Jason M. Merlo

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Education

Ph.D. Electrical Engineering	**Expected Fall 2024**
Michigan State University, East Lansing, MI	Advisor: Professor Jeffrey A. Nanzer
B.S. Computer Engineering	**Dec. 2018**
Michigan State University, East Lansing, MI	

Research Interests

Distributed radar/communications system coordination; software-defined radios; interferometric radar arrays; synthetic aperture radar (SAR); joint radar-communications (RadCom) systems; radar applications in robotics, aerospace, automotive, and human-computer interface (HCI).

Research Experience

Graduate Research Assistant   **Jan. 2019 – Present**
Distributed Electromagnetics Theory and Application (DELTA) Group   *Michigan State University, East Lansing*

- Research topics include:
    - High accuracy wireless radar/communications array coordination
    - Automotive low frequency communication waveform reuse for SAR imaging for scene mapping and localization
    - Correlation interferometric radar for direct multi-dimensional target tracking and distortion mitigation
- Mentored and trained new group members on lab equipment use and care, and measurement best practices
- Managed software-defined radio (SDR) resources for the research group
- Maintained two Python/C++ software packages for software-defined radio, radar, and distributed array coordination, simulation, and real-time signal processing

Summer Research scholar   **Summer 2023**
Lawrence Livermore National Laboratory   *Livermore, CA*

- Continuation of doctoral research related to the high accuracy time and frequency alignment of distributed wireless antenna arrays.

Undergraduate Research Assistant   **May 2018 – Dec. 2018**
Distributed Electromagnetics Theory and Application (DELTA) Group   *Michigan State University, East Lansing*

- Investigated various approaches to reduce tracking error and drift using Doppler-only radar array measurements
- Designed, simulated, and fabricated miniaturized Doppler radar baseband amplifier printed circuit board
- Designed and implemented real-time radar data acquisition, processing, and visualization package for Python using PyQtGraph
- Assisted with measurements and fabrication of microwave tomography device for forestry applications

Awards and Fellowships

IEEE MTT-S Graduate Fellowship Recipient   **2023 – 2024**
IEEE Microwave Theory and Technology Society

- For the support of research towards "High Accuracy Wireless Distributed Coherent Array Synchronization"

Young Scientist Awardee, URSI General Assembly   **Aug. 2023**
International Union of Radio Science (URSI)

- For the paper "Picosecond Non-Line-of-Sight Wireless Time and Frequency Synchronization for Coherent Distributed Aperture Antenna Arrays"

Honorable Mention, IEEE International Symposium on Antennas and Propagation Student Paper Contest
                                                       July 2023

IEEE Antennas and Propagation Society

- For the paper "Wireless Time and Phase Alignment for Wideband Beamforming in Distributed Phased Arrays"

First Place, IEEE/MTT-S International Microwave Symposium (IMS) Student Paper Contest   **June 2023**
IEEE Microwave Theory and Technology Society

- For the paper "High Accuracy Wireless Time-Frequency Transfer For Distributed Phased Array Beamforming"

Departmental Finalist (Electrical Eng.), Fitch H. Beach Award for Outstanding PhD Research in Engineering   **Mar. 2023**
Michigan State University, College of Engineering

Second Place, IEEE AP-S Student Design Competition   **July 2020**
IEEE Antennas and Propagation Society

- For the project "A Low-Cost 5.8 GHz FMCW Radar For Drone Tracking"

Finalist, NHTSA Student Safety Technology Design Competition   **July 2017**
Electronic Safety of Vehicles Conference

- For the project "Doppler Radar Pedestrian Classifier"

Teaching and Mentoring Experience

Graduate Mentor   **Sept. 2020 – Present**
Distributed Electromagnetics Theory and Application (DELTA) Group   *Michigan State University, East Lansing*

- Mentored undergraduate and incoming graduate research assistants on research related towards wireless distributed coordination and antennas and microwave system fabrication and testing

Undergraduate Teaching Assistant   **Spring 2017**
Introduction to Programming I in Python (CSE 231)   *Michigan State University, East Lansing*

- Led weekly lab session, including a weekly skills recap presentation
- Graded lab section's weekly project assignments
- Worked weekly help room and answered questions via online forum

Professional Experience

Engineering Intern, Supply Chain   **Summer 2017**
Cisco Systems   *San Jose, CA*

