ELECTRICAL AND COMPUTER ENGINEERING (ECE)

at the

University of Michigan

RECENT FACULTY PUBLICATIONS, PATENTS, AND CURRENT STUDENTS

DECEMBER 2021

UNIVERSITY OF MICHIGAN

Graduate Offices

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ECE at Michigan is a top-ranked, world-class department that is pushing the boundaries of research in the most high-tech and innovative areas affecting society. Our faculty and students are relentless in their pursuit of excellence, and apply their knowledge and skills to the needs of society.

At Michigan ECE, students learn, create, play, make lifelong friends, and one day join an enormous network of 19,000+ welcoming alumni. Our graduate program is designed around the excellence, diversity, and curiosity of our students.

This document provides current and prospective students a summary of recent research publications and related information about tenure and tenure-track faculty in Electrical and Computer Engineering (ECE) at the University of Michigan.

Michigan ECE faculty specialize in the areas listed below, while continually reaching into new areas and collaborating across disciplines with faculty throughout the University of Michigan, the country, and the world. The University of Michigan has more than 100 graduate programs ranked in the top 10 by U.S News & World Report, including ECE.

Get ready to change the world by sharpening your expertise in any of the following areas:

- Applied Electromagnetics & RF Circuits
- Computer Vision
- Control Systems
- Embedded Systems
- ECE Education Research
- Integrated Circuits & VLSI
- MEMS & Microsystems
- Network, Communication, and Information Systems
- Optics & Photonics
- Plasma Science and Engineering
- Power & Energy
- Quantum Science and Engineering
- Robotics and Autonomous Systems
- Signal & Image Processing and Machine Learning
- Solid-State Devices & Nanotechnology

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Afshari, Ehsan

Website: http://unic.eecs.umich.edu/

Research Interests: High frequency circuits and systems for imaging, bio-sensing, and high data rate communication.

Recent Publications

- Khoeini F, Hadidian B, Zhang K, Afshari E, "A transimpedance-to-noise optimized analog front-end with high PSRR for pulsed TOF lidar receivers," IEEE Transactions on Circuits and Systems I: Regular Papers, 9/1/2021, https://doi.org/10.1109/TCSI.2021.3089098
- Chen L, Nooshabadi S, Khoeini F, Khalifa Z, Hadidian B, Afshari E, "An ultra-fast frequency shift mechanism for high data-rate sub-THz wireless communications in CMOS," Applied Physics Letters, 6/14/2021, https://doi.org/10.1063/5.0055503
- Chen L, Nooshabadi S, Cathelin A, Afshari E, "A Compact 196 GHz FSK Transmitter for Point-to-Point Wireless Communication with Novel Direct Modulation Technique," Digest of Papers - IEEE Radio Frequency Integrated Circuits Symposium, 6/7/2021, https://doi.org/10.1109/RFIC51843.2021.9490475
- Fayazi M, Colter Z, Afshari E, Dreslinski R, "Applications of Artificial Intelligence on the Modeling and Optimization for Analog and Mixed-Signal Circuits: A Review," IEEE Transactions on Circuits and Systems I: Regular Papers, 6/1/2021, https://doi.org/10.1109/TCSI.2021.3065332
- Hadidian B, Khoeini F, Hossein Naghavi SM, Cathelin A, Afshari E, "An Energy Efficient Fully Integrated 20Gbps OOK Wireless Transmitter at 220GHz," Proceedings of the Custom Integrated Circuits Conference, 4/1/2021, https://doi.org/10.1109/CICC51472.2021.9431436
- Hossein Naghavi SM, Seyedabbaszadehesfahlani S, Khoeini F, Cathelin A, Afshari E, "A 250GHz Autodyne FMCW Radar in 55nm BiCMOS with Micrometer Range Resolution," Digest of Technical Papers - IEEE International Solid-State Circuits Conference, 2/13/2021, https://doi.org/10.1109/ISSCC42613.2021.9365759
- Aghasi H, Naghavi SMH, Tavakoli Taba M, Aseeri MA, Cathelin A, Afshari E, "Terahertz electronics: Application of wave propagation and nonlinear processes," Applied Physics Reviews, 6/1/2020, https://doi.org/10.1063/1.5129403
- Taba MT, Khalifa Z, Naghavi SMH, Afshari E, "Progress towards fully on-chip frequency-stabilization for sub-terahertz sources," 2020 IEEE 20th Topical Meeting on

Silicon Monolithic Integrated Circuits in RF Systems, SiRF 2020, 1/1/2020, https://doi.org/10.1109/SIRF46766.2020.9040182

- Khoeini F, Hadidian B, Zhang K, Afshari E, "Reflection-Based Short Pulse Generation in CMOS," IEEE Solid-State Circuits Letters, 1/1/2020, https://doi.org/10.1109/LSSC.2020.3018129

Current Graduate Students Advised

- Hamad Alotaibi, ECE PhD
- Lili Chen, ECE PhD
- James Gruber, ECE PhD
- Bahareh Hadidian, ECE PhD
- Zainulabideen Khalifa, ECE PhD
- Farzad Khoeini, ECE PhD
- Aditya Varma Muppala, ECE PhD (co-advised)
- Seyyedmohammadhossein Naghavi, ECE PhD
- Morteza Tavakoli Taba, ECE PhD

Ahmadi, Elaheh

Website: https://ahmadi.engin.umich.edu/

Research Interests: Epitaxial growth, fabrication and characterization of III-N and Oxide semiconductor materials and devices for high power and high frequency applications.

Recent Publications

- Jian AZ, Khan K, Ahmadi E, "*β*-$(Ga)_2O_3$ for High Power Applications: A Review on Material Growth and Device Fabrication," chapter in Wide Bandgap Semiconductor Electronics and Devices, 2/1/2020, https://doi.org/10.1142/9789811216480_0006
- Jian ZA, Sayed I, Mohanty S, Liu W, Ahmadi E, "Improved operational reliability of MOCVD-grown AlSiO gate dielectric on *β*-$(Ga)_2O_3$(001) by post-metallization annealing," Semiconductor Science and Technology, 9/1/2021, https://doi.org/10.1088/1361-6641/ac1566
- Wang P, Wang D, Wang B, Mohanty S, Diez S, Wu Y, Sun Y, Ahmadi E, Mi Z, "N-polar ScAlN and HEMTs grown by molecular beam epitaxy," Applied Physics Letters, 8/23/2021, https://doi.org/10.1063/5.0055851
- Romanczyk B, Guidry M, Zheng X, Shrestha P, Li H, Ahmadi E, Keller S, Mishra UK, "Evaluation of linearity at 30 GHz for N-polar GaN deep recess transistors with 10.3 W/mm of output power and 47.4% PAE," Applied Physics Letters, 8/16/2021, https://doi.org/10.1063/5.0058587
- Mohanty S, Sayed I, Jian Z, Mishra U, Ahmadi E, "Investigation and optimization of HfO_2 gate dielectric on N-polar GaN: Impact of surface treatments, deposition, and annealing conditions," Applied Physics Letters, 7/26/2021, https://doi.org/10.1063/5.0053886
- Jian Z, Sayed I, Liu W, Mohanty S, Ahmadi E, "Characterization of MOCVD-grown AlSiO gate dielectric on *β*-Ga_2O_3(001)," Applied Physics Letters, 4/26/2021, https://doi.org/10.1063/5.0048990
- Clymore CJ, Mohanty S, Jian Z, Krishna A, Keller S, Ahmadi E, "HfO_2as gate insulator on N-polar GaN-AlGaN heterostructures," Semiconductor Science and Technology, 3/1/2021, https://doi.org/10.1088/1361-6641/abe21c
- Jian ZA, Mohanty S, Ahmadi E, "Switching Performance Analysis of 3.5 kV Ga_2O_3 Power FinFETs," IEEE Transactions on Electron Devices, 2/1/2021, https://doi.org/10.1109/TED.2020.3043988

- Mohanty S, Diez S, Jian ZA, Ahmadi E, "Design of ultra-scaled-channel N-polar GaN HEMTs with high charge density: A systematic study of hole traps and their impact on charge density in the channel," Journal of Applied Physics, 12/21/2020, https://doi.org/10.1063/5.0019222
- Mauze A, Zhang Y, Itoh T, Ahmadi E, Speck JS, "Sn doping of (010) β-Ga_2O_3 films grown by plasma-assisted molecular beam epitaxy," Applied Physics Letters, 11/30/2020, https://doi.org/10.1063/5.0027870
- Wu Y, Laleyan DA, Deng Z, Ahn C, Aiello AF, Pandey A, Liu X, Wang P, Sun K, Ahmadi E, Sun Y, Kira M, Bhattacharya P, Kioupakis E, Mi Z, "Controlling Defect Formation of Nanoscale AlN: Toward Efficient Current Conduction of Ultrawide-Bandgap Semiconductors," Advanced Electronic Materials, 9/1/2020, https://doi.org/10.1002/aelm.202000337
- Hatui N, Krishna A, Li H, Gupta C, Romanczyk B, Acker-James D, Ahmadi E, Keller S, Mishra UK, "Ultra-high silicon doped N-polar GaN contact layers grown by metal-organic chemical vapor deposition," Semiconductor Science and Technology, 9/1/2020, https://doi.org/10.1088/1361-6641/ab9727
- Diez S, Mohanty S, Kurdak C, Ahmadi E, "Record high electron mobility and low sheet resistance on scaled-channel N-polar GaN/AlN heterostructures grown on on-axis N-polar GaN substrates by plasma-assisted molecular beam epitaxy," Applied Physics Letters, 7/27/2020, https://doi.org/10.1063/5.0014460
- Khan K, Biswas M, Ahmadi E, "Growth of high quality (In,Ga)N films on O-face ZnO substrates by plasma-assisted molecular beam epitaxy," AIP Advances, 7/1/2020, https://doi.org/10.1063/5.0012854
- Jian Z, Mohanty S, Ahmadi E, "Deep UV-assisted capacitance-voltage characterization of post-deposition annealed Al_2O_3/β-Ga_2O_3 (001) MOSCAPs," Applied Physics Letters, 6/15/2020, https://doi.org/10.1063/5.0011144
- Jian ZA, Mohanty S, Ahmadi E, "Temperature-dependent current-voltage characteristics of β-Ga_2O_3 trench Schottky barrier diodes," Applied Physics Letters, 4/13/2020, https://doi.org/10.1063/5.0002520
- Romanczyk B, Guidry M, Zheng X, Li H, Ahmadi E, Keller S, Mishra UK, "Bias-Dependent Electron Velocity Extracted from N-Polar GaN Deep Recess HEMTs," IEEE Transactions on Electron Devices, 4/1/2020, https://doi.org/10.1109/TED.2020.2973081
- Bisi, D; Meneghesso, G; Mishra, U; Zanoni, E; Wienecke, S; Romanczyk, B; Li, H; Ahmadi, E; Keller, S; Guidry, M; De Santi, C; Meneghini, M, "Observation of I_DV_D Kink in N-Polar GaN MIS-HEMTs at Cryogenic Temperatures," IEEE Electron Device Letters, 3/1/2020, https://doi.org/10.1109/LED.2020.2968875
- Romanczyk B, Mishra UK, Zheng X, Guidry M, Li H, Hatui N, Wurm C, Krishna A, Ahmadi E, Keller S, Mishra U, "W-Band Power Performance of SiN-Passivated N-Polar

GaN Deep Recess HEMTs," IEEE Electron Device Letters, 3/1/2020, https://doi.org/10.1109/LED.2020.2967034

- Wurm C, Ahmadi E, Wu F, Hatui N, Keller S, Speck J, Mishra U, "Growth of high-quality N-polar GaN on bulk GaN by plasma-assisted molecular beam epitaxy," Solid State Communications, 1/1/2020, https://doi.org/10.1016/j.ssc.2019.113763

Current Graduate Students Advised

- Majid Aalizadeh, ECE PhD
- Zhe Jian, ECE PhD
- Kamruzzaman Khan, MSE PhD
- Md Irfan Khan, ECE PhD
- Stefan Kosanovic, ECE PhD
- Subhajit Mohanty, ECE PhD
- Oguz Odabasi, ECE PhD
- Ruby Wellen, ECE PhD
- Zhuoqun Wen, MSE PhD
- Xin Zhai, ECE PhD

Anastasopoulos, Achilleas

Website: https://anastasopoulos.engin.umich.edu/

Research Interests: Resource allocation on networked systems with emphasis on analysis of dynamic games and mechanism design; Information theory with emphasis on fundamental QoS limits in multiuser environments; Communication theory with emphasis on design of capacity-achieving transmission schemes for noisy channels.

