

CURRICULUM VITAE

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University of Southern California
Ming Hsieh Department of Electrical and Computer Engineering
Wireless Devices and Systems Group (WiDeS)
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EDUCATION

Doctor of Philosophy in Electrical and Computer Engineering Aug. 2017 – current
Master of Science in Electrical Engineering (GPA: 3.7) Aug. 2017 – May 2020
University of Southern California, Los Angeles, CA, United States.

Research topics: wireless communication system, massive MIMO, cell-free massive MIMO (distributed MIMO), drone (UAV) communications, millimeter-wave, antennas, RF system, calibration, channel sounder development, channel sounding measurements, propagation, channel modeling, and channel extrapolation.
Supervisor: Andreas F. Molisch.

Master of Science in Aerospace Engineering (GPA: 3.7) Aug. 2015 – May 2017
Georgia Institute of Technology, Atlanta, GA, United States.

Thesis title: *User Guide and Status Update for Small Satellite Communication System at Georgia Tech.*

Research topics: small satellites, ground station development, software-defined radios, antennas, and RF system.
Supervisor: E. Glenn Lightsey.

Bachelor of Science in Electrical Engineering (GPA: 3.5 – Cum Laude) Aug. 2011 – May 2015
University of Southern California, Los Angeles, CA, United States.

RESEARCH EXPERIENCE

Graduate Research Assistant, Wireless Devices and Systems Group (WiDeS) Aug. 2017 – current
University of Southern California, Los Angeles, CA, United States.

I develop channel sounders at two different frequency ranges (sub-6 GHz & mmWave) using off-the-shelf RF equipment and large antenna arrays (concentrated & distributed) I design. After mounting the channel sounders to either a cart or a drone, I conduct channel measurement campaigns in numerous environments (static/mobile, outdoors/indoors). The collected measurement data are then compensated by the equipment calibration data, which are used for channel parameter estimation, channel modeling, communication system performance analysis, and development of new wireless technology (channel extrapolation, etc.).

Graduate Research Assistant, Space Systems Design Laboratory (SSDL)

Aug. 2015 – May 2017

Georgia Institute of Technology, Atlanta, GA, United States.

In order to serve many small satellites with different communication requirements, I installed and tested ground stations based on software defined radios at three different locations on Georgia Tech campus. I also was a telecommunications team lead for the MicroNimbus satellite project, evaluating link budget, configuring transceiver, and analyzing effects of satellite body on antenna pattern.

Co-op / Academic Part Time, Telecom Architectures Group

Feb. 2014 – Aug. 2015

NASA Jet Propulsion Laboratory, Pasadena, CA, United States.

I have simulated, developed, and tested an inflatable antenna for small satellites, using ANSYS HFSS software and anechoic chamber facility. Through two design phases, I contributed to 20 dB increase in antenna gain by parabolic structural modifications. I have also compared statistical and deterministic ARQ links in fast/slow fading scenarios with varying SNRs in deep space/proximity.

Undergraduate Research Assistant, Space Engineering Research Center

Jan. 2013 – Jan. 2014

University of Southern California Information Sciences Institute, Marina Del Rey, CA, United States.

I have simulated radiation patterns for small satellite and ground station antennas. I have also operated the ground station to receive telemetry data from the small satellite.

INTERNSHIPS

Wireless System Engineering Intern, Terragraph (Facebook Connectivity)

May 2020 – Aug. 2020

Facebook, Menlo Park, CA, United States.

I have worked on wireless technology at mmWave and beyond frequencies

Transceiver Testing Intern, Reprogrammable Signal Processing Group

May 2017 – July 2017

NASA Jet Propulsion Laboratory, Pasadena, CA, United States.

I have developed test plans for transponders of many different small satellites

Launch Pad Intern, Launch Communications and Networking Group

May 2016 – July 2016

SpaceX, Cape Canaveral, FL, United States.

