

HYUNGJOO SEO

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INTERESTS

Blind Source Separation (BSS) | Radio-Frequency Integrated Circuits (RFIC) | Wireless Systems and Multiplexing Schemes | Signal Processing and Machine Learning in RF/Wireless/Acoustics | Interference Management and Frequency Planning.

EDUCATION

- The University of Illinois (UIUC)**, Urbana-Champaign, IL, USA Aug 2018-
▪ **Ph.D.** in Electrical and Computer Engineering (Advisors: Jin Zhou, Romit R. Choudhury)
• Focus: Blind Source Separation Algorithms, Programmable RF Receiver/Front-ends, Interference Cancellation
- The University of Michigan**, Ann Arbor, MI, USA (CGPA:3.893/4.000) Sep 2016 – Jun 2018
▪ **M.S.** in Electrical and Computer Engineering (Advisors: Ehsan Afshari, David Blaauw)
• Focus: Autonomous Beam Alignment, Injection-locked Coupled Oscillators, RF Power Receiver
- Tokyo Institute of Technology (Tokyo Tech)**, Tokyo, Japan (CGPA:94.3/100) Apr 2011 – Aug 2013,
Sep 2015 – Mar 2016
▪ **B.Eng.** in Electrical and Computer Engineering (Summa Cum laude) (Advisors: Makoto Ando, Jiro Hirokawa)
• Early Graduation With Excellence (3-year Graduation)
• Korean Mandatory Military Service (2013 - 2015)

RESEARCH EXPERIENCE

- Quantum Research Intern**, IBM Thomas J. Watson Research Center May 2022 – Aug 2022
(Mentor: Dr. Sudipto Chakraborty)
▪ Sub-System optimization and permutation algorithm for next-generation quantum state controller.
▪ Explored the applicability of various wireless communication techniques on quantum computing applications.
- Systems and Networking Research Group (SyNRG)**, UIUC Jun 2020 –
(Advisors: Prof. Romit Roy Choudhury and Prof. Jin Zhou)
▪ Under-determined BSS and angle-of-arrival (AoA) estimation based on optimal array geometry searching utilizing intrinsic angular aliasing properties via Markov Decision Process. [9]
▪ Deeply-learned angular manifold model for enhanced signal recovery in under-determined convoluted mixtures. [10]
- Wireless Microsystems and Circuits Lab (WiMAC Lab)**, UIUC Aug 2018 –
(Advisor: Prof. Jin Zhou)
▪ Novel interference-tolerant receiver architecture for 5G & software-defined radios. [1, 4, 5, 6, 7, 8, 11]
• Impedance aliasing phenomenon: analysis & derivation on harmonically-coupled feedback process in time-varying N-path mixers loaded with general LTI systems.
• By avoiding impedance aliasing, a hybrid CMOS-acoustic design for widely-tunable blocker-tolerant RF bandpass filtering Rx front-end is proposed to substantially reduce acoustic filter count. (TSMC65nm)
▪ Fully-integrated full-duplex/FDD receiver with self-adaptive self-interference cancellation. [2]
• Analysis and simulation of various gradient-descent algorithms for self-interference cancellation in software-modelled QAM transceiver with RF and analog hybrid-analog-digital autonomous adaptation loops.
▪ Sub-Nyquist wideband spectrum sensing system using acoustic comb filters. [3]
• Sparse recovery algorithm for detection of densely-occupied bands across a wide spectrum sampled below Nyquist rate.
▪ CADELAC(Commutated-Circuit-and-Acoustic-Delay-Line-based Adaptive Canceller) - QIF2021 Finalist
• Explored DNN-based weight initialization for direct-RF adaptive interference cancellation scheme in full-duplex wireless systems to overcome non-idealities from frequency-translational acoustic delay lines.
- Research-oriented Course Projects**, UIUC Aug 2018 –
▪ DNN Receiver: Replaced existing QAM receiver and decoder with deep neural network-based Rx (ECE598NS)
▪ Indoor localization using WLS algorithm for multiple voice assistants with MIC arrays (CS434)
▪ Graph-based spectral clustering and probabilistic K-Medoid for soft-labeled image clustering (CS545)
- Radiation Laboratory (RadLab)**, U Michigan Aug 2017 – Aug 2018
(Advisor: Prof. Ehsan Afshari)
▪ A 77-GHz retro-directive transceiver with injection-locked coupled oscillators for self-aligning and self-steering beams to provide robust links among wireless nodes. (ST130nm)
▪ Analysis on human language efficiency as information code with entropy of English, Japanese, Korean, and Mandarin as a communication system by proposing M-PSK equivalent high-order Markov Chain.
- Michigan Integrated Circuit Laboratory (MICL)**, U Michigan Dec 2016 – Aug 2017
(Advisor: Prof. David Blaauw)

- Multi-band RF harvester using a hybrid RF-DC & DC-DC converter adaptively controlled by VCO for optimal power delivery point. And analyzed power conversion efficiency of amplifier-first RF harvester. (TSMC180nm)

Millimeter-wave EM and Antenna Laboratory, Tokyo Tech
(Advisor: Prof. Makoto Ando and Prof. Jiro Hirokawa)

Sep 2015 – Jun 2016

- Quadrupled beamforming antenna element number from 32x32 to 64x64 by suppressing structural distortions via supportive bridge configurations using diffusion-bonding half-etching technique. (simulated and measured)