Recent Publications

- Vasal D, Anastasopoulos A, "Signaling Equilibria for Dynamic LQG Games with Asymmetric Information," IEEE Transactions on Control of Network Systems, 9/1/2021, https://doi.org/10.1109/TCNS.2021.3059835
- Wei X, Anastasopoulos A, "Mechanism design for demand management in energy communities," Games, 9/1/2021, https://doi.org/10.3390/g12030061
- Sinha A, Anastasopoulos A, "Distributed mechanism design with learning guarantees for private and public goods problems," IEEE Transactions on Automatic Control, 10/1/2020, https://doi.org/10.1109/TAC.2019.2955999
- Anastasopoulos A, Pradhan S, "Decentralized sequential active hypothesis testing and the MAC feedback capacity," IEEE International Symposium on Information Theory - Proceedings, 6/1/2020, https://doi.org/10.1109/ISIT44484.2020.9174166
- Heydaribeni N, Anastasopoulos A, "Distributed Mechanism Design for Network Resource Allocation Problems," IEEE Transactions on Network Science and Engineering, 4/1/2020, https://doi.org/10.1109/TNSE.2019.2923959
- Anastasopoulos A, Pradhan S, "New perspectives on MAC feedback capacity using decentralized sequential active hypothesis testing paradigm," 2020 Information Theory and Applications Workshop, ITA 2020, 2/2/2020, https://doi.org/10.1109/ITA50056.2020.9244995

Current Graduate Students Advised

- Nasimeh Heydaribeni, ECE PhD
- Aathira Prasad, ECE PhD
- Xupeng Wei, ECE PhD

Avestruz, Al-Thaddeus

Website: https://avestruz.engin.umich.edu/

Research Interests: High Performance Power Electronics, Wireless Power Transfer. Complementary Interests in Circuits and Systems for Sensing, Electromagnetic Systems, Feedback and Controls, Renewable Energy, Automotive, Biomedical, and Consumer.

Recent Publications

- S. Y. Chu, X. Zan and A. -T. Avestruz, "Electromagnetic Model-Based Foreign Object Detection for Wireless Power Transfer," in IEEE Transactions on Power Electronics, vol. 37, no. 1, pp. 100-113, Jan. 2022, doi: 10.1109/TPEL.2021.3100420.
- A. Ramyar, Y. Altheyabi and A. -T. Avestruz, "Reliable Method for the Measurement of Diffusion Capacitance in Solar Photovoltaic Cells," 2021 IEEE Energy Conversion Congress and Exposition (ECCE), 2021, pp. 576-582, doi: 10.1109/ECCE47101.2021.9595437.
- J. Rademacher, X. Zan and A. Avestruz, "High Power, High Efficiency Wireless Power Transfer at 27.12 MHz Using CMCD Converters," 2021 IEEE Energy Conversion Congress and Exposition (ECCE), 2021, pp. 5698-5703, doi: 10.1109/ECCE47101.2021.9594951.
- Cui X, Deng C, Avestruz AT, "A fast response DC-DC converter with programmable ripple for combined distributed computation and communication," Conference Proceedings - IEEE Applied Power Electronics Conference and Exposition - APEC, 6/14/2021, https://doi.org/10.1109/APEC42165.2021.9487391
- Zhao S, Dongye Z, Wang Y, Zan X, Zhang H, Zheng S, Lu X, Avestruz AT, Lu F, "A 4kV/120A SiC Solid-State DC Circuit Breaker Powered by a Load-independent IPT System," IEEE Transactions on Industry Applications, 1/1/2021, https://doi.org/10.1109/TIA.2021.3084130
- Sarin A, Avestruz AT, "A framework for code division multiple access wireless power transfer," IEEE Access, 1/1/2021, https://doi.org/10.1109/ACCESS.2021.3116114
- Ramyar A, Avestruz A-T, "Reconfigurable Photovoltaic Emulator for Differential Diffusion Charge Redistribution Solar Modules," IEEE Open Journal of Industry Applications, 1/1/2021, https://doi.org/10.1109/ojia.2021.3063842
- Chu SY, Cui X, Zan X, Avestruz AT, "Transfer-Power Measurement Using a Non-Contact Method For Fair and Accurate Metering of Wireless Power Transfer in Electric Vehicles," IEEE Transactions on Power Electronics, 1/1/2021, https://doi.org/10.1109/TPEL.2021.3105689

- Zan X, Avestruz AT, "Isolated Ultrafast Gate Driver with Variable Duty Cycle for Pulse and VHF Power Electronics," IEEE Transactions on Power Electronics, 12/1/2020, https://doi.org/10.1109/TPEL.2020.2999481
- Zan X, Avestruz AT, "100 MHz Wireless Power Transfer for Lightweight UAVs and Agile Robots," Conference Proceedings - IEEE Applied Power Electronics Conference and Exposition - APEC, 3/1/2020, https://doi.org/10.1109/APEC39645.2020.9124492
- Sarin A, Abbot D, Revzen S, Avestruz AT, "Bidirectional Capacitive Wireless Power Transfer for Energy Balancing in Modular Robots," Conference Proceedings - IEEE Applied Power Electronics Conference and Exposition - APEC, 3/1/2020, https://doi.org/10.1109/APEC39645.2020.9124139
- Sarin A, Avestruz AT, "Code Division Multiple Access Wireless Power Transfer for Energy Sharing in Heterogenous Robot Swarms," IEEE Access, 1/1/2020, https://doi.org/10.1109/ACCESS.2020.3010202

Recent U.S. Patents

- Wireless Power Transfer Metering, #10732251, 2020
- Switched Receiver for Wireless Power Transfer, #10734844, 2020

Current Graduate Students Advised

- Ruiying Chai, ECE PhD
- Veronica Contreras, ECE PhD
- Xiaofan Cui, ECE PhD, Data Science Cert.
- Austin Lin, ECE PhD (co-advised)
- Alireza Ramyar, ECE PhD
- Xin Zan, ECE PhD

Balzano, Laura

Website: http://web.eecs.umich.edu/~girasole/

Research Interests: Statistical signal processing, machine learning, numerical linear algebra, and optimization theory and methods for dealing with large complex data.

Recent Publications

- Hong, D., Gilman, K., Balzano, L., & Fessler, J. A. (2021). HePPCAT: Probabilistic PCA for Data with Heteroscedastic Noise. IEEE Transactions on Signal Processing, 1–1. https://doi.org/10.1109/TSP.2021.3104979
- Lipor, J., Hong, D., Tan, Y. S., & Balzano, L. (2021). Subspace clustering using ensembles of K-subspaces. Information and Inference: A Journal of the IMA, 10(1), 73–107. https://doi.org/10.1093/imaiai/iaaa031
- Ongie, G., Pimentel-Alarcón, D., Balzano, L., Willett, R., & Nowak, R. D. (2021). Tensor Methods for Nonlinear Matrix Completion. SIAM Journal on Mathematics of Data Science, 253–279. https://doi.org/10.1137/20M1323448
- Lyu, H., Needell, D., & Balzano, L. (2020). Online matrix factorization for Markovian data and applications to Network Dictionary Learning. Journal of Machine Learning Research, 21(251), 1–49. http://jmlr.org/papers/v21/20-444.html
- Bower, A., & Balzano, L. (2020). Preference Modeling with Context-Dependent Salient Features. International Conference on Machine Learning, 1067–1077. https://proceedings.mlr.press/v119/bower20a.html

Current Graduate Students Advised

- Zhe Du, ECE PhD (co-advised)
- Geoffrey Fortman, ECE PhD
- Kyle Gilman, ECE PhD
- Byungsu Min, ECE PhD
- Rachel Rhoades, ECE PhD (co-advised)
- Alexander Ritchie, ECE PhD (co-advised)
- Javier Salazar Cavazos, ECE PhD (co-advised)
- Can Yaras, ECE PhD (co-advised)

Berenson, Dmitry

Website: http://web.eecs.umich.edu/~dmitryb/

Research Interests: Motion planning and machine learning for robotic manipulation.

Recent Publications

- Chou G, Berenson D, Ozay N, "Learning constraints from demonstrations with grid and parametric representations," International Journal of Robotics Research, 9/1/2021, https://doi.org/10.1177/02783649211035177
- Lin YC, Berenson D, "Long-horizon humanoid navigation planning using traversability estimates and previous experience," Autonomous Robots, 9/1/2021, https://doi.org/10.1007/s10514-021-09996-3
- Knuth C, Chou G, Ozay N, Berenson D, "Planning with Learned Dynamics: Probabilistic Guarantees on Safety and Reachability via Lipschitz Constants," IEEE Robotics and Automation Letters, 7/1/2021, https://doi.org/10.1109/LRA.2021.3068889
- Mitrano P, McConachie D, Berenson D, "Learning where to trust unreliable models in an unstructured world for deformable object manipulation," Science Robotics, 5/19/2021, https://doi.org/10.1126/scirobotics.abd8170
- Power T, Berenson D, "Keep it simple: Data-efficient learning for controlling complex systems with simple models," IEEE Robotics and Automation Letters, 4/1/2021, https://doi.org/10.1109/LRA.2021.3056368
- Zhong S, Zhang Z, Fazeli N, Berenson D, "TAMPC: A Controller for Escaping Traps in Novel Environments," IEEE Robotics and Automation Letters, 4/1/2021, https://doi.org/10.1109/LRA.2021.3057789
- Chou G, Ozay N, Berenson D, "Learning temporal logic formulas from suboptimal demonstrations: theory and experiments," Autonomous Robots, 1/1/2021, https://doi.org/10.1007/s10514-021-10004-x
- McConachie D, Dobson A, Ruan M, Berenson D, "Manipulating deformable objects by interleaving prediction, planning, and control," International Journal of Robotics Research, 7/1/2020, https://doi.org/10.1177/0278364920918299
- Saund B, Berenson D, "Fast Planning over Roadmaps via Selective Densification," IEEE Robotics and Automation Letters, 4/1/2020, https://doi.org/10.1109/LRA.2020.2972820

- Chou G, Ozay N, Berenson D, "Learning Constraints from Locally-Optimal Demonstrations under Cost Function Uncertainty," IEEE Robotics and Automation Letters, 4/1/2020, https://doi.org/10.1109/LRA.2020.2974427
- McConachie D, Power T, Mitrano P, Berenson D, "Learning When to Trust a Dynamics Model for Planning in Reduced State Spaces," IEEE Robotics and Automation Letters, 4/1/2020, https://doi.org/10.1109/LRA.2020.2972858
- Lin YC, Righetti L, Berenson D, "Robust Humanoid Contact Planning with Learned Zero- and One-Step Capturability Prediction," IEEE Robotics and Automation Letters, 4/1/2020, https://doi.org/10.1109/LRA.2020.2972825
- Knuth C, Chou G, Ozay N, Berenson D, "Inferring Obstacles and Path Validity from Visibility-Constrained Demonstrations," chapter in International Workshop on the Algorithmic Foundations of Robotics, 1/0/1900, https://doi.org/10.1007/978-3-030-66723-8_2

Current Graduate Students Advised

- Glen Chou, ECE PhD (co-advised)
- Ishank Juneja, ROB PhD
- Mark Van Der Merwe, ROB PhD
- Peter Mitrano, ROB PhD
- Tom Power, ROB PhD
- Johnson Zhong, ROB PhD

Bhattacharya, Pallab

Website: https://bhattacharya.engin.umich.edu/

Research Interests: Molecular beam epitaxy, low-dimensional quantum confined systems, quantum dot lasers and detectors, optoelectronic integrated circuits, spintronic devices.

Recent Publications

- Aggarwal T, Udai A, Banerjee D, Pendem V, Chouksey S, Saha P, Sankaranarayanan S, Ganguly S, Bhattacharya P, Saha D, "Investigation of Ultrafast Carrier Dynamics in InGaN/GaN-Based Nanostructures Using Femtosecond PumpProbe Absorption Spectroscopy," Physica Status Solidi (B) Basic Research, 10/1/2021, https://doi.org/10.1002/pssb.202100223
- Udai A, Aiello A, Aggarwal T, Saha D, Bhattacharya P, "Gradual Carrier Filling Effect in "green" InGaN/GaN Quantum Dots: Femtosecond Carrier Kinetics with Sequential Two-Photon Absorption," ACS Applied Materials and Interfaces, 9/22/2021, https://doi.org/10.1021/acsami.1c11096
- Aiello A, Das D, Bhattacharya P, "InGaN/GaN Quantum Dot Light-Emitting Diodes on Silicon with Coalesced GaN Nanowire Buffer Layer," ACS Applied Nano Materials, 2/26/2021, https://doi.org/10.1021/acsanm.0c03227
- Pandey A, Aiello A, Gim J, Hovden R, Kioupakis E, Bhattacharya P, Mi Z, "On the Origin of Efficiency Droop of AlGaN Deep Ultraviolet Light Emitting Diodes," 2020 IEEE Photonics Conference, IPC 2020 - Proceedings, 9/1/2020, https://doi.org/10.1109/IPC47351.2020.9252278
- Wu Y, Laleyan DA, Deng Z, Ahn C, Aiello AF, Pandey A, Liu X, Wang P, Sun K, Ahmadi E, Sun Y, Kira M, Bhattacharya P, Kioupakis E, Mi Z, "Controlling Defect Formation of Nanoscale AlN: Toward Efficient Current Conduction of Ultrawide-Bandgap Semiconductors," Advanced Electronic Materials, 9/1/2020, https://doi.org/10.1002/aelm.202000337
- Biswas M, Kumar R, Chatterjee A, Wu Y, Mi Z, Bhattacharya P, Pal SK, Chakrabarti S, "Effects of rapid thermal annealing in InGaN/GaN quantum disk-in-GaN nanowire arrays," Journal of Luminescence, 6/1/2020, https://doi.org/10.1016/j.jlumin.2020.117123
- Aiello A, Wu Y, Mi Z, Bhattacharya P, "Deep ultraviolet monolayer GaN/AlN disk-in-nanowire array photodiode on silicon," Applied Physics Letters, 2/10/2020, https://doi.org/10.1063/1.5135570

- Chung K, Pandey A, Sarwar T, Aiello A, Mi Z, Bhattacharya P, Ku PC, "Wavelength tuning in the purple wavelengths using strain-controlled $Al_xGa_{1-x}N$/GaN disk-in-wire structures," Applied Physics Letters, 1/27/2020, https://doi.org/10.1063/1.5140996
- Chung K, Pandey A, Sarwar T, Aiello A, Mi Z, Bhattacharya P, Ku PC, "Design chip-scale integration of tunable short-wavelength photonic devices," Optics InfoBase Conference Papers, 1/1/2020, https://doi.org/10.1364/CLEO_SI.2020.SF1O.4
- Das D, Aiello A, Guo W, Bhattacharya P, "InGaN/GaN Quantum Dots on Silicon with Coalesced Nanowire Buffer Layers: A Potential Technology for Visible Silicon Photonics," IEEE Transactions on Nanotechnology, 1/1/2020, https://doi.org/10.1109/TNANO.2020.3007732

Current Graduate Students Advised

- Ayush Pandey, EE MS (co-advised)

Blaauw, David

Website: https://blaauw.engin.umich.edu/

Research Interests: Low power and high performance VLSI design; Low power wireless sensors and embedded systems.