I have supported voice/RF/fiber communications from launch pad to operations facility

TECHNICAL SKILLS

- Hardware: VNA, AWG, spectrum analyzer, oscilloscope, power meter, anechoic chamber
- Software Tools: HFSS, CST, FEKO, GNU Radio, LabVIEW
- Languages: C++, Java, Python, English, Korean

SCIENTIFIC EXPERIENCE

Scientific Publications

I have published the following (and additional papers are under review):

- 1 book chapter
- 6 peer-reviewed journal articles
- 16 peer-reviewed conference papers

These publications have received 151 citations. These citations correspond to an *h*-index of 7 (source: [Google Scholar](#), Sep. 2, 2021).

Open and Reproducible Research

I am an active promoter of reproducibility of research results and of open publishing. I have made my measurement data and code available here: <https://github.com/tomathchoi>

Invited Talks

- Invited speaker at the Korea University Research Seminar, Jan. 2020.

Reviewer in International Journals and Conferences

- I am a reviewer of journal articles in IEEE Transactions on Vehicular Technology and IEEE Communications Letters.

LEADERSHIP / OUTREACH

Research Project Lead

- I am currently leading massive MIMO and drone communications projects (Aug. 2017 – current).
- I have previously led a small satellite ground station working group (Jan. 2016 – May 2017).

Research Supervision

I am currently a supervisor of one master's student:

- Srushti Rajeev Patil, USC, since January 2021.

I am currently a supervisor of two undergraduate students:

- Ruiyi Shen, USC, since May 2020.
- Colton Bullard, USC, since May 2020.

I have previously been a supervisor of four master's students:

- Alexandro Alvarado, graduated in May 2020 at CSULA (systems engineer at Northrop Grumman).
- Aldo Adame, graduated in May 2020 at CSULA (electronic engineer at Northrop Grumman).
- Akshay Ramesh, graduated in May 2020 at USC (senior systems engineer at MaxLinear).
- Peng Luo, graduated in May 2020 at USC (PhD student in China).

Laboratory Management

I am currently a lab manager of USC Ultralab facility (May 2018 – current).

Student Groups

- I was a social chair of Korean Graduate Student Association (June 2019 – May 2020).
- I was a research chair of USC IEEE (Aug. 2014 – May 2015).
- I was a social chair of USC Korean-American Scientists and Engineers Assoc. (Jan. 2012 – May 2015).

Mentorship

I gave a mentorship talk for Korean undergraduate students studying engineering at USC (2020-2021).

HONORS & AWARDS

- **Best Research Project (USC EE 599: Deep Learning):** channel extrapolation using DL (May 2020).
- **Best Paper Award (EuCAP):** for work on comparing various mmWave channel sounders (Apr. 2019).
- **Trustee Scholarship:** full tuition scholarship for four years (Aug. 2011 – May 2015).
- **Merit Research Award:** paid undergraduate research (Aug. 2011 – Jan. 2014).

SCIENTIFIC PUBLICATIONS

Book Chapters

[B1] Andreas F. Molisch, Thomas Choi, Naveed Abbasi, François Rottenberg, and Jianzhong Zhang, “*Millimeter-wave Channels*,” in Wiley 5G REF: The Essential 5G Reference Online, To appear.

Journal Articles

[J6] Thomas Choi, Masaaki Ito, Issei Kanno, Jorge Gomez-Ponce, Colton Bullard, Takeo Ohseki, Kosuke Yamazaki, and Andreas F. Molisch, “*Energy Efficiency of Uplink Cell-Free Massive MIMO With Transmit Power Control in Measured Propagation Channel*,” IEEE Open Journal of Circuits and Systems, To appear.

[J5] Thomas Choi, François Rottenberg, Jorge Gomez-Ponce, Akshay Ramesh, Peng Luo, Charlie Jianzhong Zhang, Andreas F. Molisch, “*Experimental Investigation of Frequency Domain Channel Extrapolation in Massive MIMO Systems for Zero-Feedback FDD*,” IEEE Transactions on Wireless Communications, vol. 20, no. 1, pp. 710-725, Jan. 2021.