Virtual Manufacturing Test Platform Lab Management System

- Developed and implemented hardware and software to replace physical manufacturing test platform networks and terminal servers with all-in-one wireless module and virtualized private networks using a custom wireless embedded compute system
- Developed scripts to image, set-up, and update the network of devices, and a web interface to reconfigure virtual lab environments

Powertrain Software Engineering Intern   **Summer 2016**
Stellantis (Formerly, Fiat Chrysler Automobiles)   *Auburn Hills, MI*

Real-Time Combustion Physics Software Optimization

- Learned essential PowerPC assembly instructions and basic statistical methods for software optimization
- Developed MATLAB script to analyze disassembly traces for slow conditions

- Identified inefficient implementation of exponentiation function and replaced with an alternative implementation which doubled effective execution rate of the overall software

Embedded Linux Applications Engineering Intern   **Summer 2015**
Texas Instruments   *Dallas, TX*

Real-Time Industrial Control Reference Design
- Developed reference design hardware and software for PID brushed motor control and web interface for tuning utilizing an ARM Linux processor and real-time coprocessors (http://www.ti.com/tool/TIDEP0073)
- Learned to develop Linux Kernel modules and fixed point emulation for integer ALUs

Software Engineering Intern   **Summer 2013, 2014**
Reliable Solutions and Services (Re-Sol)   *Auburn Hills, MI*
- Designed, authored, and maintained software for multiple fuel flow measurement lines using C++, Windows CE, and PIC MCUs
- Set up an internal Git Source Code Management system for Re-Sol software source control
- Assembled and wired cabinets for fuel flow measurement systems to be shipped to automotive OEMs

Publications

Array Phase Center Dynamics Using Spatial Amplitude Modulation for High Efficiency Secure Wireless Communication

Jacob R. Randall, **Jason M. Merlo**, Amer Abu Arisheh, and Jeffrey A. Nanzer   **Aug. 2023**
IEEE Antennas and Wireless Propagation Letters   *doi: 10.1109/TAP.2023.3323141*

A Dynamic Array Using Spatial Amplitude Modulation with an Asymmetric Wilkinson Power Divider for Secure Wireless Applications

Jacob R. Randall, Amer Abu Arisheh, **Jason M. Merlo**, and Jeffrey A. Nanzer   **Aug. 2023**
IEEE Antennas and Wireless Propagation Letters   *doi: 10.1109/LAWP.2023.3310911*

Coherent Distributed Bistatic Radar Using Wireless Frequency Syntonization and Internode Ranging

Anton Schlegel, **Jason M. Merlo**, and Jeffrey A. Nanzer   **July 2023**
IEEE Microwave and Wireless Technology Letters   *doi: 10.1109/LMWT.2023.3283918*

Design of a Single-Element Dynamic Antenna for Secure Wireless Applications   **June 2023**
Amer Abu Arisheh, **Jason M. Merlo**, and Jeffrey A. Nanzer
IEEE Microwave and Wireless Technology Letters   *doi: 10.1109/TAP.2023.3288013*

Multiobjective Distributed Array Beamforming in the Near Field Using Wireless Syntonization   **Feb. 2023**
Ahona Bhattacharyya, **Jason M. Merlo**, Serge R. Mghabghab, Anton Schlegel, and Jeffrey A. Nanzer
IEEE Transactions on Antennas and Propagation   *doi: 10.1109/LMWT.2022.3231183*

Wireless Picosecond Time Synchronization for Distributed Antenna Arrays   **Dec. 2022**
Jason M. Merlo, Serge R. Mghabghab, and Jeffrey A. Nanzer
IEEE Transactions on Microwave Theory and Techniques   *doi: 10.1109/TMTT.2022.3227878*A

Microwave Tomography System Using Time-Reversal Imaging for Forestry Applications   **Oct. 2022**
Saptarshi Mukerjee, John Doroshewitz, **Jason M. Merlo**, Christopher Oakley, Lalita Udpa, David MacFarlane, Emily Huff, and Jeffrey A. Nanzer
IEEE Journal of Microwaves   *doi: 10.1109/JMW.2022.3199194*

A C-Band Fully Polarimetric Automotive Synthetic Aperture Radar   **Dec. 2021**
Jason M. Merlo and Jeffrey A. Nanzer
IEEE Transactions on Vehicular Technology   *doi: 10.1109/TVT.2021.3138348*

A Point Target Model for Interferometric Radar Angular Velocity Estimation   **Dec. 2021**
Eric Klinefelter, **Jason M. Merlo**, Hayder Radha, and Jeffrey A. Nanzer
IEEE Transactions on Microwave Theory and Techniques   *doi: 10.1109/TMTT.2021.3136265*

