# Kai-Chieh (Kevin) **Hsu**

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## Research Interests

**Signal Processing** BIOMEDICAL SIGNAL PROCESSING, ARRAY SIGNAL PROCESSING AND COMPRESSED SENSING

**Machine Learning** LOW-COMPLEXITY ALGORITHMS AND SPARSITY-BASED ALGORITHMS (DICTIONARY LEARNING)

**VLSI design** CO-OPTIMIZATION WITH SOFTWARE

## Education

### National Taiwan University (NTU) *Taipei, Taiwan*

B.S. IN DEPARTMENT OF ELECTRICAL ENGINEERING SEP. 2014 - PRESENT

- ACHIEVED 4.19/4.3 OVERALL GPA AND 4.19/4.3 MAJOR GPA.
- HARDWARE COURSES: COMPUTER ARCHITECTURE(A+), ADVANCED INTEGRATED CIRCUIT DESIGN(A+) AND DIGITAL CIRCUIT LAB(A+)
- COMMUNICATION COURSES: PRINCIPLES OF COMMUNICATIONS(A), ADVANCED DIGITAL SIGNAL PROCESSING(A+), INTRODUCTION TO WIRELESS AND MOBILE NETWORKING(A+) AND RF MICROWAVE WIRELESS SYSTEMS(A+)
- MACHINE LEARNING COURSES: MACHINE LEARNING(A+), MATHEMATICAL PRINCIPLES OF MACHINE LEARNING(A+) AND OPTIMIZATION ALGORITHMS(ONGOING)

## Research Experiences

### ECG Real-Time Telemonitoring *Taipei, Taiwan*

UNDER PROF. AN-YEU (ANDY) WU, ACCESS LAB 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 *Taipei, Taiwan*

UNDER PROF. JEAN-FU KIANG, GROUP OF ELECTROMAGNETIC APPLICATIONS FEB. 2017 - PRESENT

- APPLIED DIFFERENT METHODS 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

### Low-Complexity Compressed Analysis in Eigenspace with Limited Labeled Data for Real-Time Electrocardiography Telemonitoring *Anaheim, USA*

K.-C. HSU AND B.-H. CHO, C.-Y. CHOU AND A.-Y. (ANDY) WU NOV. 2018

IEEE GLOBAL CONFERENCE ON SIGNAL AND INFORMATION PROCESSING

### Joint Estimation of DOA and Carrier Frequency Based on Coprime Arrays *Toyama, Japan*

K.-C. HSU AND J.-F. KIANG AUG. 2018

PROGRESS IN ELECTROMAGNETICS RESEARCH SYMPOSIUM

### DOA Estimation With Triply Primed Arrays Based on Fourth-Order Statistics *Boston, USA*

K.-C. HSU AND J.-F. KIANG JUL. 2018

IEEE AP-S SYMPOSIUM ON ANTENNAS AND PROPAGATION AND USNC-URSI RADIO SCIENCE MEETING

### DOA Estimation Using Triply Primed Arrays Based on Fourth-Order Statistics | [PDF] *Cambridge, USA*

K.-C. HSU AND J.-F. KIANG MAR. 2018

PROGRESS IN ELECTROMAGNETICS RESEARCH M, VOL. 67, PP. 55-64

**DOA estimation of quasi-stationary signals using a partly-calibrated uniform linear array with fewer sensors than sources | [PDF]** *Cambridge, USA*

K.-C. Hsu and J.-F. Kiang Jan. 2018

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

## Honors & Awards

**3rd Prize** in Integrated Circuit Design Contest Award *Ministry of Education, Taiwan*

- Out of about 300 teams

Jul. 2018

**2nd Prize** in Taiwan Creative Electromagnetic Implementation Competition *High-speed RF and mm-Wave Tech. Cneter, NTU*

- 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

**Professor Chun-Hsiung Chen Scholarship** *Electromagnetic Industry-Academia Consortium, Taiwan*

- Rewarded outstanding performances in electromagnetic fields

Nov. 2017

**Presidential Awards** $\times 2$ *Dept. of EE, NTU*

- Given to top ten students of that semester

second semester of 2014 and 2016

## Selected Course Projects

**Pipelined MIPS CPU | [PDF]** *Computer Architecture*

Verilog, team project Jun. 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 multiply and divide instructions

**Different Handover Policies in Different Environments | [PDF]** *Intro. to Wireless and Mobile Networking*

Matlab, team project Jun. 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 downlink cases

**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

**Survey of Dictionary Learning | [PDF]** *Mathematical Principles of Machine Learning*

team project Jun. 2018

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

## Extracurricular Activity

**MV Dance Club of NTU** *Taipei, Taiwan*

Associate Club Leader Jul. 2015 - Jun. 2016

- Gained expertise in coordination with team members, schools and other clubs.
- Attracted more than hundred club members.
- Held a dance performance attracting more than hundred audiences.

**Teaching Assistant** *Taipei, Taiwan*

Digital System Design Feb. 2018 - Jun. 2018

**Research Assistant** *Taipei, Taiwan*

Under Prof. An-Yeu (Andy) Wu, Access Lab Feb. 2018 - PRESENT