[J4] Camillo Gentile, Andreas F. Molisch, Jack Chuang, David G. Michelson, Anuraag Bodi, Anmol Bhardwaj, Ozgur Ozdemir, Wahab Ali Gulzar Khawaja, Ismail Guvenc, Zihang Cheng, François Rottenberg, Thomas Choi, Robert Muller, Niu Han, Diego Dupleich, “*Methodology for Benchmarking Radio-Frequency Channel Sounders Through a System Model*,” IEEE Transactions on Wireless Communications, vol. 19, no. 10, pp. 6504-6519, Oct. 2020.

[J2] Rui Wang, Celalettin Umit Bas, Zihang Cheng, Thomas Choi, Hao Feng, Zheda Li, Xiaokang Ye, Pan Tang, Seun Sangodoyin, Jorge Gómez-Ponce, Robert Monroe, Thomas Henige, Gary Xu, Jianzhong Zhang, Jeongho Park, Andreas F. Molisch, “*Enabling Super-Resolution Parameter Estimation for mm-Wave Channel Sounding*,” IEEE Transactions on Wireless Communications, vol. 19, no. 5, pp. 3077-3090, May 2020.

[J2] François Rottenberg, Thomas Choi, Peng Luo, Charlie Jianzhong Zhang, Andreas F. Molisch, “*Performance Analysis of Channel Extrapolation in FDD Massive MIMO Systems*,” IEEE Transactions on Wireless Communications, vol. 19, no. 4, pp. 2728-2741, Apr. 2020.

[J1] C Umit Bas, Rui Wang, Seun Sangodoyin, Thomas Choi, Sooyoung Hur, Kuyeon Whang, Jeongho Park, Jianzhong Zhang, Andreas F. Molisch, “*Outdoor to Indoor Propagation Channel Measurements at 28 GHz*,” IEEE Transactions on Wireless Communications, vol. 18, no. 3, pp. 1477-1489, Mar. 2019.