Distributed Antenna Array Dynamics for Secure Wireless Communication   **Dec. 2021**
Sean M. Ellison, **Jason M. Merlo**, and Jeffrey A. Nanzer
IEEE Transactions on Antennas and Propagation   *doi: 10.1109/TAP.2021.3137449*

Three Dimensional Velocity Measurement Using a Dual Axis Millimeter-Wave Interferometric Radar
Jason M. Merlo, Eric Klinefelter and Jeffrey A. Nanzer   **Nov. 2021**
IEEE Transactions on Microwave Theory and Techniques   *doi: 10.1109/TMTT.2021.3124251*

A Multiple Baseline Interferometric Radar for Multiple Target Angular Velocity Measurement   **Aug. 2021**
Jason M. Merlo, Eric Klinefelter, Stavros Vakalis, and Jeffrey A. Nanzer
IEEE Microwave and Wireless Components Letters   *doi: 10.1109/LMWC.2021.3079842*

Conference Papers and Presentations

High Accuracy Wireless Timing Synchronization Using Software Defined Radios   **Sept. 2023**
Ahona Bhattacharyya*, **Jason M. Merlo**, and Jeffrey A. Nanzer   Berlin, Germany
20th European Radar Conference (EuRAD), pp. 331–334   doi: *10.23919/EuRAD58043.2023.10289274*

High Accuracy Wireless Timing Synchronization Using Software Defined Radios   **Aug. 2023**
Jason M. Merlo*, and Jeffrey A. Nanzer   Tempe, Arizona, USA
GNU Radio Conference (GRCon)

Picosecond Non-Line-of-Sight Wireless Time and Frequency Synchronization for Coherent Distributed Aperture Antenna Arrays   **Aug. 2023**
Young Scientist Awardee   Sapporo, Japan
Jason M. Merlo*, and Jeffrey A. Nanzer
XXXVth General Assembly and Scientific Symposium of the International Union of Radio Science (URSI GASS)
                    doi: *10.23919/URSIGASS57860.2023.10265506*

Wireless Time and Phase Alignment for Wideband Beamforming in Distributed Phased Arrays   **July 2023**
Honorable Mention, Student Paper Contest   Portland, Oregon, USA
Jason M. Merlo*, and Jeffrey A. Nanzer
IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, pp. 365–366   doi: *10.1109/USNC-URSI52151.2023.10238024*

Sub-Millimeter Ranging Accuracy for Distributed Antenna Arrays Using Two-Way Time Transfer   **July 2023**
Naim Shandi*, **Jason M. Merlo**, and Jeffrey A. Nanzer   Portland, Oregon, USA
IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, pp. 517–518   doi: *10.1109/IMS37964.2023.10188022*

High Accuracy Wireless Time-Frequency Transfer For Distributed Phased Array Beamforming   **June 2023**
First Place, Student Paper Contest   San Diego, California, USA
Jason M. Merlo*, Anton Schlegel, and Jeffrey A. Nanzer
IEEE/MTT-S International Microwave Symposium (IMS), pp. 109–112   doi: *10.1109/IMS37964.2023.10188022*

Multi-Pass Automotive Synthetic Aperture Radar Image Fusion (*Invited*)   **May 2023**
Jason M. Merlo* and Jeffrey A. Nanzer   San Antonio, Texas, USA
IEEE Radar Conference   doi: *10.1109/RadarConf2351548.2023.10149757*

High Accuracy Wireless Time Synchronization for Distributed Antenna Arrays   **July 2022**
Jason M. Merlo* and Jeffrey A. Nanzer   Denver, Colorado, USA
IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, pp. 1966–1967   doi: 10.1109/AP-S/USNC-URSI47032.2022.9887217

A Dynamic Pattern Dipole Antenna for Secure Wireless Communications   **July 2022**
Amer Abu Arisheh*, **Jason M. Merlo**, and Jeffrey A. Nanzer   Denver, Colorado, USA
IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, pp. 1470–1471   doi: 10.1109/AP-S/USNC-URSI47032.2022.9887173

Joint Measurement of Target Angle and Angular Velocity Using Interferometric Radar with FM Waveforms
Sept. 2020
Jason M. Merlo*, Eric Klinefelter, and Jeffrey A. Nanzer   Florence, Italy (Virtual)
IEEE Radar Conference   doi: 10.1109/RadarConf2043947.2020.9266419

