

Chia-Yi Yeh

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Research Interests

Design, implementation, and experimental demonstration of next-generation wireless systems for communication, security, and sensing based on theoretical foundations.

Education

Rice University

Ph.D. of Electrical and Computer Engineering

M.S. of Electrical and Computer Engineering

Houston, TX

12/2021

12/2017

National Taiwan University (NTU)

B.S. in Electrical Engineering

Taipei, Taiwan

06/2014

Research Experience

Postdoctoral Scholar in Network Coding and Reliable Communications Group & Mittleman Lab

Boston, TX

Advisor: Muriel Médard (MIT) & Daniel M. Mittleman (Brown)

08/2022 – present

Absolute Security in High-Frequency Wireless Links

- Propose to exploit the frequency-varying minima in antenna radiation pattern, combined with secure network coding scheme, to provide physical layer security with probability 1 in an engineered region

Postdoctoral Associate in Rice Networks Group, Rice University

Houston, TX

Advisor: Edward W. Knightly

01/2022 – 07/2022

Experimental Demonstration of Orbital Angular Momentum (OAM) Beam Using Massive MIMO

- Investigate OAM multiplexing for large array systems in sub-6 GHz band

Stealthy Off-Target Coupled-Control-Plane Jamming in WLAN

- Demonstrated TCP throughput reduction to 1% with less than 0.1% of jamming air-time
- Showed seconds-to-minute scale outages by targeting the L2 control frames for L4 or L7 setup messages

Ph.D. Student in Rice Networks Group, Rice University

Houston, TX

Advisor: Edward W. Knightly

08/2015 – 12/2021

Security of Angularly Dispersive (AD) Wideband Terahertz (THz) Links

- World's first experimental demonstration of AD wideband THz link eavesdropping
- Identified unique security properties e.g., vulnerable edge frequencies, bandwidth-beamwidth coupling
- Demonstrated joint secure coding across channel is crucial to establish secure AD links
- Verified security properties and secure coding performance with analytical model and experiments

Single-Antenna Nodal and Environmental Mobility Tracking with a Leaky-Wave Antenna (LWA)

- Proposed nodal mobility and blockage tracking via unique spectrally coded signals at different spatial directions
- Realized proposed color-coded scan using a THz LWA with unique frequency signatures across angles
- Showed low average estimation error experimentally: angular position error $< 1^\circ$; rotation angle error $< 2^\circ$; detect object within the field-of-view with position and size estimation
- Characterized the detection zones considering physical limitations of the color-coded scan

Eavesdropping of Highly Directional Sub-THz Communication

- World's first experimental study on sub-THz directional link security using 100-400 GHz band
- Showed eavesdropping is increasingly difficult with a narrower beam in higher frequency
- Demonstrated successful object reflecting attack for beamwidth as narrow as 1.6° with precise placement of a flat reflective object off-axis, which redirects signals with minor disturbance for the main link

Experimental Analysis of Passive Eavesdropping in Massive MIMO

- World's first experimental study of Massive MIMO eavesdropping using a 96-element antenna array
- Identified eavesdropper (Eve) advantages due to channel correlation, which scales with more antennas at Eve
- Demonstrated Eve's advantage by simply sharing the elevation angle with the target user in the LoS scenario

Energy-Efficient Cross-Layer Jamming Attack Against TCP in 802.11 (WiFi) WLAN

- Proposed an energy-efficient periodic jam-and-sleep attack in 802.11 WLAN targeting TCP retransmission timeout mechanism
- Implemented the attack in NS3 and showed a persistent effect of MAC-layer jamming on transport layer

Research Assistant in Wireless Mobile Network Laboratory, NTU

Taipei, Taiwan

Advisor: Hung-Yu Wei

09/2014 – 07/2015

- Proposed auction-based resource allocation for energy-aware M2M devices in cellular networks
- Led 5 undergrad students' research projects in mmWave and game theory