Recent Publications

- Bick CS, Lee I, Coote T, Haponski AE, Blaauw D, Foighil D, "Millimeter-sized smart sensors reveal that a solar refuge protects tree snail Partula hyalina from extirpation," Communications Biology, 12/1/2021, https://doi.org/10.1038/s42003-021-02124-y
- Bao, Y; Wadden, J; Erb-Downward, J; Ranjan, P; Zhou, W; McDonald, T; Mills, R; Boyle, A; Dickson, R; Blaauw, D; Welch, J, "SquiggleNet: real-time, direct classification of nanopore signals," , 10/27/2021, https://doi.org/10.1186/s13059-021-02511-y
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Recent U.S. Patents

- Error recovery within integrated circuit, #10572334, 2020
- Error recovery within integrated circuit, #10579463, 2020
- Analog-To-Digital Conversion Circuit and Image Sensor Including the Same, #10594333, 2020
- Low-Power, Long-Range RF Localization System and Method, #10746844, 2020
- Millimeter-scale bluetooth low energy transmitter with dual purpose loop antenna, #10911078, 2021
- Devices and methods to control clamping devices, #11024624, 2021

Current Graduate Students Advised

- Andrea Bejarano, ECE PhD (co-advised)
- Kuan-Yu Chen, ECE PhD
- Joseph Costello, ECE PhD (co-advised)
- Alhad Daftardar, ECE PhD (co-advised)
- Zhen Feng, ECE PhD
- Yichen Gu, ECE PhD (co-advised)
- Jungho Lee, ECE PhD
- Rohit Rothe, ECE PhD

- Jihwan Seol, ECE PhD (co-advised)
- Chien-Wei Tseng, ECE PhD
- Yunfan Wang, ECE PhD
- Zhehong Wang, ECE PhD

Deotare, Parag

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Research Interests: Research includes light-matter interaction in nanoscale systems and the development of low energy photonic and excitonic devices for applications in data communication and life sciences.

Recent Publications

- Sung S. H., Schnitzer N., Novakov S., Baggari I., Luo X., Gim J., Vu N., Li Z., Brintlinger T., Sun Y., Deotare P. B., Sun K., Zhao L., Kourkoutis L. F., Heron J. T. and Hovden R.," Two-dimensional electronic order stabilized in clean polytype heterostructures", Nature Communications, (accepted).
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Current Graduate Students Advised

- Kanak Datta, ECE PhD
- Zidong Li, ECE PhD
- Zhengyang Lyu, AP PhD
- Che-Hsuan Cheng, MSE PhD
- Xiaheng Huang, ECE PhD (co-advised)

Dick, Robert

Website: http://robertdick.org/

Research Interests: Embedded systems.

Recent Publications

- Chang Y, Zhao Y, Dong M, Wang Y, Lu Y, Lv Q, Dick RP, Lu T, Gu N, Shang L, "MemX: An Atention-Aware Smart Eyewear System for Personalized Moment Auto-capture," Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies, 6/1/2021, https://doi.org/10.1145/3463509
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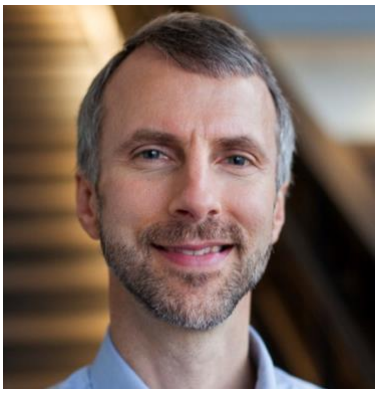
- Ma Y, Zhou J, Chantem T, Dick RP, Wang S, Hu XS, "Online Resource Management for Improving Reliability of Real-Time Systems on "Big-Little" Type MPSoCs," IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, 1/1/2020, https://doi.org/10.1109/TCAD.2018.2883990

Current Graduate Students Advised

- Ekdeep Singh Lubana, ECE PhD
- Tony Zhang, ECE PhD



Fessler, Jeffrey A.

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Research Interests: Statistical signal and image processing; Tomographic imaging; Parameter estimation; machine-learning methods for inverse problems.

Recent Publications

- Zhang, D; Xu, Z; Huang, Z; Gutierrez, A; Blocker, C; Liu, C; Lien, M; Cheng, G; Liu, Z; Chun, I; Fessler, J; Zhong, Z; Norris, T, "Neural network based 3D tracking with a graphene transparent focal stack imaging system," Nature Communications, 12/1/2021, https://doi.org/10.1038/s41467-021-22696-x
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- Muthukrishnan H, Nellans D, Lustig D, Fessler JA, Wenisch TF, "Efficient multi-GPU shared memory via automatic optimization of fine-grained transfers," Proceedings - International Symposium on Computer Architecture, 6/1/2021, https://doi.org/10.1109/ISCA52012.2021.00020
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- Shah NP, Marleau P, Fessler JA, Chichester DL, Wehe DK, "Improved Localization Precision and Angular Resolution of a Cylindrical, Time-Encoded Imaging System from Adaptive Detector Movements," IEEE Transactions on Nuclear Science, 4/1/2021, https://doi.org/10.1109/TNS.2021.3060071
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- Gao M, Samala RK, Fessler JA, Chan HP, "Deep convolutional neural network denoising for digital breast tomosynthesis reconstruction," Progress in Biomedical Optics and Imaging - Proceedings of SPIE, 1/1/2020, https://doi.org/10.1117/12.2549361
- Lim H, Dewaraja YK, Fessler JA, "Joint low-count PET/CT segmentation and reconstruction with paired variational neural networks," Progress in Biomedical Optics and Imaging - Proceedings of SPIE, 1/1/2020, https://doi.org/10.1117/12.2543252
- Chun IY, Fessler JA, "Convolutional Analysis Operator Learning: Acceleration and Convergence," IEEE Transations on Image Processing, 1/1/2020, https://doi.org/10.1109/TIP.2019.2937734
- Lin CY, Fessler JA, "Efficient Regularized Field Map Estimation in 3D MRI," IEEE Transactions on Computational Imaging, 1/1/2020, https://doi.org/10.1109/TCI.2020.3031082
- Ravishankar S, Ye JC, Fessler JA, "Image Reconstruction: From Sparsity to Data-Adaptive Methods and Machine Learning," Proceedings of the IEEE, 1/1/2020, https://doi.org/10.1109/JPROC.2019.2936204
- Lim H, Chun IY, Dewaraja YK, Fessler JA, "Improved Low-Count Quantitative PET Reconstruction With an Iterative Neural Network.," IEEE Trans. Medical Imaging, 1/1/2020, https://doi.org/10.1109/TMI.2020.2998480

- Chun IY, Huang Z, Lim H, Fessler J, "Momentum-Net: Fast and convergent iterative neural network for inverse problems," IEEE Transactions on Pattern Analysis and Machine Intelligence, 1/1/2020, https://doi.org/10.1109/TPAMI.2020.3012955
- Moore BE, Ravishankar S, Nadakuditi RR, Fessler JA, "Online Adaptive Image Reconstruction (OnAIR) Using Dictionary Models," IEEE Transactions on Computational Imaging, 1/1/2020, https://doi.org/10.1109/TCI.2019.2931092
- Fessler JA, "Optimization Methods for Magnetic Resonance Image Reconstruction: Key Models and Optimization Algorithms," IEEE Signal Processing Magazine, 1/1/2020, https://doi.org/10.1109/MSP.2019.2943645
- Abella M, Martinez C, Desco M, Vaquero JJ, Fessler JA, "Simplified Statistical Image Reconstruction for X-ray CT with Beam-Hardening Artifact Compensation," IEEE Transactions on Medical Imaging, 1/1/2020, https://doi.org/10.1109/TMI.2019.2921929

Current Graduate Students Advised

- Cameron Blocker, ECE PhD, Comput Discovery & Engin Cert
- Eric Cheek, ECE PhD
- Caroline Crockett, ECE PhD, Engin Education Research Cert (co-advised)
- Mingjie Gao, ECE PhD (co-advised)
- Shouchang Guo, ECE PhD (co-advised)
- Anish Lahiri, ECE MSE (co-advised)
- Zongyu Li, ECE PhD
- Amaya Murguia, ECE PhD (co-advised)
- Naveen Murthy, ECE PhD
- Javier Salazar Cavazos, ECE PhD (co-advised)
- Guanhua Wang, BME PhD (co-advised)
- Steven Whitaker, ECE PhD (co-advised)
- Haowei Xiang, ECE PhD (co-advised)

Finelli, Cynthia

Website: https://finelli.engin.umich.edu/

Research Interests: Engineering education research: evidence-based teaching, active learning, faculty practices that support diverse students, student learning, institutional change, with current projects studying: Motivators and barriers to adoption of active learning; Student resistance to active learning; Success of STEM undergraduate students with neurodiversities (e.g., ADHD); Ways to help engineers become better public welfare watchdogs.

Recent Publications

2021 in alphabetical order

- Andrews, M., Prince, M., Finelli, C. J., Graham, M., Borrego, M., & Husman, J. (2021). Explanation and facilitation strategies reduce student resistance to active learning. College Teaching, published online 10/08/21. https://DOI:10.1080/87567555.2021.1987183 Available as open access
- Brennan-Wydra, E., Henderson, T., Johnson, A. W., Millunchick, J. M., & Finelli, C. J. (2021). The role of college knowledge and proactive behavior on participation in co-curricular activities. Journal of Engineering Education, 110(1), 114-142. https://DOI:10.1002/jee.20380
- Crockett, C., Finelli, C. J., DeMonbrun, M., Nguyen, K., Tharayil, S., Shekhar, P., & Rosenberg R. (2021). Common characteristics of high-quality papers studying student response to active learning. International Journal of Engineering Education, 37(2), 420-432.
- Johnson, A. W., Su, M. P.*, Blackburn, M. W.*, & Finelli, C. J. (2021). Instructor use of a flexible classroom to facilitate active learning in undergraduate engineering courses. European Journal of Engineering Education, 46(4), 618-635. https://DOI:10.1080/03043797.2020.1865878 Available as open access
- Millunchick, J. M., Brennan-Wydra, E., Henderson, T., Johnson, A. W., Millunchick, J. M., & Finelli, C. J. (2021). The role of college knowledge and proactive behavior on participation in co-curricular activities. Journal of Engineering Education, 110(1), 114-142.
- Nguyen, K. A., Borrego, M., Finelli, C. J., DeMonbrun, M., Crockett, C., Tharayil, S., Shekhar, P., Waters, C., & Rosenberg, R. (2021). Instructor strategies for implementing active learning: A systematic literature review. International Journal of STEM Education, 8(1), 9. https://DOI:10.1186/s40594-021-00270-7 Available as open access

2020 in alphabetical order

- Andrews, M. E., Graham, M., Prince, M. J., Borrego, M., Finelli, C. J., & Husman, J. (2020). Student resistance to active learning: Do instructors (mostly) get it wrong? Australasian Journal of Engineering Education, 25(2), 142-153. https://DOI: 10.1080/22054952.2020.1861771
- Brennan-Wydra, E., Millunchick, J. M., Henderson, T., Johnson, A. W., & Finelli, C. J. (2020 Jul/Aug). Investigating the adaptation of socialization processes scales in engineering education context. International Journal of Engineering Education, 36(4), 1383-1395.
- Carroll, L. J., & Finelli, C. J. (2021, Jul). Work in Progress: College students with ADHD: A framework for studying the role of precollege factors and teaching practices on academic success. Proceedings of the 2021 ASEE Annual Conference & Exposition (virtual conference).
- Carroll, L. J., Marlor, L. K., Finelli, C. J., Graham, M. C., Andrews, M. E., Husman, J., Prince, M. J., & Borrego, M. (2021, Jul). Applying research on reducing student resistance to active learning through faculty development: Project update. Proceedings of the 2021 ASEE Annual Conference & Exposition (virtual conference).
- Crockett, C. E., & Finelli, C. J. (2021, Jul). Factors influencing conceptual understanding in a signals and systems course. Proceedings of the 2021 ASEE Annual Conference & Exposition (virtual conference).
- Crockett, C. E., Powell, H., & Finelli, C. J. (2020, Jun). Work in Progress: A longitudinal study of students' conceptual understanding of signals and systems. Proceedings of the 2020 ASEE Annual Conference & Exposition (virtual conference).
- Finelli, C. J., & Borrego, M. J. (2020). Evidence-based strategies to reduce student resistance to active learning. In J. J. Mintzes & E. M. Walter (Eds.), Active learning in college science: The case for evidence-based practice. pp. 943-952. Cham, Switzerland: Springer Nature.
- Husman, J. E., Graham, M. C., Borrego, M. J., Finelli, C. J., Prince, M. J., & Bermudez, B. (2020, Apr). Reducing student resistance to active learning: Development and validation of a measure [Roundtable]. Accepted for presentation at 2020 American Educational Research Association (AERA) Annual Conference, San Francisco, CA (conference cancelled due to COVID-19).
- Marlor, L. K., Carroll, L. J., & Finelli, C. J. (2021, Jul). Work in progress: Barriers faculty encounter when using active learning in an online classroom setting. Proceedings of the 2021 ASEE Annual Conference & Exposition (virtual conference).
- Marlor, L. K., Finelli, C. J., Andrews, M. E., Bermudez, B., Borrego, M., Carroll, L., Derosia, N. M., Graham, M. C., Husman, J., & Prince, M. J. (2020, Jun). Reducing student

resistance to active learning: Applying research results to faculty development. Proceedings of the 2020 ASEE Annual Conference & Exposition (virtual conference).