A Dual-Axis Interferometric Radar for Instantaneous 2D Angular Velocity Measurement   **July 2020**
Jason M. Merlo*, Eric Klinefelter, and Jeffrey A. Nanzer   Montréal, Canada (Virtual)
IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, pp. 1661–
1662   doi: 10.1109/IEEECONF35879.2020.9330294

A Microwave Tomography System Using Time-Reversal Imaging   **July 2019**
John Doroshewitz*, **Jason M. Merlo**, Christopher Oakley, Lalita Udpa, Jeffrey A. Nanzer, David MacFarlane,
Emily Huff, and Saptarshi Mukherjee   Atlanta, Georgia, USA
2019 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting

* denotes presenter   *doi: 10.1109/APUSNCURSINRSM.2019.8889157*

Collegiate Design Competitions

General Motors / SAE AutoDrive Challenge Competition   **Aug. 2017 – June 2021**
Project Manager / Team Co-Lead, Electrical Sub-Team Leader

- Leading overall vehicle development and electrical hardware development during four-year competition
Graduate Student Advisor: Perception Sub-Team

- Guiding efforts to develop, implement, and test object detection and lane-finding algorithms using camera,
  lidar, and radar using ROS in C++ and Python

IEEE Antennas and Propagation Society Student Design Competition   **Nov. 2019 – July 2020**
Drone Detection and Tracking Radar

- Led design, simulation, and assembly of PCB for a low-cost, 4-channel, 5.8 GHz FMCW drone detection and
  tracking radar system
- Collaborated with others to create a real-time tracking and data visualization dashboard using Python and
  PyQt/PyQtGraph
- Placed second overall and presented at the 2020 IEEE International Symposium on Antennas and Propagation
  and North American Radio Science Meeting
- Open sourced hardware, software source code and instructions – available at: https://gitlab.msu.edu/delta/
  aps2020-competition

NHTSA Safety Technology Design Competition   **Sept. 2016 – July 2017**
Doppler Radar Pedestrian Classifier

- Led team of students to designed, assemble, and test a portable X-band CW radar for pedestrian detection
- Placed in the top six semi-finalist teams and presented at the "Enhanced Safety of Vehicles" conference in
  Detroit, July 2017

MSU Solar Racing Team   **Sept. 2014 – Mar. 2015**
Electrical Sub-Team Member

- Wrote C library for SPI interface CAN controller and data-logging software for wireless communications via
  XBee radio.
- Designed PCB for MSP430 development board used to test CAN system, 7-segment dashboard displays
  driven by shift registers, and dc/dc step-down power supply, and dashboard PCB.

University Outreach

Introduce A Girl To Engineering Day   **Feb. 2019, 2020**
Volunteer
- Developed and ran interactive demonstrations for 4th-8th grade students to demonstrate electromagnetic scattering of different objects, and Doppler shift using a continuous-wave X-band Doppler radar and real-time visualization in Python

SpartaHack Hackathon   **2015 – 2017**
Founding Member, Organizer
- Helped with organization of the Spartahack hackathon for college and high school students from across the world

Spartan Hackers   **Fall 2015**
Founding Member
- Helped to organize and give talks at MSU on relevant computer science skills not taught in the classroom

Professional Service

Journal Reviewer
- IEEE Transactions on Antennas and Propagation
- IEEE Antennas and Wireless Propagation Letters
- IEEE Transactions on Intelligent Transportation Systems
- IEEE Signal Processing Letters

Conference Reviewer
- IEEE AP-S/URSI Symposium
- IEEE Vehicular Technology Conference
- European Conference on Antennas and Propagation (EUCaP)

Professional Memberships

- Institute of Electrical and Electronics Engineers (IEEE)
  - IEEE Aerospace and Electronic Systems (AESS)
  - IEEE Antennas and Propagation Society (AP-S)
- IEEE Microwave Theory and Technology Society (MTT-S)
- IEEE Vehicular Technology Society (VTS)

Technical Skills

Programming Languages, Tools and Skills:
- Python (Numpy, SciPy, PyQt, PyQtGraph, Matplotlib), C/C++, MATLAB, Parallel/high-performance computing, Docker, GNU Radio, ROS, OpenCV, Git, Shell Scripting, Computer Networks, Software Defined Radios (SDRs), UNIX system administration

Design Tools and Skills:
- KiCad EDA, ANSYS HFSS, Keysight ADS, SPICE (simulation), Autodesk AutoCAD, distributed element microwave circuits, antenna design, MVG StarLab antenna measurement