Publications

Journal

- **C.-Y. Yeh**, A. Cohen, R. G. L. D'Oliveira, M. Médard, D. M. Mittleman, and E. W. Knightly, "Securing Angularly Dispersive Terahertz Links with Coding," under review for publication in *IEEE Transactions on Information Forensics and Security*.
- **C.-Y. Yeh**, Y. Ghasempour, Y. Amarasinghe, D. M. Mittleman, and E. W. Knightly, "Security and Angle-Frequency Coupling in Terahertz WLANs," under review for publication in *IEEE/ACM Transactions on Networking*.
- **C.-Y. Yeh** and E. W. Knightly. "Eavesdropping in Massive MIMO: New Vulnerabilities and Countermeasures," *IEEE Transactions on Wireless Communications*, 20(10):6536-6550, October 2021.
- Y. Ghasempour, Y. Amarasinghe, **C.-Y. Yeh**, E. W. Knightly, and D. M. Mittleman. "Line-of-Sight and Non-Line-of-Sight Links for Dispersive Terahertz Wireless Networks," *APL Photonics*, 6(4): 041304, April 2021.
- J. Ma, R. Shrestha, J. Adelberg, **C.-Y. Yeh**, Z. Hossain, E. W. Knightly, J. M. Jornet, and D. M. Mittleman. "Security and Eavesdropping in Terahertz Wireless Links," *Nature*, 563, 89-93, October 2018.
- M.-J. Shih, K. D. Huang, **C.-Y. Yeh**, and Hung-Yu Wei. "To Wait or To Pay: A Game Theoretic Mechanism for Low-Cost M2M and Mission-Critical M2M," *IEEE Transactions on Wireless Communications*, 15(11): 7314-7328, November 2016.

Conference

- A. Cohen, R. G. L. D'Oliveira, **C.-Y. Yeh**, H. Guerboukha, R. Shrestha, Z. Fang, E. W. Knightly, M. Médard, and D. M. Mittleman, "Absolute Security in High-Frequency Wireless Links," in *Proceedings of IEEE CNS 2022*, Austin, TX, October 2022.
- S. Gupta, **C.-Y. Yeh**, and E. W. Knightly, "Stealthy Off-Target Coupled-Control-Plane Jamming," in *Proceedings of IEEE CNS 2022*, Austin, TX, October 2022.
- **C.-Y. Yeh**, A. Cohen, R. G. L. D'Oliveira, M. Medard, D. M. Mittleman, and E. W. Knightly, "Secure Coding for Angularly Dispersive Terahertz Links: from Theoretical Foundations to Experiments," in *Proceedings of ACM WiSec 2022*, San Antonio, USA, May 2022.
- Y. Ghasempour, **C.-Y. Yeh**, R. Shrestha, Y. Amarasinghe, D. M. Mittleman, and E. W. Knightly, "LeakyTrack: Non-Coherent Single-Antenna Nodal and Environmental Mobility Tracking with a Leaky-Wave Antenna," in *Proceedings of ACM SenSys 2020*, Yokohama (Virtual), Japan, November 2020.
- Y. Ghasempour, **C.-Y. Yeh**, R. Shrestha, D. M. Mittleman, E. W. Knightly, "Single Shot Single Antenna Path Discovery in THz Networks," in *Proceedings of ACM MobiCom 2020*, London (Virtual), U.K., September 2020.
- **C.-Y. Yeh**, Y. Ghasempour, Y. Amarasinghe, D. M. Mittleman, and E. W. Knightly, "Security in Terahertz WLANs with Leaky Wave Antennas," in *Proceedings of ACM WiSec 2020*, Linz (Virtual), Austria, July 2020.
- **C.-Y. Yeh**, and E. W. Knightly. "Feasibility of Passive Eavesdropping in Massive MIMO: An Experimental Approach," in *Proceedings of IEEE CNS 2018*, Beijing, China, May 2018.
- M.-J. Shih, **C.-Y. Yeh**, K. D. Huang, and H.-Y. Wei. "Energy-Aware Waiting-Line Based Resource Allocation in Cellular Network with M2M/H2H Co-existence," in *Proceedings of IEEE ICC 2015*, London, UK, June 2015.