- Shekhar, P., Borrego, M., DeMonbrun, M., Finelli, C. J., Crockett, C., & Nguyen, K. (2020, Jul/Aug). Negative student responses to active learning in STEM classrooms: A systematic review of underlying reasons. Journal of College Science Teaching, 49(6), 45-54.

Current Graduate Students Advised

- Caroline Crockett, ECE PhD, Engin Education Research Cert (co-advised)
- Laura Carroll, Engin Education Research PhD
- Gabriel Draughon, Civil Environ Engin PhD, Engin Education Research Cert (co-advised)
- Lea Marlor, Engin Education Research PhD
- Mary Judge, ECE PhD, Engin Education Research MS (co-advised)
- Xiaping Li, Engin Education Research PhD
- Nolgie Oquendo Colon, Engine Education Research PhD

Flynn, Michael P.

Website: https://www.mpflynngroup.com/

Research Interests: Analog circuits, analog-to-digital conversion, RF and wireless circuits. high-speed serial transceivers.

Recent Publications

- Lu R, Flynn MP, "A 300MHz-BW 38mW 37dB/40dB SNDR/DR Frequency-Interleaving Continuous-Time Bandpass Delta-Sigma ADC in 28nm CMOS," IEEE Symposium on VLSI Circuits, Digest of Technical Papers, 6/13/2021, https://doi.org/10.23919/VLSICircuits52068.2021.9492383
- Zheng B, Jie L, Flynn MP, "A 6-GHz MU-MIMO eight-element direct digital beamforming TX utilizing FIR H-Bridge DAC," IEEE Transactions on Microwave Theory and Techniques, 6/1/2021, https://doi.org/10.1109/TMTT.2021.3064318
- Lu R, Weston C, Weyer D, Buhler F, Lambalot D, Flynn MP, "A 16-Element Fully Integrated 28-GHz Digital RX Beamforming Receiver," IEEE Journal of Solid-State Circuits, 5/1/2021, https://doi.org/10.1109/JSSC.2021.3067504
- Kang T, Lee S, Haghigat M, Abramson D, Flynn M, "A 50W 4-channel 83dBA-SNDR Speech Recognition Front-End with Adaptive Beamforming and Feature Extraction," Proceedings of the Custom Integrated Circuits Conference, 4/1/2021, https://doi.org/10.1109/CICC51472.2021.9431579
- Brown PL, O'Shaughnessy M, Rozell C, Romberg J, Flynn M, "A 17.8-MS/s compressed sensing radar accelerator using a spiking neural network," IEEE Journal of Solid-State Circuits, 3/1/2021, https://doi.org/10.1109/JSSC.2020.3025864
- Jie L, Chen HW, Zheng B, Flynn MP, "10.3 A 100MHz-BW 68dB-SNDR Tuning-Free Hybrid-Loop DSM with an Interleaved Bandpass Noise-Shaping SAR Quantizer," Digest of Technical Papers - IEEE International Solid-State Circuits Conference, 2/13/2021, https://doi.org/10.1109/ISSCC42613.2021.9366006
- Kang T, Lee S, Haghighat M, Abramson D, Flynn MP, "A 650-W 4-Channel 83-dBA-SNDR speech recognition front-end with adaptive beamforming and feature extraction," IEEE Solid-State Circuits Letters, 1/1/2021, https://doi.org/10.1109/LSSC.2021.3109241
- Jie L, Chen HW, Zheng B, Flynn MP, "A Hybrid-Loop Structure and Interleaved Noise-Shaped Quantizer for a Robust 100-MHz BW and 69-dB DR DSM," IEEE Journal of Solid-State Circuits, 1/1/2021, https://doi.org/10.1109/JSSC.2021.3114319

- Lee S, Kang T, Bell J, Haghighat M, Martinez A, Flynn MP, "An Eight-Element Frequency-Selective Acoustic Beamformer and Bitstream Feature Extractor," IEEE Journal of Solid-State Circuits, 1/1/2021, https://doi.org/10.1109/JSSC.2021.3103727
- Wang X, Pinkham R, Zidan MA, Meng FH, Flynn MP, Zhang Z, Lu WD, "TAICHI: A Tiled Architecture for In-memory Computing and Heterogeneous Integration," IEEE Transactions on Circuits and Systems II: Express Briefs, 1/1/2021, https://doi.org/10.1109/TCSII.2021.3097035
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- Buhler FN, Wehe DK, Flynn MP, "A secure measurement unit for an inspection system used in nuclear arms-control verification," Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, 12/1/2020, https://doi.org/10.1016/j.nima.2020.164577
- Lu R, Weston C, Weyer D, Buhler F, Flynn MP, "A 16-Element Fully Integrated 28GHz Digital Beamformer with In-Package 4x4 Patch Antenna Array and 64 Continuous-Time Band-Pass Delta-Sigma Sub-ADCs," Digest of Papers - IEEE Radio Frequency Integrated Circuits Symposium, 8/1/2020, https://doi.org/10.1109/RFIC49505.2020.9218309
- Zheng B, Jie L, Wang R, Flynn MP, "A 6 GHz 160 MHz Bandwidth MU-MIMO Eight-Element Direct Digital Beamforming TX Utilizing FIR H-bridge DAC," Digest of Papers - IEEE Radio Frequency Integrated Circuits Symposium, 8/1/2020, https://doi.org/10.1109/RFIC49505.2020.9218294
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- Correll JM, Bothra V, Cai F, Lim Y, Lee SH, Lee S, Lu WD, Zhang Z, Flynn MP, "A Fully Integrated Reprogrammable CMOS-RRAM Compute-in-Memory Coprocessor for Neuromorphic Applications," IEEE Journal on Exploratory Solid-State Computational Devices and Circuits, 6/1/2020, https://doi.org/10.1109/JXCDC.2020.2992228
- Brown P, O'Shaugnessy M, Rozell C, Romberg J, Flynn M, "A 17.8MS/s Neural-Network Compressed Sensing Radar Processor in 16nm FinFET CMOS," Proceedings of the Custom Integrated Circuits Conference, 3/1/2020, https://doi.org/10.1109/CICC48029.2020.9075955
- Flynn MP, Jeong J, Jang S, Chae H, Weyer D, Lu R, Bell J, "Continuous-Time Bandpass Delta-Sigma Modulators and Bitstream Processing: (Invited)," Proceedings of the Custom Integrated Circuits Conference, 3/1/2020, https://doi.org/10.1109/CICC48029.2020.9075928

- Jie L, Zheng B, Chen HW, Wang R, Flynn MP, "A 4th-Order Cascaded-Noise-Shaping SAR ADC with 88dB SNDR over 100kHz Bandwidth," Digest of Technical Papers - IEEE International Solid-State Circuits Conference, 2/1/2020, https://doi.org/10.1109/ISSCC19947.2020.9062905

Current Graduate Students Advised

- Matthew Belz, ECE PhD
- Hsiang-Wen Chen, ECE PhD
- Justin Correll, ECE PhD
- Zeke Dalisky, ECE PhD
- Evangelos Dikopoulos, ECE PhD
- Taewook Kang, ECE PhD
- Seungjong Lee, ECE PhD
- Seungheun Song, ECE PhD
- Evelyn Ware, ECE PhD
- Christine Weston, ECE PhD (co-advised)
- Luke Wormald, ECE PhD
- Zhengqi Xu, ECE PhD

Forrest, Stephen R.

Website: http://www.umich.edu/~ocm/

Research Interests: Organic Electronics, Photonic Integrated Circuits, Photonic Materials.

Books

- Forrest SR, Organic Electronics: Foundations to Applications, 8/21/2020, https://doi.org/10.1093/oso/9780198529729.003.0009

Recent Publications

- Li Y, Huang X, Ding K, Sheriff HKM, Ye L, Liu H, Li CZ, Ade H, Forrest SR, "Non-fullerene acceptor organic photovoltaics with intrinsic operational lifetimes over 30 years," Nature Communications, 12/1/2021, https://doi.org/10.1038/s41467-021-25718-w
- Huang X, Fan D, Forrest SR, "Scalable semitransparent prototype organic photovoltaic module with minimal resistance loss," Organic Electronics, 10/1/2021, https://doi.org/10.1016/j.orgel.2021.106276
- Huang X, Li Z, Liu X, Hou J, Kim J, Forrest SR, Deotare PB, "Neutralizing Defect States in MoS_2 Monolayers," ACS Applied Materials and Interfaces, 9/22/2021, https://doi.org/10.1021/acsami.1c07956
- Jung MC, Facendola J, Kim J, Muthiah Ravinson DS, Djurovich PI, Forrest SR, Thompson ME, "Molecular Alignment of Homoleptic Iridium Phosphors in Organic Light-Emitting Diodes," Advanced Materials, 9/1/2021, https://doi.org/10.1002/adma.202102882
- Roy-Layinde B, Burger T, Fan D, Lee B, McSherry S, Forrest SR, Lenert A, “Sustaining Efficiency at Elevated Power Densities with InGaAs Air Bridge Cells,” arXiv.org, 8/19/2021, https://arxiv.org/abs/2108.07320v2
- Burger T, Fan D, McSherry S, Lee B, Forrest SR, Lenert A, "Approaching zero thermal emissivity in thermophotovoltaic cells," New Concepts in Solar and Thermal Radiation Conversion IV, 8/3/2021, https://doi.org/10.1117/12.2598075
- Mittapally R, Lee B, Zhu L, Reihani A, Lim JW, Fan D, Forrest SR, Reddy P, Meyhofer E, "Near-field thermophotovoltaics for efficient heat to electricity conversion at high power density," Nature Communications, 7/16/2021, https://doi.org/10.1038/s41467-021-24587-7

- Tadle AC, El Roz KA, Soh CH, Sylvinson Muthiah Ravinson D, Djurovich PI, Forrest SR, Thompson ME, "Tuning the Photophysical and Electrochemical Properties of Aza-Boron-Dipyridylmethenes for Fluorescent Blue OLEDs," Advanced Functional Materials, 7/1/2021, https://doi.org/10.1002/adfm.202101175
- Forrest SR, "Waiting for Act 2: what lies beyond organic light emitting diode (OLED) displays for organic electronics?" chapter in Frontiers in Optics and Photonics, 5/25/2021, https://doi.org/10.1515/9783110710687-003
- Kim J, Zhang S, Hou S, Lee B, Wei G, Forrest SR, "Large-Area Organic-Transition Metal Dichalcogenide Hybrid Light-Emitting Device," ACS Photonics, 4/21/2021, https://doi.org/10.1021/acsphotonics.1c00047
- Burger T, Fan D, McSherry S, Lee B, Lenert A, Forrest SR, "Airbridge cell for ultra-efficient photovoltaic conversion of thermal radiation," Energy Harvesting and Storage: Materials, Devices, and Applications XI, 4/13/2021, https://doi.org/10.1117/12.2589946
- Song Y, Liu X, Li Y, Nguyen HH, Duan R, Kubarych KJ, Forrest SR, Ogilvie JP, "Mechanistic Study of Charge Separation in a Nonfullerene Organic Donor-Acceptor Blend Using Multispectral Multidimensional Spectroscopy," Journal of Physical Chemistry Letters, 4/8/2021, https://doi.org/10.1021/acs.jpclett.1c00407
- Idris, M; Kapper, S; Tadle, A; Batagoda, T; Muthiah Ravinson, D; Abimbola, O; Djurovich, P; Kim, J; Coburn, C; Forrest, S; Thompson, M, "Blue Emissive fac/mer-Iridium (III) NHC Carbene Complexes and their Application in OLEDs," Advanced Optical Materials, 4/1/2021, https://doi.org/10.1002/adom.202001994
- Evke EE, Huang C, Wu YW, Arwashan M, Lee B, Forrest SR, Shtein M, "Kirigami-Based Compliant Mechanism for Multiaxis Optical Tracking and Energy-Harvesting Applications," Advanced Engineering Materials, 4/1/2021, https://doi.org/10.1002/adem.202001079
- Zhang L, Wu F, Hou S, Zhang Z, Chou YH, Watanabe K, Taniguchi T, Forrest SR, Deng H, "Van der Waals heterostructure polaritons with moire-induced nonlinearity," Nature, 3/4/2021, https://doi.org/10.1038/s41586-021-03228-5
- Ding K, Huang X, Li Y, Forrest SR, "Photogeneration and the bulk quantum efficiency of organic photovoltaics," Energy and Environmental Science, 3/1/2021, https://doi.org/10.1039/d0ee03885g
- Horowitz JA, Zhong X, Depalma SJ, Ward Rashidi MR, Baker BM, Lahann J, Forrest SR, "Printable Organic Electronic Materials for Precisely Positioned Cell Attachment," Langmuir, 2/9/2021, https://doi.org/10.1021/acs.langmuir.0c03319
- Arneson C, Huang X, Huang X, Fan D, Gao M, Ye L, Ade H, Li Y, Forrest SR, "Relationship between charge transfer state electroluminescence and the degradation of organic photovoltaics," Applied Physics Letters, 2/8/2021, https://doi.org/10.1063/5.0037710

