Jason M. Merlo

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Education

Ph.D. Electrical Engineering **Expected Aug. 2025**
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
- Mentor and train new group members on lab equipment use and care, and measurement best practices
- Manage software-defined radio (SDR) resources for the research group
- Develop and maintain two Python/C++ software packages for software-defined radio, radar, and distributed array coordination, simulation, and real-time signal processing
- Develop and maintain the “DELTA Framework,” a distributed computing framework for managing deployment and synchronization of libraries and applications in ephemeral, ad-hoc distributed, networked compute arrays

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

2nd Place, Student Paper Contest, IEEE International Symposium on Phased Array Systems & Technology
IEEE Boston Section **Sept. 2024**
- For the paper "Fully Wireless Collaborative Beamforming Using A Three-Element Coherent Distributed Phased Array"

Finalist, Student Paper Contest, IEEE International Symposium on Antennas and Propagation **July 2024**
IEEE Antennas and Propagation Society
- For the paper "Distributed Interferometric Radar for Radial and Angular Velocity Measurement"

Finalist, Student Paper Contest & Top Papers of IMS 2024, IEEE/MTT-S International Microwave Symposium (IMS) **June 2024**
IEEE Microwave Theory and Technology Society
- For the paper "Fully Wireless Coherent Distributed Phased Array System for Networked Radar Applications"

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
IEEE Antennas and Propagation Society **July 2023**
- 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

Decentralized Picosecond Synchronization for Distributed Wireless Systems **Oct. 2024**
Naim Shandi, **Jason M. Merlo**, and Jeffrey A. Nanzer
IEEE Transactions on Communications *doi: 10.1109/TCOMM.2024.3480993*

Fully Wireless Coherent Distributed Phased Array System for Networked Radar Applications **Mar. 2024**
Jason M. Merlo, Samuel Wagner, John Lancaster, and Jeffrey A. Nanzer
IEEE Microwave and Wireless Technology Letters *doi: 10.1109/LMWT.2024.3375085*

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**
I*EEE 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

** Denotes Presenter*

Fully Wireless Collaborative Beamforming Using A Three-Element Coherent Distributed Phased Array
2nd Place, Student Paper Contest **Sept. 2024**
Jason M. Merlo*, Naim Shandi, Matthew Dula, Ahona Bhattacharyya, and Jeffrey A. Nanzer
IEEE International Symposium on Phased Array Systems & Technology (PAST) Boston, Massachusetts, USA

Distributed Interferometric Radar for Radial and Angular Velocity Measurement **July 2024**
Jason M. Merlo*, and Jeffrey A. Nanzer Florence, Italy
IEEE International Symposium on Antennas and Propagation and INC/USNC-URSI Radio Science Meeting (AP-S/INC-USNC-URSI) doi: 10.1109/AP-S/INC-USNC-URSI52054.2024.10686149

High Accuracy Decentralized Time Synchronization Using SNR Based Weighting **July 2024**
Naim Shandi*, **Jason M. Merlo**, and Jeffrey A. Nanzer Florence, Italy
IEEE International Symposium on Antennas and Propagation and INC/USNC-URSI Radio Science Meeting (AP-S/INC-USNC-URSI) doi: 10.1109/AP-S/INC-USNC-URSI52054.2024.10686155

A Distributed Microwave Correlation Interferometer for Fourier Domain Imaging Using Wireless Time and Frequency Coordination **July 2024**
Derek Luzano*, **Jason M. Merlo**, Daniel Chen, Jorge R. Colon–Berrios, Ahona Bhattacharyya, and Jeffrey A. Nanzer Florence, Italy
IEEE International Symposium on Antennas and Propagation and INC/USNC-URSI Radio Science Meeting (AP-S/INC-USNC-URSI) doi: 10.1109/AP-S/INC-USNC-URSI52054.2024.10686889

Fully Wireless Coherent Distributed Phased Array System for Networked Radar Applications **June 2024**
Finalist, Student Paper Contest Washington, D.C., USA
Jason M. Merlo*, Samuel Wagner, John Lancaster, and Jeffrey A. Nanzer
IEEE Microwave and Wireless Technology Letters / MTT-S International Microwave Symposium (IMS)
doi: 10.1109/LMWT.2024.3375085

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

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

MSU Science Festival **April 2024**

Exhibitor

- Collaborated to prepare and staff a booth discussing our work on distributed communication and sensing technologies to a general audience, including a demonstrating of distributed time synchronization.

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 Radar Systems
- 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