Conference Papers

- [C16] Thomas Choi, Masaaki Ito, Issei Kanno, Takeo Oseki, Kosuke Yamazaki, Andreas F Molisch, “*Uplink Energy Efficiency of Cell-Free Massive MIMO with Transmit Power Control in Measured Propagation Channels*,” Proceedings of IEEE International Workshop on Signal Processing Systems (SiPS), Coimbra, Portugal, Oct. 2021.
- [C15] Jorge Gomez Ponce, Thomas Choi, Naveed A Abbasi, Aldo Adame, Alexander Alvarado, Colton Bullard, Ruiyi Shen, Fred Daneshgaran, Harpreet S Dhillon, Andreas F Molisch, “*Air-to-Ground Directional Channel Sounder with Drone and 64-antenna Dual-polarized Cylindrical Array*,” IEEE International Conference on Communications (ICC), Workshop on Integrating UAVS into 5G and Beyond, Workshops (ICC Workshops), Montreal, QC, Canada, Jun. 2021.
- [C14] Thomas Choi, Peng Luo, Akshay Ramesh, Andreas F Molisch, “*Co-Located vs Distributed vs Semi-Distributed MIMO: Measurement-Based Evaluation*,” Proceedings of Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA, USA, Nov. 2020.
- [C13] François Rottenberg, Ming-Chun Lee, Thomas Choi, Jianzhong Zhang, Andreas F Molisch, “*Robust Non-Coherent Beamforming for FDD Downlink Massive MIMO*,” Proceedings of IEEE Vehicular Technology Conference (VTC), Antwerp, Belgium, May 2020.
- [C12] Thomas Choi, François Rottenberg, Jorge Gomez-Ponce, Akshay Ramesh, Peng Luo, Jianzhong Zhang, Andreas F Molisch, “*Channel Extrapolation for FDD Massive MIMO: Procedure and Experimental Results*,” Proceedings of IEEE Vehicular Technology Conference (VTC), Honolulu, HI, USA, Sep. 2019.
- [C11] Alec J Weiss, Dylan F Williams, Jeanne Quimby, Rod Leonhardt, Thomas Choi, Zihang Cheng, Kate A Remley, Andreas Molisch, Benjamin Jamroz, Jake Rezac, Peter Vouras, Jianzhong Zhang, “*Large-Signal Network Analysis for Over-the-Air Test of Up-Converting and Down-Converting Phased Arrays*,” Proceedings of IEEE MTT-S International Microwave Symposium (IMS), Boston, MA, USA, Jun. 2019.
- [C10] David G Michelson, Camillo Gentile, Andreas F Molisch, Jack Chuang, Anuraag Bodi, Anmol Bhardwaj, Ozgur Ozdemir, Wahab Ali Gulzar Khawaja, Ismail Guvenc, Zihang Cheng, Thomas Choi, Robert Müller, “*System Distortion Model for the Cross-Validation of Millimeter-Wave Channel Sounders*,” Proceedings of European Conference on Antennas and Propagation (EuCAP), Krakow, Poland, Apr. 2019. **Best Paper Award.**
- [C9] Thomas Choi, François Rottenberg, Peng Luo, Jianzhong Zhang, Andreas F Molisch, “*How Many Antennas Do We Need for Massive MIMO Channel Sounding? – Validating Through Measurement*,” Proceedings of IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, Atlanta, GA, USA, Jul. 2019.
- [C8] Thomas Choi, C Umit Bas, Rui Wang, Sooyoung Hur, Jeongho Park, Jianzhong Zhang, Andreas F Molisch, “*Measurement Based Directional Modeling of Dynamic Human Body Shadowing at 28 GHz*,” Proceedings of IEEE Global Communications Conference (GLOBECOM), Abu Dhabi, United Arab Emirates, Dec. 2018.
- [C7] C Umit Bas, Rui Wang, Thomas Choi, Sooyoung Hur, Kuyeon Whang, Jeongho Park, Jianzhong Zhang, Andreas F Molisch, “*Outdoor to Indoor Penetration Loss at 28 GHz for Fixed Wireless Access*,” Proceedings of IEEE International Conference on Communications (ICC), Kansas City, MO, USA, May 2018.
- [C6] Thomas Choi, Terry Stevenson, E Glenn Lightsey, “*Reference Ground Station Design for University Satellite Missions with Varying Communication Requirements*,” Proceedings of AIAA Aerospace Sciences Meeting, Grapevine, TX, USA, Jan. 2017.
- [C5] Alessandra Babuscia, Thomas Choi, Jonathan Sauder, Aman Chandra, Jekan Thangavelautham, “*Inflatable Antenna for CubeSats: Development of the X-Band Prototype*,” Proceedings of IEEE Aerospace Conference, Big Sky, MT, USA, Mar. 2016.
- [C4] Kar-Ming Cheung, Thomas Choi, “*Statistical ARQ Link Analysis and Planning for Dynamic Links*,” Proceedings of IEEE Aerospace Conference, Big Sky, MT, USA, Mar. 2016.
- [C3] Alessandra Babuscia, Thomas Choi, Kar-Ming Cheung, “*Inflatable Antenna for CubeSat: Extension of the Previously Developed S-Band Design to the X-Band*,” Proceedings of AIAA SPACE Conference and Exposition, Pasadena, CA, USA, Sep. 2015.

[C2] Alessandra Babusia, Thomas Choi, Charles Lee, Kar-Ming Cheung “*Inflatable Antennas and Arrays for Interplanetary Communication Using CubeSats and Smallsats,*” Proceedings of IEEE Aerospace conference, Big Sky, MT, USA, Mar. 2015.

[C1] Alessandra Babusia, Kar-Ming Cheung, Charles Lee, Thomas Choi, “*Communication and Coverage Analysis for a Network of Small Satellites Around Mars,*” Proceedings of Interplanetary Small Satellite Conference, Pasadena, CA, USA, Apr. 2014.

Theses

[T1] Thomas Choi, “*User Guide and Status Update for Small Satellite Communication System at Georgia Tech,*” Master of Science Thesis, Daniel Guggenheim School of Aerospace Engineering, Georgia Institute of Technology, May 2017.

Last update: Sep. 2, 2021