- Sheriff HKM, Li Y, Qu B, Forrest SR, "Aperiodic optical coatings for neutral-color semi-transparent organic photovoltaics," Applied Physics Letters, 1/18/2021, https://doi.org/10.1063/5.0037104
- Zhang, L; Zhang, Z; Wu, F; Wang, D; Gogna, R; Hou, S; Watanabe, K; Taniguchi, T; Kulkarni, K; Kuo, T; Forrest, S; Deng, H, "Twist-angle dependence of moire excitons in WS_2MoSe_2 heterobilayers," Nature Communications, 12/1/2020, https://doi.org/10.1038/s41467-020-19466-6
- Song Y, Liu X, Li Y, Nguyen HH, Duan R, Kubarych KJ, Forrest SR, Ogilvie JP, "Charge generation mediated by bound polaron pairs and delocalized charge transfer states in non-fullerene organic solar cells," Optics InfoBase Conference Papers, 11/16/2020, https://doi.org/10.1364/UP.2020.Th2A.7
- Kim J, Hou S, Zhao H, Forrest SR, "Nanoscale Mapping of Morphology of Organic Thin Films," Nano Letters, 11/11/2020, https://doi.org/10.1021/acs.nanolett.0c03440
- Lee B, Lahann L, Li Y, Forrest SR, "Cost estimates of production scale semitransparent organic photovoltaic modules for building integrated photovoltaics," Sustainable Energy and Fuels, 11/1/2020, https://doi.org/10.1039/d0se00910e
- Qu B, Ding K, Sun K, Hou S, Morris S, Shtein M, Forrest SR, "Fast organic vapor phase deposition of thin films in light-emitting diodes," ACS Nano, 10/27/2020, https://doi.org/10.1021/acsnano.0c07017
- Fan D, Burger T, McSherry S, Lee B, Lenert A, Forrest SR, "Near-perfect photon utilization in an air-bridge thermophotovoltaic cell," Nature, 10/8/2020, https://doi.org/10.1038/s41586-020-2717-7
- Jiang C, Huang X, Sun B, Li Y, Gao M, Ye L, Ade H, Forrest SR, Fan J, "A 3D nonfullerene electron acceptor with a 9,9-bicarbazole backbone for high-efficiency organic solar cells," Organic Electronics, 9/1/2020, https://doi.org/10.1016/j.orgel.2020.105784
- Li Y, Guo X, Peng Z, Qu B, Yan H, Ade H, Zhang M, Forrest SR, "Color-neutral, semitransparent organic photovoltaics for power window applications," Proceedings of the National Academy of Sciences of the United States of America, 9/1/2020, https://doi.org/10.1073/pnas.2007799117
- Kim J, Zhao H, Hou S, Khatoniar M, Menon V, Forrest SR, "Using fourier-plane imaging microscopy for determining transition-dipole-moment orientations in organic light-emitting devices," Physical Review Applied, 9/1/2020, https://doi.org/10.1103/PhysRevApplied.14.034048
- Forrest SR, “Waiting for Act 2: What lies beyond organic light-emitting diode (OLED) displays for organic electronics?” Nanophotonics, 8/24/20, https://doi.org/10.1515/nanoph-2020-0322
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- Forrest SR, "Status of organic lasers, the challenges they face, and prospects for the future," Organic and Hybrid Light Emitting Materials and Devices XXIV, 8/20/2020, https://doi.org/10.1117/12.2572857
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- Ding K, Forrest SR, "Reducing Energy Losses at the Organic-anode-buffer Interface of Organic Photovoltaics," Physical Review Applied, 5/1/2020, https://doi.org/10.1103/PhysRevApplied.13.054046
- Qu Y, Hou S, Forrest SR, "Temperature-Dependence of an Amorphous Organic Thin Film Polariton Laser," ACS Photonics, 4/15/2020, https://doi.org/10.1021/acsphotonics.9b01656
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- Lee B, Fan D, Forrest SR, "A high throughput, linear molecular beam epitaxy system for reduced cost manufacturing of GaAs photovoltaic cells: Will GaAs ever be inexpensive enough?" Sustainable Energy and Fuels, 4/1/2020, https://doi.org/10.1039/c9se01255a
- Deshmukh R, Marques P, Panda A, Sfeir MY, Forrest SR, Menon VM, "Modifying the Spectral Weights of Vibronic Transitions via Strong Coupling to Surface Plasmons," ACS Photonics, 1/15/2020, https://doi.org/10.1021/acsphotonics.9b01357
- Hou S, Khatoniar M, Ding K, Qu Y, Menon VM, Forrest SR, "Exciton polariton-mediated long-range excitation energy transport in disordered organic semiconductors," Optics InfoBase Conference Papers, 1/1/2020, https://doi.org/10.1364/CLEO_QELS.2020.FTh1Q.7
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- Song Y, Schubert A, Liu X, Bhandari S, Forrest SR, Dunietz BD, Geva E, Ogilvie JP, "Efficient charge generation via hole transfer in dilute organic donor-fullerene blends,"

ACS Applied Materials and Interfaces, 1/1/2020, https://doi.org/10.1021/acs.jpclett.0c00058

- Huang X, Liu X, Ding K, Forrest SR, "Is there such a thing as a molecular organic alloy?" Materials Horizons, 1/1/2020, https://doi.org/10.1039/c9mh01351b

Recent U.S. Patents

- Fabrication of Thin-Film Electronic Devices with Non-Destructive Wafer Reuse, #10,535,685, 2020
- Organometallic Complexes as Phosphorescent Emitters in Organic LEDs, #10,629,827, 2020
- Autonomous Solar Tracking in Flat-Plate Photovoltaic Panels using Kirigami-Inspired Microstructures, #10,637,391, 2020
- Non-Destructive Wafer Recycling for Epitaxial Lift-Off Thin-Film Device using a Superlattice Epitaxial Layer, #10,680,132, 2020
- Inverted Organic Photosensitive Devices, #10,770,670, 2020
- Highly Reliable Stacked White Organic Light Emitting Device, #10,770,673, 2020
- OLED with Minimal Plasmonic Losses, #10,770,690, 2020
- Device and Method of Monolithic Integration of Microinverters on Solar Cells, #10,778,141, 2020
- Nozzle geometry for organic vapor jet printing, #10,941,481, 2021
- Fabrication of thin-film electronic devices with non-destructive wafer reuse, #10,964,732, 2021
- Solar tracking system, #10,965,243, 2021
- Method of forming a semiconductor device, #10,971,542, 2021
- Exciton management in organic photovoltaic multi-donor energy cascades, #10,978,654, 2021
- Integrated photovoltaic window and light source, #10,992,252, 2021
- Microfluidic device and method using double anodic bonding, #11,021,785, 2021
- Efficient solar cells using all-organic nanocrystalline networks, #11,031,567, 2021
- Excited state management, #11,031,569, 2021
- Preparation of compound semiconductor substrate for epitaxial growth via non-destructive epitaxial lift-off, #11,087,974, 2021
- Excitonic energy transfer to increase inorganic solar cell efficiency, #11,088,338, 2021

- High efficiency small molecule tandem photovoltaic devices, #11,094,902, 2021
- Hybrid planar-mixed heterojunction for organic photovoltaics, #11,121,336, 2021
- High efficiency multi-junction small-molecule photovoltaic devices, #11,145,834, 2021

Current Graduate Students Advised

- Claire Arneson, Physics PhD
- Jeffrey Horowitz, ECE PhD
- Xinjing Huang, Applied Physics PhD
- Byungjun Lee, ECE PhD
- Rebecca Lentz, ECE PhD
- Jihun Lim, ECE PhD
- Boning Qu, Materials Science & Engineering PhD
- Hafiz Sheriff, Applied Physics PhD
- Haonan Zhao, Physics PhD

Freudenberg, James S.

Website: https://freudenberg.engin.umich.edu/

Research Interests: Fundamental design limitations in feedback control systems, embedded control systems.

Recent Publications

- Bhardwaj A, Slavin D, Walsh J, Freudenberg J, Gillespie RB, "Estimation and decomposition of rack force for driving on uneven roads," Control Engineering Practice, 9/1/2021, https://doi.org/10.1016/j.conengprac.2021.104876
- Cutlip S, Freudenberg J, Brent Gillespie R, "Respecting the Coupled Dynamics: Haptic Feedback Carries both Power and Information," IEEE Haptics Symposium, HAPTICS, 3/1/2020, https://doi.org/10.1109/HAPTICS45997.2020.ras.HAP20.10.e37f63b1
- Bhardwaj A, Slavin D, Walsh J, Freudenberg J, Gillespie RB, "Rack force estimation for driving on uneven road surfaces," IFAC-PapersOnLine, 1/1/2020, https://doi.org/10.1016/j.ifacol.2020.12.1441

Galvanauskas, Almantas

Website: https://galvanauskas.engin.umich.edu/

Research Interests: High power ultrafast fiber lasers for nonlinear optics, high intensity laser-matter interactions, laser driven secondary-radiation such as gamma and x-ray sources, and laser acceleration of charged particles. Main emphasis of current research efforts is on developing a new generation of laser-plasma accelerator drivers that could enable high energy and brightness particle accelerators for future fundamental science experiments as well as for new applications in biology, medicine and material science.

Recent Publications

- Du W, Xiao X, Cui Y, Nees J, Jovanovic I, Galvanauskas A, "Demonstration of 067-mJ and 10-ns high-energy pulses at 2.72 µm from large core Er:ZBLAN fiber amplifiers," Optics Letters, 9/30/2020, https://doi.org/10.1364/OL.400065
- Xiao X, Nees J, Huang H, Galvanauskas A, Jovanovic I, "Optical parametric amplification at 10.6 pm in GaSe pumped by a 2.75-pm parametric source," Optics InfoBase Conference Papers, 1/1/2020, https://doi.org/10.1364/CLEO_AT.2020.JTu2F.19
- Hanzhang Pei, Mathew Whittlesey, Qiang Du, Almantas Galvanauskas, “Design and Operation of Coherent Pulse Stacking Amplification as a Deep Recurrent Neural Network, “in Conference on Lasers and Electro-Optics, OSA Technical Digest (online) (Optical Society of America, 2021), paper Stu2E.2
- Alexander Rainville, Mingshu Chen, Mathew Whittlesey, Qiang Du and Almantas Galvanauskas, “22mJ Coherent Beam Combining from Three 85µm Core CCC Fiber Amplifiers,” in Conference on Lasers and Electro-Optics, OSA Technical Digest (online) (Optical Society of America, 2021), paper SW2B.4
- Weizhi Du, Eunjeong Hyeon, Hanzhang Pei, Zhengyu Huang, YeonJoon Cheong, Siyuan Zheng and Almantas Galvanauskas, “Improved Machine Learning Algorithms for Optimizing Coherent Pulse Stacking Amplification,” ,” in Conference on Lasers and Electro-Optics, OSA Technical Digest (online) (Optical Society of America, 2021), paper JTh3A.1
- Yifan Cui, Weizhi Du, Mingshu Chen, and Almantas Galvanauskas, “Generation of 95 fs mid-IR pulses with 1.8 W average power using an Er: ZrF4 fiber mode-locked oscillator and a nonlinear amplifier,” in Conference on Lasers and Electro-Optics, OSA Technical Digest (online) (Optical Society of America, 2021), paper STh4N.7

- A. Galvanauskas, “Coherent combining of ultrashort pulse fiber lasers – a pathway towards multi-TW peak and multi-kW average power sources,” Tutorial presentation at CLEO 2021, May 9 - 14 2021, paper Stu2E.1
- Siyun Chen, Mathew Whittlesey, Yifan Cui, Russel Wilcox, and Almantas Galvanauskas, “Demonstration of complete gain-narrowing compensation for 100fs duration pulses with ~30nm bandwidth in Yb-doped fiber amplifier system with up to 150dB of total multi-stage gain”, SPIE Photonics West 2021, SPIE LASE Fiber Lasers XVIII: Technology and Systems, 6 – 11 March 2021, Paper 11665-36
- Mathew Whittlesey, Alexander Rainville, Christopher Pasquale, Mingshu Chen, Siyun Chen, Qing Du, and Almantas Galvanauskas, “Simultaneous coherent pulse stacking amplification and spatial combining of ultrashort pulses at multi-mJ energies”, SPIE Photonics West 2022, SPIE LASE Fibber Lasers XIX: Technology and Systems, to be presented in February 2022
- Yifan Cui, Mingshu Chen, Weizhi Du, Yu Bai, and Almantas Galvanauskas, "Generation of 85 fs mid-IR pulses with up to 2.4 W average power using an Er:ZBLAN fiber mode-locked oscillator and a nonlinear amplifier“, Accepted for publication in Optics Express, to be published in December 2021

Current Graduate Students Advised

- Yu Bai, ECE MS
- Mingshu Chen, ECE PhD
- Siyun Chen, ECE PhD
- Tayari Coleman, Applied Physics PhD
- Lauren Cooper, ECE PhD
- Yifan Cui, ECE PhD
- Weizhi Du, ECE PhD, Comput Discovery & Engin Cert
- Yanwen Jing, ECE PhD (co-advised)
- Christopher Pasquale, ECE PhD
- Alexander Rainville, ECE PhD
- Theodore Whittlesey, ECE PhD

Gianchandani, Yogesh B.

