# Kai-Chieh (Kevin) Hsu

*Rm. 6, 8F., No.78, Zhongzheng Rd., Zhonghe Dist., New Taipei City 235, Taiwan*

(+886) 953-060560 | kevin71104@gmail.com | kevin71104.github.io/ | kevin71104

## Research Interests

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|---|---|
| **Biomedical Monitoring System** | low-complexity, privacy-preserving, and high-performance |
| **Signal Processing** | biomedical signal processing, array signal processing and compressed sensing |
| **Machine Learning** | low-complexity algorithms and sparsity-based algorithms |
| **VLSI design** | 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 with Compressed Analysis

NTU, Taiwan

Access IC Lab (Prof. An-Yeu (Andy) Wu, IEEE Fellow) — Aug. 2017 - PRESENT

- **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 (DOA) Estimation

NTU, Taiwan

Group of Electromagnetic Applications (Prof. Jean-Fu Kiang) — Feb. 2017 - PRESENT

- **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** (ongoing): Consider the influence of multipath propagation (coherent signal) and sea clutter (backscattered signal from the sea surface)

## Publications

### Accepted

**[1] 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 — Anaheim, USA
IEEE Global Conference on Signal and Information Processing (GlobalSIP) — Nov. 2018

**[2] Joint Estimation of DOA and Carrier Frequency Based on Coprime Arrays**
**K.-C. Hsu** and J.-F. Kiang — Toyama, Japan
Progress In Electromagnetics Research Symposium (PIER S) — Aug. 2018

**[3] DOA Estimation With Triply Primed Arrays Based on Fourth-Order Statistics**
**K.-C. Hsu** and J.-F. Kiang — Boston, USA
IEEE AP-S Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting (AP-S/URSI) — July 2018

**[4] DOA Estimation Using Triply Primed Arrays Based on Fourth-Order Statistics |**
**K.-C. Hsu** and J.-F. Kiang
Progress In Electromagnetics Research M, Vol. 67, pp. 55-64 — Mar. 2018

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

### Ready to Submit

- **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," ready to submit 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

**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, NTU, Taiwan
- Under the supervision of Prof. Tzong-Lin Wu, IEEE Fellow
- 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 — 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

## 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 reconstructive and predictive dictionary learning, including MOD, ODL, K-SVD and TDDL
- 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

**Different Handover Policies in Different Environments** | — 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 compared performances among different environments in both uplink and downlink cases

**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 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

**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