Workshop

- **C.-Y. Yeh**, Y. Ghasempour, Y. Amarasinghe, E. W. Knightly, and D. M. Mittleman. "Non-Uniform Secrecy Capacity in Terahertz Networks," In *IEEE UCMMT 2020*, Virtual, August 2020.

Professional Activities

- Breakout Group Co-lead** of NSF RFDDataFactory Workshop 06/2022
 - Summarized breakout room discussion of Panel II: dataset generation barriers
- Technical Program Committee Member** of IEEE WCNC 2022 10/2021 – 12/2021
 - Track 4: Emerging Technologies, Standards, and Applications
- Co-Chair** of ACM S3 (of the Students, by the Students, and for the Students) Workshop 02/2019 – 10/2019
 - Form a student TPC and organize the review process
 - Build and manage the workshop website
 - Publicize the workshop and find sponsorship

General Research Activities

Interdisciplinary and Industry Collaborations

- Initiated 3-party collaborations between Rice, MIT, and Brown *2020 – Present*
- Lead student liaison for Army Research Lab security project *2020 – 2022*
- Regular research reviews by Intel CTO and Cisco Director of Engineering *2018 – 2022*

Funding and Lab Equipment

Contributed to NSF grant proposals

- [RINGS 2021] Coding, High-Frequency and Antennas for Post-Quantum Security
- [SpecEES 2019] Efficient and Secure Access to Spectrum up to THz
- [SpecEES 2018] DoS Resilience, Secrecy, and Throughput in Massive MIMO

Led THz experimental equipment acquisition and lab design at Rice Network Group

- Terahertz time-domain spectroscopy (TeraMetrix T-Ray® 5000)
- Keysight/VDI 1x2 modulated transmission platform at 240 GHz with 10 GHz bandwidth

Teaching Experience

Guest Lecturer

2018 & 2021

- Introduction to Communication Networks: TCP, Network Security

Undergrad Summer Research Mentorship

2020 & 2022

- [2022] John Reko & Gabriel Baquero: OAM transmission with sub-6 GHz massive MIMO systems
- [2020] Samuel Zhou: Jamming Leaky Wave Antennas with Optimized Power Allocation

Teaching Assistant at Rice ECE

2015-2018

- Computer Systems Architecture, Digital Wireless Architecture (lab), Fundamentals of Electrical Engineering, Random Signals in Electrical Engineering Systems, Introduction to Communication Networks

Coursera Online Teaching Assistant ([The Red Chamber Dream](#))

2013-2014

- Course virtualization management: coordination of video production team, homework design, course website management, communication with online students

Teacher Education Program, National Taiwan University

2012-2014

- Related Courses: Principles of Instruction, Sociology of Education, Principles and Practice in Guidance and Counseling, Educational Measurement and Evaluation, Psychology of Adolescence, Educational Psychology, Teaching Methods and Materials in Information Science and Technology, Team Learning & Outdoor Leadership

Leadership

Board Member of National Taiwan University Alumni Association in Houston

02/2019 – 02/2020

- Manage the website and publicize social and culture events
- Hold social events and traditional Taiwanese celebrations for Taiwanese in Houston

Secretary of National Taiwan University Alumni Association in Houston

02/2018 - 01/2019

- Arranged meetings, composed and distributed meeting agendas and meeting minutes

President of Rice Taiwanese Student Association

07/2016 – 06/2017

- Managed the Rice Taiwanese student population and provided services to newcomers
- Held social events and traditional Taiwanese celebrations at Rice University

Awards

- 2021 JCAA Leadership & Community Service Scholarship
- 2015 TI Fellowship