Website: https://gianchandani.engin.umich.edu/

Research Interests: Design and fabrication of microsensors, microactuators, and micro-electro-mechanical systems (MEMS) for a variety of applications such as environmental sensing, micro gas chromatographs, gas phase micropumps, microfluidics, microoptics, and biomedical instrumentation; Development of manufacturing processes using combinations of traditional and novel materials and techniques, for example, micro-electro-discharge machining and microplasmas; Design of interface circuits for MEMS and development of co-fabrication techniques for circuits and MEMS.

Recent Publications

- A. Benken, Y. Gianchandani, “A High-Yield Microfabrication Process for Sapphire Substrate Pressure Sensors Providing 70 MPa Range and 0.5 kPa Resolution,” IEEE Sensors Journal, December 15, 2021, pp. 1-10, https://doi.org/10.1109/JSEN.2021.3122280
- Sui Y, Benken AC, Ma Y, Trickey-Glassman A, Li T, Gianchandani YB, "An Autonomous Environmental Logging Microsystem (ELM) for Harsh Environments," IEEE Sensors Journal, 9/15/2021, https://doi.org/10.1109/JSEN.2021.3095143
- Cooke AM, Garmire D, Davis J, Creech M, Gianchandani Y, "A wireless optical position sensing and communications system for a locking differential," 2021 IEEE International Workshop on Metrology for Automotive, MetroAutomotive 2021 - Proceedings, 7/1/2021, https://doi.org/10.1109/MetroAutomotive50197.2021.9502863
- Liao W, Zhao X, Lu HT, Byambadorj T, Qin Y, Gianchandani YB, "Progressive cellular architecture in microscale gas chromatography for broad chemical analyses," Sensors, 5/1/2021, https://doi.org/10.3390/s21093089
- Byambadorj T, Cheng Q, Qin Y, Gianchandani YB, "A monolithic Si-micromachined four-stage Knudsen pump for μGC applications," Journal of Micromechanics and Microengineering, 3/1/2021, https://doi.org/10.1088/1361-6439/abd264
- Lu HT, Qin Y, Gianchandani Y, "A microvalve module with high chemical inertness and embedded flow heating for microscale gas chromatography," Sensors (Switzerland), 1/2/2021, https://doi.org/10.3390/s21020632
- Cheng Q, Qin Y, Gianchandani YB, "A bidirectional knudsen pump with a 3d-printed thermal management platform," Micromachines, 1/1/2021, https://doi.org/10.3390/mi12010058

- Gupta R, Mejia C, Gianchandani YB, Kajikawa Y, "Ambidextrous Firm Strategy Insights From Internet of Things Linked Interfirm Deals," IEEE Transactions on Engineering Management, 1/1/2021, https://doi.org/10.1109/TEM.2020.3041250
- Gupta R, Mejia C, Gianchandani Y, Kajikawa Y, "Analysis on formation of emerging business ecosystems from deals activities of global electric vehicles hub firms," Energy Policy, 10/1/2020, https://doi.org/10.1016/j.enpol.2020.111532
- Ordonez Varela JR, Boero Rollo JG, Le Beulze A, Ochi J, Vellaluru N, Dutta PP, Benken A, Gianchandani Y, "Wireless advanced nano-devices for well monitoring," Society of Petroleum Engineers - Abu Dhabi International Petroleum Exhibition and Conference 2020, ADIP 2020, 1/1/2020, https://doi.org/10.2118/SPE-203242-MS

Recent U.S. Patents

- Environmental Logging Microsystem (ELM), #10782446, 2020
- Progressive Cellular Architecture for Microfabricated Gas Chromatograph, #10866220, 2020
- Magnetoelastic implantable actuation device and method, #11083624, 2021

Current Graduate Students Advised

- Hind AlYahya, MS BME (co-advised)
- Mr. Ryan Aridi, MS ECE (co-advised)
- Tsenguun Byambadorj, ECE PhD (co-advised)
- Partha Dutta, ECE PhD
- Adrienne Fueredi, ECE PhD
- Zeyu Li, ECE PhD
- Weilin Liao, ECE PhD (co-advised)
- Leo Hsueh Tsung Lu, ME PhD (co-advised)
- Declan Winship, ECE PhD
- Qu Xu, Integrative Systems & Design Dept. D. Eng.
- Xiangyu Zhao, ECE PhD (co-advised)
- Mr. Hanfei Zheng, MS ECE (co-advised)

Gilchrist, Brian E.

Website: https://gilchrist.engin.umich.edu/

Research Interests: Plasma electrodynamics and diagnostics; Wireless Technology; Space Systems & Technology.

Recent Publications

- Borovsky, J; Delzanno, G; Dors, E; Thomsen, M; Sanchez, E; Henderson, M; Marshall, R; Gilchrist, B; Miars, G; Carlsten, B; Storms, S; Holloway, M; Nguyen, D, "Solving the auroral-arc-generator question by using an electron beam to unambiguously connect critical magnetospheric measurements to auroral images," Journal of Atmospheric and Solar-Terrestrial Physics, 9/15/2020, https://doi.org/10.1016/j.jastp.2020.105310
- Miars GC, Delzanno GL, Gilchrist BE, Leon O, Lucco Castello F, "Ion Emission from a Positively Biased Hollow Cathode Plasma," IEEE Transactions on Plasma Science, 8/1/2020, https://doi.org/10.1109/TPS.2020.3004553

Grbic, Anthony

Website: https://grbic.engin.umich.edu/

Research Interests: Engineered electromagnetic structures (metamaterials, metasurfaces, electromagnetic band-gap materials, frequency selective surfaces), antennas, near-field radiation and localized waves, microwave circuits, plasmonics, optics, wireless power transmission systems, and analytical modeling in electromagnetics/optics.

Recent Publications

- Lin CW, Grbic A, "Analysis and synthesis of cascaded cylindrical metasurfaces using a wave matrix approach," IEEE Transactions on Antennas and Propagation, 10/1/2021, https://doi.org/10.1109/TAP.2021.3070084
- Budhu J, Pfiester NA, Choi KK, Young S, Ball C, Krishna S, Grbic A, "Dielectric resonator antenna-coupled antimonide-based detectors (dracad) for the infrared," IEEE Transactions on Antennas and Propagation, 10/1/2021, https://doi.org/10.1109/TAP.2021.3069522
- Budhu J, Grbic A, "Accelerated optimization of metasurfaces with the woodbury matrix identity," 2021 International Applied Computational Electromagnetics Society Symposium, ACES 2021, 8/1/2021, https://doi.org/10.1109/ACES53325.2021.00107
- Alsolamy F, Grbic A, "Modal network formulation for the analysis and design of mode-converting metasurfaces in cylindrical waveguides," IEEE Transactions on Antennas and Propagation, 8/1/2021, https://doi.org/10.1109/TAP.2020.3048590
- Szymanski L, Raeker BO, Lin CW, Grbic A, "Fundamentals of lossless, reciprocal bianisotropic metasurface design," Photonics, 6/1/2021, https://doi.org/10.3390/photonics8060197
- Raeker BO, Grbic A, "Lossless Complex-Valued Optical-Field Control with Compound Metaoptics," Physical Review Applied, 5/1/2021, https://doi.org/10.1103/PhysRevApplied.15.054039
- Szymanski L, Gok G, Grbic A, "Circuit-based Inverse Design of Metastructured MIMO Devices," 15th European Conference on Antennas and Propagation, EuCAP 2021, 3/22/2021, https://doi.org/10.23919/EuCAP51087.2021.9411442
- Budhu J, Grbic A, "Passive Reflective Metasurfaces for Far-Field Beamforming," 15th European Conference on Antennas and Propagation, EuCAP 2021, 3/22/2021, https://doi.org/10.23919/EuCAP51087.2021.9411154

- Scarborough C, Grbic A, "The Interpath Relation for Spatially-Discrete Traveling-Wave Modulated Structures," 15th European Conference on Antennas and Propagation, EuCAP 2021, 3/22/2021, https://doi.org/10.23919/EuCAP51087.2021.9410929
- Alsolamy F, Alomar WA, Grbic A, "Cylindrical Vector Beams for Wireless Power Transfer," IEEE Transactions on Antennas and Propagation, 3/1/2021, https://doi.org/10.1109/TAP.2020.3026428
- Pfiester, N; Mills, S; Budhu, J; Choi, K; Ball, C; Young, S; Grbic, A; Lubyshev, D; Fastenau, J; Liu, A; Krishna, S, "Self-aligned etching of subwavelength longwave infrared Type-II superlattice pixels," Proceedings of SPIE - The International Society for Optical Engineering, 1/1/2021, https://doi.org/10.1117/12.2587766
- Alsolamy F, Grbic A, "Antenna Aperture Synthesis Using Mode-Converting Metasurfaces," IEEE Open Access Journal of Power and Energy, 1/1/2021, https://doi.org/10.1109/OJAP.2021.3089046
- Pakovic S, Zhou S, Gonzalez-Ovejero D, Pavone SC, Grbic A, Ettorre M, "Bessel-Gauss Beam Launchers for Wireless Power Transfer," IEEE Open Journal of Antennas and Propagation, 1/1/2021, https://doi.org/10.1109/OJAP.2021.3078234
- Budhu J, Grbic A, "Perfectly Reflecting Metasurface Reflectarrays: Mutual Coupling Modeling between Unique Elements through Homogenization," IEEE Transactions on Antennas and Propagation, 1/1/2021, https://doi.org/10.1109/TAP.2020.3001450
- Wu Z, Scarborough C, Grbic A, "Space-Time-Modulated Metasurfaces with Spatial Discretization: Free-Space N -Path Systems," Physical Review Applied, 12/21/2020, https://doi.org/10.1103/PhysRevApplied.14.064060
- Yang F, Raeker BO, Nguyen DT, Miller JD, Xiong Z, Grbic A, Ho JS, "Antireflection and Wavefront Manipulation with Cascaded Metasurfaces," Physical Review Applied, 12/14/2020, https://doi.org/10.1103/PhysRevApplied.14.064044
- Salas F, Alomar W, Grbic A, "A Phase Conjugating Metasurface," 2020 14th International Congress on Artificial Materials for Novel Wave Phenomena, Metamaterials 2020, 9/27/2020, https://doi.org/10.1109/Metamaterials49557.2020.9285015
- Budhu J, Grbic A, "A Reflective Metasurface for Perfect Cylindrical to Planar Wavefront Transformation," 2020 14th International Congress on Artificial Materials for Novel Wave Phenomena, Metamaterials 2020, 9/27/2020, https://doi.org/10.1109/Metamaterials49557.2020.9285080
- Alsolamy F, Grbic A, "Mode Conversion in Cylindrical Waveguides Using Metasurfaces," 2020 14th International Congress on Artificial Materials for Novel Wave Phenomena, Metamaterials 2020, 9/27/2020, https://doi.org/10.1109/Metamaterials49557.2020.9284973
- Scarborough C, Grbic A, "Modified Floquet Boundary Condition for Open Boundary Problems with N-Path Symmetry," 2020 14th International Congress on Artificial

Materials for Novel Wave Phenomena, Metamaterials 2020, 9/27/2020, https://doi.org/10.1109/Metamaterials49557.2020.9285138

- Wu Z, Scarborough C, Grbic A, "Retroreflective Subharmonic Frequency Translation with a Spatiotemporal Metasurface," 2020 14th International Congress on Artificial Materials for Novel Wave Phenomena, Metamaterials 2020, 9/27/2020, https://doi.org/10.1109/Metamaterials49557.2020.9285037
- Loncar J, Grbic A, Sipus Z, "Synthesis of NIC-based Reflection Amplifiers for Metasurfaces," 2020 14th International Congress on Artificial Materials for Novel Wave Phenomena, Metamaterials 2020, 9/27/2020, https://doi.org/10.1109/Metamaterials49557.2020.9285051
- Del Mastro M, Ettorre M, Grbic A, "Dual-Band, Orthogonally-Polarized LP-to-CP Converter for SatCom Applications," IEEE Transactions on Antennas and Propagation, 9/1/2020, https://doi.org/10.1109/TAP.2020.2989868
- Scarborough C, Grbic A, "Coupled Line Unit Cell for Independent Control of even and Odd Mode Phase Delays," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9330327
- Budhu J, Grbic A, Pfiester N, Ball C, Choi KK, Krishna S, "Dielectric Resonator Antenna Coupled Infrared Antimonide Photodetectors," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9329773
- Budhu J, Grbic A, Michielssen E, "Dualband Stacked Metasurface Reflectarray," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9329918
- Raeker BO, Grbic A, Zhou Y, Zheng H, Valentine J, "Measurements of All-Dielectric Compound Metaoptics for Wavefront Transformation," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9329642
- Alsolamy F, Grbic A, "Radial Gaussian Beam Metasurface Antenna," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9329945
- Wu Z, Scarborough C, Grbic A, "Subharmonic Mixing Using a Reflective Spatio-Temporally Modulated Metasurface," 2020 USNC-URSI Radio Science Meeting (Joint with AP-S Symposium), USNC/URSI 2020 - Proceedings, 7/5/2020, https://doi.org/10.23919/USNC/URSI49741.2020.9321648