PUBLICATIONS & PATENTS

- [1] H. Seo and J. Zhou, "A 2.5-to-4.5-GHz Switched-LC-Mixer-First Acoustic-Filtering RF Front-End Achieving <6dB NF, +30dBm IIP3 at 1xBandwidth Offset," *IEEE Radio Frequency Integrated Circuits Symposium (RFIC '20)*, Los Angeles, CA, USA, Jun 2020.
- [2] Y. Cao, X. Cao, H. Seo, and J. Zhou, "An Integrated Full-Duplex/FDD Duplexer and Receiver Achieving 100MHz Bandwidth 58dB/48dB Self-Interference Suppression Using Hybrid-Analog-Digital Autonomous Adaptation Loops," *IEEE International Microwave Symposium (IMS '20)*, Los Angeles, CA, USA, Jun 2020.
- [3] J. Guan, J. Zhang, R. Lu, H. Seo, J. Zhou, S. Gong, and H. Hassanieh, "Efficient Wideband Spectrum Sensing Using MEMS Acoustic Resonators," *The 18th USENIX Symposium on Networked Systems Design and Implementation (NSDI '21)*, Boston, MA, USA, Apr 2021.
- [4] H. Seo and J. Zhou, "A Mixer-First Acoustic-Filtering Superheterodyne RF Front-End," *IEEE Journal of Solid-State Circuits (JSSC)*, May 2021. (Invited from RFIC 2020 paper).
- [5] H. Seo, M. Sha, and J. Zhou, "A 3.5-to-6.2-GHz Mixer-First Acoustic-Filtering Receiver Chipset with Mixed-Domain Asymmetric IF and Complex BB Recombination Achieving 170MHz BW and +27dBm IIP3 at 1xBW offset," *IEEE Radio Frequency Integrated Circuits Symposium (RFIC '21)*, Atlanta, GA, USA, Jun 2021.
- [6] H. Seo, M. Sha, and J. Zhou, "A Passive-Mixer-First Acoustic-Filtering Chipset Using Mixed-Domain Recombination," *IEEE Transactions on Microwave Theory and Techniques (TMTT '22)*
- [7] H. Seo, M. Sha, and J. Zhou, "Periodically Switched Acoustic-Filtering RF Front-Ends Using Commutated-LC Circuits for Wireless Receivers," *IEEE Wireless and Microwave Technology Conference (WAMICON '22)*
- [8] J. Zhou and H. Seo, "Mixer-first Acoustic-filtering Systems and Related Methods," *US Patent and Trademark Office* (Filed on Apr 2022)
- [9] H. Seo, S. B. Karnoor and R. R. Choudhury, "RoSS: Utilizing Rotational Motion for Audio Source Separation and Localization," *IEEE International Conference on Robotics and Automation (ICRA '22)* (Submitted)
- [10] H. Seo, and R. R. Choudhury, "AlignSS: Learning the Spatial-domain Representation of Convolutional Mixtures for Angular Alignment-based Source Enhancement," *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP '23)* (In Preparation)
- [11] H. Seo, and J. Zhou, "Harmonically Coupled Feedback Loop Analysis and Impedance Aliasing in N-path Structures interfaced with General LTI Responses," *IEEE Transactions on Circuits and Systems (TCAS)* (In Preparation)

HONORS & AWARDS

- Finalist team of Qualcomm Innovation Fellowship Award (QIF) - Team CADELAC 2021
- Recipient of PhD Student Sponsorship Initiative by IEEE RFIC/IMS 2019 at Boston 2019
- Recipient of Kwanjeong Educational Foundation Scholarship (17th) 2018– 2022
- Recipient of U Michigan ECE Departmental Fellowship for 3 semesters 2016– 2017
- Selected as a representative of Tokyo Tech, Academic Excellence Award upon graduation. 2016
- 3-Year Graduation with Excellence at Tokyo Tech 2016
(One of the very few achieved cases in Tokyo Tech history.)
- Recipient of Korea-Japan Joint Government Scholarship (11th). 2010 – 2016

PROFESSIONAL AFFILIATIONS & ACTIVITIES

- Teaching Assistantship (TA) @ UIUC:
 - Communication Networks (CS438) Fall 2021
 - Radio-Frequency IC design (ECE498JZ), Electronic Circuits (ECE342) Fall/Spring 2020
- President of UIUC Korean ECE student association. Fall 2021
- Vice president of University of Michigan Korean EECS student association. [\[Link\]](#) 2016 – 2017
- Co-organizer of the 1st ASPIRE League E-Olympics at KAIST, South Korea. [\[Link\]](#) Aug 2014
- Director and Editor of a Youtube video clip of 180K views of Tokyo Tech [\[Link\]](#) Feb 2013
- President of Tokyo Tech International Student Association (TISA) [\[Link\]](#) Feb 2012 – Jul 2013

KEY COURSES

UIUC

- Random Process | Detection and Estimation Theory | Statistical Learning Theory | MDPs and Reinforcement Learning
- Mobile Computing | Adv. Wireless Networks & Sensing | Quantum Information Theory
- Machine Learning (ML) | ML for Signal Processing | Deep Learning in Hardware
- Advanced Analog IC Design | Radio-Frequency IC & System Design | Advanced Signal Integrity

U Michigan

- Analog/Digital Interfaces | Analog IC Design | VLSI Design I
- Adv. Electromagnetic Theory | Microwave Circuits | Digital Communication & Coding

LANGUAGE &SKILLS

Language

- Korean(Native), English(Fluent), Japanese(Bilingual), Chinese(Beginner)

Programming

- Python, MATLAB, C++, \LaTeX , CSS/HTML

Framework

- PyTorch, TensorFlow, Scipy, scikit-learn, SciKit(DSP, Comm), CVXPY, OpenCV, Qiskit

Tools/Equipment

- Cadence Virtuoso, HFSS, ADS, PCB Design tools, VNA, Signal/Spectral Analyzer