): Consider the influence of multipath propagation (coherent signal) and sea clutter (backscattered signal from the sea surface)

## Publications

### Accepted

- [5] **Low-Complexity Compressed Analysis in Eigenspace with Limited Labeled Data for Real-Time Electrocardiography Telemonitoring**  
K.-C. Hsu, B.-H. Cho, C.-Y. Chou and A.-Y. (Andy) Wu  
IEEE Global Conference on Signal and Information Processing  
Anaheim, USA  
Nov. 2018
- [4] **Joint Estimation of DOA and Carrier Frequency Based on Coprime Arrays**  
K.-C. Hsu and J.-F. Kiang  
Progress In Electromagnetics Research Symposium  
Toyama, Japan  
Aug. 2018
- [3] **DOA Estimation With Triply Primed Arrays Based on Fourth-Order Statistics**  
K.-C. Hsu and J.-F. Kiang  
IEEE AP-S Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting  
Boston, USA  
July 2018
- [2] **DOA Estimation Using Triply Primed Arrays Based on Fourth-Order Statistics | [PDF]**  
K.-C. Hsu and J.-F. Kiang  
Progress In Electromagnetics Research M, Vol. 67, pp. 55-64  
Mar. 2018
- [1] **DOA estimation of quasi-stationary signals using a partly-calibrated uniform linear array with fewer sensors than sources | [PDF]**  
K.-C. Hsu and J.-F. Kiang  
Progress In Electromagnetics Research M, Vol. 63, pp. 185-193  
Jan. 2018

## Under Review

- **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," submitted to *Sensors*.

## In Preparation

- C.-Y. Chou, **K.-C. Hsu**, B.-H. Cho and A.-Y. (Andy) Wu, "On-Demand Recovery Algorithms for ECG Telemonitoring," in preparation for *IEEE Trans. Signal Process.*
- **K.-C. Hsu** and J.-F. Kiang, "Elevation Angle Estimation of Targets Near Sea Surface under Cluttering," in preparation for *IEEE Trans. Antennas Propagat.*

## Honors & Awards

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### 3rd Prize in Integrated Circuit Design Contest Award

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, NTU, Taiwan

- Under the supervision of Prof. Tzong-Lin Wu
- Implemented an electromagnetic structure longer than 2.5 meters operated at 3 GHz with only materials available in stationery shop to achieve -7.8 dB insertion loss

Aug. 2017

### 8th place in Data Structure and Programming Contest.

Cadence, Taiwan

- Out of about 250 students

Mar. 2017

### 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

Nov. 2017

### 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 | [PDF]

Mathematical Principles of Machine Learning

team project

June 2018

- Contribution: served as **project speaker** and surveyed on predictive dictionary learning and sparse coding optimization
- Studied on generalization bound of reconstructive and predictive dictionary learning
- Studied on optimization algorithm of reconstructive and predictive dictionary learning, including MOD, ODL, K-SVD and TDDL
- Studied on sparse coding optimization algorithm, including sub-gradient descent, ISTA and FISTA

### An Analysis of Deep Neural Networks in Hardware Perspective | [PDF]

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-art very deep CNNs, including AlexNet, VGG net, Inception, ResNet and Xception
- Analyzed with estimation accuracy and resource consumption and provide insight of hardware-friendly designs

### Different Handover Policies in Different Environments | [PDF]

Intro. to Wireless and Mobile Networking

Matlab, team project

June 2017

- Contribution: served as **project speaker**, conducted simulations and analyzed results
- Proposed four different handover policies and compare performances among different environments in both uplink and down-link cases

### Pipelined MIPS CPU | [PDF]

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 synthesizable pipelined MIPS CPU overcoming data hazard, lw-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 Lab (Prof. An-Yeu (Andy) Wu)

Feb. 2018 - PRESENT

### Teaching Assistant

NTU, Taiwan

Digital System Design

Feb. 2018 - June 2018