- Chiotellis N, Zhang S, Vardaxoglou YC, Grbic A, "X Wave Radiator Implemented with 3-D Printed Metamaterials," IEEE Transactions on Antennas and Propagation, 7/1/2020, https://doi.org/10.1109/TAP.2020.2978280
- Chuo, L; Feng, Z; Kim, Y; Chiotellis, N; Yasuda, M; Miyoshi, S; Kawaminami, M; Grbic, A; Wentzloff, D; Blaauw, D; Kim, H, "Millimeter-Scale Node-to-Node Radio Using a Carrier Frequency-Interlocking if Receiver for a Fully Integrated 4 Wireless Sensor Node," IEEE Journal of Solid-State Circuits, 5/1/2020, https://doi.org/10.1109/JSSC.2019.2959505
- Scarborough C, Grbic A, "Accelerated N-Path Network Analysis Using the Floquet Scattering Matrix Method," IEEE Transactions on Microwave Theory and Techniques, 4/1/2020, https://doi.org/10.1109/TMTT.2020.2973136
- Wu Z, Scarborough C, Grbic A, "A Spatio-Temporally Modulated Metasurface as a Free-Space N-Path System," 14th European Conference on Antennas and Propagation, EuCAP 2020, 3/1/2020, https://doi.org/10.23919/EuCAP48036.2020.9135884
- Alsolamy F, Grbic A, "Cylindrical Aperture Synthesis with Metasurfaces," 14th European Conference on Antennas and Propagation, EuCAP 2020, 3/1/2020, https://doi.org/10.23919/EuCAP48036.2020.9135935
- Budhu J, Grbic A, Michielssen E, "Design of Multilayer, Dualband Metasurface Reflectarrays," 14th European Conference on Antennas and Propagation, EuCAP 2020, 3/1/2020, https://doi.org/10.23919/EuCAP48036.2020.9135957
- Ebrahimpouri M, Quevedo-Teruel O, Ettorre M, Grbic A, "Ultra-Wide Band Non-Dispersive Leaky-Wave Antenna Based on Glide-Symmetric Meandered Transmission Lines," 14th European Conference on Antennas and Propagation, EuCAP 2020, 3/1/2020, https://doi.org/10.23919/EuCAP48036.2020.9135678
- Wu Z, Grbic A, "Serrodyne Frequency Translation Using Time-Modulated Metasurfaces," IEEE Transactions on Antennas and Propagation, 3/1/2020, https://doi.org/10.1109/TAP.2019.2943712
- Young S, Szymanski L, Grbic A, "Metastructures consisting of cascaded high-contrast subwavelength gratings," Proceedings of SPIE - The International Society for Optical Engineering, 1/1/2020, https://doi.org/10.1117/12.2543368
- Pfiester NA, Budhu J, Lee SH, Rogers V, Choi KK, Ball CD, Young SM, Grbic A, Krishna S, "Modeling and extraction of optical characteristics of InAs/GaSb strained layer superlattice," Proceedings of SPIE - The International Society for Optical Engineering, 1/1/2020, https://doi.org/10.1117/12.2558525
- Szymanski L, Grbic A, "2-D Circuit-based Bianisotropic Omega Media," IEEE Transactions on Antennas and Propagation, 1/1/2020, https://doi.org/10.1109/TAP.2020.3000868

Current Graduate Students Advised

- Faris Alsolamy, ECE PhD

- Zachary Fritts, ECE PhD (co-advised)
- Chun-Wen Lin, ECE PhD
- Brian Raeker, ECE PhD
- Cody Scarborough, ECE PhD
- Luke Szymanski, ECE PhD
- Zhanni Wu, ECE PhD

Gregg, Bobby

Website: https://gregg.engin.umich.edu/

Research Interests: Wearable Robots, Legged Robots, Prosthetics & Orthotics, Bipedal Locomotion, Nonlinear Control Theory, Rehabilitation Engineering.

Recent Publications

- Kamidi VR, Horn JC, Gregg RD, Hamed KA, "Distributed Controllers for Human-Robot Locomotion: A Scalable Approach Based on Decomposition and Hybrid Zero Dynamics," IEEE Control Systems Letters, 12/1/2021, https://doi.org/10.1109/LCSYS.2020.3045669
- Bolivar-Nieto EA, Summers T, Gregg RD, Rezazadeh S, "A convex optimization framework for robust-feasible series elastic actuators," Mechatronics, 11/1/2021, https://doi.org/10.1016/j.mechatronics.2021.102635
- Lin J, Divekar NV, Lv G, Gregg RD, "Optimal Task-Invariant Energetic Control for a Knee-Ankle Exoskeleton," IEEE Control Systems Letters, 11/1/2021, https://doi.org/10.1109/LCSYS.2020.3043838
- Yeatman M, Gregg RD, "Using Energy Shaping and Regulation for Limit Cycle Stabilization, Generation, and Transition in Simple Locomotive Systems," JOURNAL OF COMPUTATIONAL AND NONLINEAR DYNAMICS, 9/1/2021, https://doi.org/10.1115/1.4051589
- Allen DP, Little R, Laube J, Warren J, Voit W, Gregg RD, "Towards an ankle-foot orthosis powered by a dielectric elastomer actuator," Mechatronics, 6/1/2021, https://doi.org/10.1016/j.mechatronics.2021.102551
- Kamidi VR, Horn JC, Gregg RD, Hamed KA, "Distributed Controllers for Human-Robot Locomotion: A Scalable Approach Based on Decomposition and Hybrid Zero Dynamics," Proceedings of the American Control Conference, 5/25/2021, https://doi.org/10.23919/ACC50511.2021.9483320
- Lin J, Divekar NV, Lv G, Gregg RD, "Optimal Task-Invariant Energetic Control for a Knee-Ankle Exoskeleton," Proceedings of the American Control Conference, 5/25/2021, https://doi.org/10.23919/ACC50511.2021.9483212
- Embry KR, Gregg RD, "Analysis of Continuously Varying Kinematics for Prosthetic Leg Control Applications," IEEE Transactions on Neural Systems and Rehabilitation Engineering, 1/1/2021, https://doi.org/10.1109/TNSRE.2020.3045003

- Zhu H, Nesler C, Divekar N, Peddinti V, Gregg R, "Design Principles for Compact, Backdrivable Actuation in Partial-Assist Powered Knee Orthoses," IEEE/ASME Transactions on Mechatronics, 1/1/2021, https://doi.org/10.1109/TMECH.2021.3053226
- Macaluso R, Embry K, Villarreal DJ, Gregg RD, "Parameterizing Human Locomotion across Quasi-Random Treadmill Perturbations and Inclines," IEEE Transactions on Neural Systems and Rehabilitation Engineering, 1/1/2021, https://doi.org/10.1109/TNSRE.2021.3057877
- Cheng S, Bolivar-Nieto E, Gregg RD, "Real-Time Activity Recognition with Instantaneous Characteristic Features of Thigh Kinematics," IEEE Transactions on Neural Systems and Rehabilitation Engineering, 1/1/2021, https://doi.org/10.1109/TNSRE.2021.3107780
- Lv G, Lin J, Gregg RD, "Trajectory-Free Control of Lower-Limb Exoskeletons through Underactuated Total Energy Shaping," IEEE Access, 1/1/2021, https://doi.org/10.1109/ACCESS.2021.3094979
- Elery T, Rezazadeh S, Nesler C, Gregg RD, "Design and validation of a powered knee-ankle prosthesis with high-torque, low-impedance actuators," IEEE Transactions on Robotics, 12/1/2020, https://doi.org/10.1109/TRO.2020.3005533
- Elery T, Rezazadeh S, Reznick E, Gray L, Gregg RD, "Effects of a Powered Knee-Ankle Prosthesis on Amputee Hip Compensations: A Case Series," IEEE Transactions on Neural Systems and Rehabilitation Engineering, 12/1/2020, https://doi.org/10.1109/TNSRE.2020.3040260
- Divekar NV, Lin J, Nesler C, Borboa S, Gregg RD, "A Potential Energy Shaping Controller with Ground Reaction Force Feedback for a Multi-Activity Knee-Ankle Exoskeleton," Proceedings of the IEEE RAS and EMBS International Conference on Biomedical Robotics and Biomechatronics, 11/1/2020, https://doi.org/10.1109/BioRob49111.2020.9224341
- Reznick E, Embry K, Gregg RD, "Predicting Individualized Joint Kinematics over a Continuous Range of Slopes and Speeds," Proceedings of the IEEE RAS and EMBS International Conference on Biomedical Robotics and Biomechatronics, 11/1/2020, https://doi.org/10.1109/BioRob49111.2020.9224413
- Kumar S, Mohammadi A, Quintero D, Rezazadeh S, Gans N, Gregg RD, "Extremum Seeking Control for Model-Free Auto-Tuning of Powered Prosthetic Legs," IEEE Transactions on Control Systems Technology, 11/1/2020, https://doi.org/10.1109/TCST.2019.2928514
- Lv G, Xing H, Lin J, Gregg RD, Atkeson CG, "A Task-Invariant Learning Framework of Lower-Limb Exoskeletons for Assisting Human Locomotion," Proceedings of the American Control Conference, 7/1/2020, https://doi.org/10.23919/ACC45564.2020.9147915

- Kumar S, Zwall MR, Bolivar-Nieto EA, Gregg RD, Gans N, "Extremum Seeking Control for Stiffness Auto-Tuning of a Quasi-Passive Ankle Exoskeleton," IEEE Robotics and Automation Letters, 7/1/2020, https://doi.org/10.1109/LRA.2020.3001541
- Horn JC, Mohammadi A, Hamed KA, Gregg RD, "Nonholonomic Virtual Constraint Design for Variable-Incline Bipedal Robotic Walking," IEEE Robotics and Automation Letters, 4/1/2020, https://doi.org/10.1109/LRA.2020.2977263
- Villarreal DJ, Gregg RD, "Controlling a Powered Transfemoral Prosthetic Leg Using a Unified Phase Variable," chapter in Wearable Robotics, 1/1/2020, https://doi.org/10.1016/b978-0-12-814659-0.00024-2

Recent U.S. Patents

- Systems and Methods for Prosthetic Device Control, #10792170B2, 2020
- Series Elastic Actuator with Electrically Modulated Stiffness, #10870202B2, 2020

Current Graduate Students Advised

- Emily Keller (ROB PhD), 2021-present
- Shihao Cheng (ROB PhD), 2021-present
- Christopher Nesler (ROB PhD), 2021-present (co-advised by Prof. Elliott Rouse)
- Thomas “Kevin” Best (ROB PhD), 2020-present (co-advised by Prof. Elliott Rouse)
- Ross Cortino (ROB PhD), 2020-present
- Daphna Raz (ROB PhD), 2020-present (co-advised by Prof. Necmiye Ozay)
- Emma Reznick (ROB PhD), 2018-present

Grizzle, Jessy W.

Website: http://web.eecs.umich.edu/faculty/grizzle/

Research Interests: Analysis and feedback control of nonlinear systems; Control of bipedal robot locomotion.

Recent Publications

- Huynh V, Burger G, Dang QV, Pelge R, Boeris G, Grizzle JW, Ames AD, Masselin M, "Versatile Dynamic Motion Generation Framework: Demonstration With a Crutch-Less Exoskeleton on Real-Life Obstacles at the Cybathlon 2020 With a Complete Paraplegic Person," Frontiers in Robotics and AI, 9/24/2021, https://doi.org/10.3389/frobt.2021.723780
- Huang JK, Wang S, Ghaffari M, Grizzle JW, "LiDARTag: A Real-Time Fiducial Tag System for Point Clouds," IEEE Robotics and Automation Letters, 7/1/2021, https://doi.org/10.1109/LRA.2021.3070302
- Christensen H, Amato N, Yanco H, Mataric M, Choset H, Drobnis A, Goldberg K, Grizzle J, Hager G, Hollerbach J, "A Roadmap for US Robotics - From Internet to Robotics 2020 Edition," Foundations and Trends in Robotics, 1/1/2021, https://doi.org/10.1561/2300000066
- Mungai ME, Grizzle JW, "Feedback Control Design for Robust Comfortable Sit-to-Stand Motions of 3D Lower-Limb Exoskeletons," IEEE Access, 1/1/2021, https://doi.org/10.1109/ACCESS.2020.3046446
- Gan L, Zhang R, Grizzle JW, Eustice RM, Ghaffari M, "Bayesian Spatial Kernel Smoothing for Scalable Dense Semantic Mapping," IEEE Robotics and Automation Letters, 4/1/2020, https://doi.org/10.1109/LRA.2020.2965390
- Hartley R, Ghaffari M, Eustice RM, Grizzle JW, "Contact-aided invariant extended Kalman filtering for robot state estimation," International Journal of Robotics Research, 3/1/2020, https://doi.org/10.1177/0278364919894385
- Huang JK, Grizzle JW, "Improvements to Target-Based 3D LiDAR to Camera Calibration," IEEE Access, 1/1/2020, https://doi.org/10.1109/ACCESS.2020.3010734

Current Graduate Students Advised (NOTE: no longer accepting new students)

- Omar Harib, ECE PhD

Guo, L. Jay

Website: http://www.guogroup.org/

Research Interests: Polymer-based photonic sensors and photoacoustics, organic and hybrid photovoltaics and photodetectors, flexible transparent conductors, nanophotonics & structural colors, nanomanufacturing technologies and applications

Recent Publications

- Y.-B. Park, C.-Y. Jeong, L. J. Guo, "Resistivity scaling transition in ultrathin metal film at critical thickness and its implication for the transparent conductor applications", *Adv. Electron. Mater*. 2021 https://doi.org/10.1002/aelm.202100970
- Sahraeibelverdi T, Guo LJ, Veladi H, Malekshahi MR, "Polymer ring resonator with a partially tapered waveguide for biomedical sensing: Computational study," Sensors, 8/1/2021, https://doi.org/10.3390/s21155017
- Zhang, Y; Liu, Z; Ji, C; Chen, X; Hou, G; Li, Y; Zhou, X; Cui, X; Yang, X; Ren, C; Liu, D; Guo, L; Zhao, Y; Zhang, X, "Low-Temperature Oxide/Metal/Oxide Multilayer Films as Highly Transparent Conductive Electrodes for Optoelectronic Devices," ACS Applied Energy Materials, 7/26/2021, https://doi.org/10.1021/acsaem.1c00586
- Zhu L, Nie X, Chen PY, Guo LJ, "Transparent and flexible self-dual antennas for hybrid inductive/capacitive and radiative power transfer," 2021 IEEE Wireless Power Transfer Conference, WPTC 2021, 6/1/2021, https://doi.org/10.1109/WPTC51349.2021.9457986
- Wang H, Zheng Z, Ji C, Jay Guo L, "Automated multi-layer optical design via deep reinforcement learning," MACHINE LEARNING-SCIENCE AND TECHNOLOGY, 6/1/2021, https://doi.org/10.1088/2632-2153/abc327
- Jeong C, Park Y-B, Guo LJ, "Tackling light trapping in organic light-emitting diodes by complete elimination of waveguide modes," SCIENCE ADVANCES, 6/1/2021, https://doi.org/10.1126/sciadv.abg0355
- Liu Z, Zhang C, Zhu W, Huang Z, Lezec HJ, Agrawal A, Guo LJ, "Compact Stereo Waveguide Display Based on a Unidirectional Polarization-Multiplexed Metagrating In-Coupler," ACS Photonics, 4/21/2021, https://doi.org/10.1021/acsphotonics.0c01885
- Han X, Fan Z, Liu Z, Li C, Guo LJ, "Inverse design of metasurface optical filters using deep neural network with high degrees of freedom," INFOMAT, 4/1/2021, https://doi.org/10.1002/inf2.12116

- Park J, Lee KT, Yeon G, Choi J, Kim M, Han B, Baac HW, Guo LJ, Ok JG, "Demonstration of the one-step continuous fabrication of flexible polymer ridge waveguides via nanochannel-guided lithography," Journal of Industrial and Engineering Chemistry, 3/25/2021, https://doi.org/10.1016/j.jiec.2020.12.034
- LIU Z, FENG W, HUANG Z, JAY GUO L, "Polarization-controlled efficient and unidirectional surface plasmon polariton excitation enabled by metagratings in a generalized Kretschmann configuration," Optics Express, 2/1/2021, https://doi.org/10.1364/OE.416057
- Zhang C, Ji C, Park YB, Guo LJ, "Thin-Metal-Film-Based Transparent Conductors: Material Preparation, Optical Design, and Device Applications," Advanced Optical Materials, 2/1/2021, https://doi.org/10.1002/adom.202001298
- Tian Z, Yan H, Peng Q, Guo LJ, Zhou S, Ding C, Li P, Luo Q, "Atomistic insights into aluminum doping effect on surface roughness of deposited ultra-thin silver films," Nanomaterials, 1/1/2021, https://doi.org/10.3390/nano11010158
- Liu Z, Zhang C, Huang Z, Guo LJ, "Compact stereo waveguide display using a polarization-multiplexed Incoupling Metagrating," Digest of Technical Papers - SID International Symposium, 1/1/2021, https://doi.org/10.1002/sdtp.15185
- Jeong C, Guo LJ, "Flexible transparent organic light-emitting diodes with suppressed waveguide modes," Digest of Technical Papers - SID International Symposium, 1/1/2021, https://doi.org/10.1002/sdtp.14985
- Chen L, Panday A, Park J, Kim M, Oh DK, Ok JG, Guo LJ, "Size-Selective Sub-micrometer-Particle Confinement Utilizing Ionic Entropy-Directed Trapping in Inscribed Nanovoid Patterns," ACS Nano, 1/1/2021, https://doi.org/10.1021/acsnano.1c00014
- Jeong C, Park YB, Jang B, Guo LJ, "Ultrathin foldable organic light-emitting diodes with high efficiency," Digest of Technical Papers - SID International Symposium, 1/1/2021, https://doi.org/10.1002/sdtp.14671
- Jeong C, Park YB, Guo LJ, "Enhanced light outcoupling from OLEDs by suppressing guided modes formation using an ultrathin flexible transparent conductor," Technical Digest - International Electron Devices Meeting, IEDM, 12/12/2020, https://doi.org/10.1109/IEDM13553.2020.9372122
- Ji C, Liu D, Zhang C, Jay Guo L, "Ultrathin-metal-film-based transparent electrodes with relative transmittance surpassing 100%," Nature Communications, 12/1/2020, https://doi.org/10.1038/s41467-020-17107-6
- Lee T, Cheong Y, Baac HW, Guo LJ, "Origin of Gouy Phase Shift Identified by Laser-Generated Focused Ultrasound," ACS Photonics, 11/18/2020, https://doi.org/10.1021/acsphotonics.0c01313
- Jeong C, Park Y-B, Guo LJ, "P185: Flexible Organic LightEmitting Diodes with Improved Outcoupling Efficiency," SID Symposium Digest of Technical Papers, 8/1/2020, https://doi.org/10.1002/sdtp.14328

- Liu Z, Liu Z, Cui Q, Huang Z, Guo LJ, "Transparent Colored Display Enabled by Flat Glass Waveguide and Nanoimprinted Multilayer Gratings," ACS Photonics, 6/17/2020, https://doi.org/10.1021/acsphotonics.9b01803
- Sedghi M, Gholami A, Guo LJ, "Analytical analysis of PT and quasi-PT symmetry in thick diffraction gratings using coupled-wave theory," JOURNAL OF OPTICS, 6/1/2020, https://doi.org/10.1088/2040-8986/ab8b24
- Yang Z, Ji C, Cui Q, Guo LJ, "High-Purity Hybrid Structural Colors by Enhancing Optical Absorption of Organic Dyes in Resonant Cavity," Advanced Optical Materials, 6/1/2020, https://doi.org/10.1002/adom.202000317
- Hu H, Tang B, Wan H, Sun H, Zhou S, Dai J, Chen C, Liu S, Guo LJ, "Boosted ultraviolet electroluminescence of InGaN/AlGaN quantum structures grown on high-index contrast patterned sapphire with silica array," Nano Energy, 3/1/2020, https://doi.org/10.1016/j.nanoen.2019.104427
- Wan W, Qiao W, Pu D, Li R, Wang C, Hu Y, Duan H, Guo LJ, Chen L, "Holographic Sampling Display Based on Metagratings," iScience, 1/24/2020, https://doi.org/10.1016/j.isci.2019.100773
- Park YB, Jeong C, Guo LJ, "Ultrathin cu-ag anode for high light outcoupling efficiency by eliminating waveguide mode in oled," Digest of Technical Papers - SID International Symposium, 1/1/2020, https://doi.org/10.1002/sdtp.14024

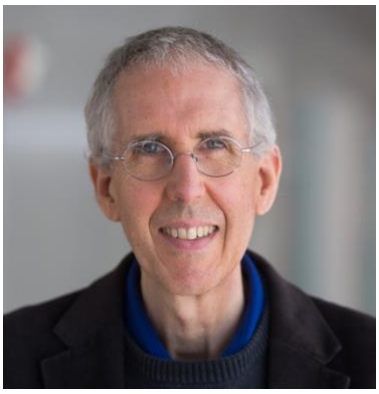
Recent U.S. Patents

- Two-dimensional micro- and nano-pattern, methods for forming the same, and microfluidic devices formed therefrom," #10661271, 2020
- Panel with reduced glare, #10908339, 2021

Current Graduate Students Advised

- Dongrui Jiang, ECE PhD
- Maxwell Li, ECE PhD (co-advised)
- Wei-Kuan Lin, ECE PhD
- Taigao Ma, Physics PhD, Data Science CertGrad
- Eymana Maria, ECE PhD
- Haozhu Wang, ECE PhD
- Weijie Feng, Macro PhD
- Jennie Paik, Macro PhD
- Boonjae Jang, Macro PhD

- Anwesha Saha, App. Phys. PhD
- Benjamin Rorem, App. Phys. PhD
- Mustafa Tobah, MSE PhD
- Evan Cheng, ECE MS



Hero, Alfred O.

Website: https://hero.engin.umich.edu/

Research Interests: Theory and algorithms underlying data science and machine learning. Theory includes applied probability, statistical modeling, and optimization. Applications include complex networks, spatio-temporal processes, computational biology, personalized health, and security.

Recent Publications

- Abram Magner, Mayank Baranwal, A.O. Hero, "Fundamental limitations of deep graph convolutional networks," to appear in IEEE Transactions on Information Theory, 2021. (.html) .
- Y. Yilmaz, M. Aktukmak, A. Hero, "Multimodal Data Fusion in High-Dimensional Heterogeneous Datasets via Generative Models," IEEE Transactions on Signal Processing, Sept 2021. (.html).
- Jinpu Lin, Qian Qian, Jon Murphy, Abigail Hsu, Alfred Hero, Alexander G.R. Thomas, Karl Krushelnick, "Feature analysis in relativistic laser-plasma experiments utilizing machine learning methods," Physics of Plasmas July 2021. (.html).
- K. Moon, K. Sricharan, A. Hero, "Ensemble Estimation of Generalized Mutual Information with Applications to Genomics," IEEE Transactions on Information Theory, 2021. (.html) .
- Y. Wang, C. Hougen, B. Oselio, W. Dempsey, A. Hero, "A geometry-driven longitudinal topic model," Harvard Data Science Review, April 30 2021. (.html) .
- B Robinson, R Malinas, Alfred Hero, "Space-Time Adaptive Detection at Low Sample Support," IEEE Trans, on Signal Processing, April 2021. arxiv.2010.03388 (.html) .
- M. Noshad, J. Choi, Y. Sun, A. Hero, I. Dinov, "A Data Value Metric for Quantifying Information Content and Utility," Journal of Big Data, Mar. 2021. (.html) .
- W. Dempsey, B. Oselio, A. Hero, "Hierarchical network models for exchangeable structured interaction processes," pp. 1-43, Journal of the American Statistical Association, Mar. 2021. (.html) .
- C. Hougen, L. Kaplan and A. Hero, "Uncertain Bayesian networks: learning from incomplete data," IEEE Machine Learning for Signal Processing, Gold Coast Australia Oct 2021.
- Ren Wang, Tianqi Chen, Stephen Lindley, Cooper Stansbury, Indika Rajapakse, Alfred Hero, "Immuno-mimetic Deep Neural Networks (Immuno-Net)," Workshop on

Computational Biology, International Conference on Machine Learning (ICML), July 2021. (Spotlight). (.html) .

- Y Wang, A Hero, “SG-PALM: a Fast Physically Interpretable Tensor Graphical Model,” International Conference on Machine Learning (ICML), July 2021. (.html) .
- E. Hou, E. Lawrence, A. Hero, “Penalized Ensemble Kalman Filters for High Dimensional Non-linear Systems,” PLoS One, 16(3): e0248046. Mar. 2021. (.html) . Available as arxiv:1610.00195 (.html) . DOE CVT, ETI.
- Baranwal M, Garg K, Panagou D, Hero AO, "Robust Distributed Fixed-Time Economic Dispatch Under Time-Varying Topology," IEEE CONTROL SYSTEMS LETTERS, 10/1/2021, https://doi.org/10.1109/LCSYS.2020.3020248
- She X, Zhai Y, Henao R, Woods CW, Chiu C, Ginsburg GS, Song PXK, Hero AO, "Adaptive Multi-Channel Event Segmentation and Feature Extraction for Monitoring Health Outcomes," IEEE Transactions on Biomedical Engineering, 8/1/2021, https://doi.org/10.1109/TBME.2020.3038652
- Zhou L, Hero AO, "Resolution Limits for the Noisy Non-Adaptive 20 Questions Problem," IEEE Transactions on Information Theory, 4/1/2021, https://doi.org/10.1109/TIT.2021.3049796
- Hou E, Lawrence E, Hero AO, "Penalized ensemble Kalman filters for high dimensional non-linear systems," PLoS ONE, 3/1/2021, https://doi.org/10.1371/journal.pone.0248046
- Altmann Y, Di Fulvio A, Paff MG, Clarke SD, Davies ME, McLaughlin S, Hero AO, Pozzi SA, "Expectation-propagation for weak radionuclide identification at radiation portal monitors," Scientific Reports, 12/1/2020, https://doi.org/10.1038/s41598-020-62947-3
- Harirchi F, Kim D, Khalil O, Liu S, Elvati P, Baranwal M, Hero A, Violi A, "On sparse identification of complex dynamical systems: A study on discovering influential reactions in chemical reaction networks," Fuel, 11/1/2020, https://doi.org/10.1016/j.fuel.2020.118204
- Liu S, Chen P-Y, Kailkhura B, Zhang G, III HAO, Varshney PK, "A Primer on Zeroth-Order Optimization in Signal Processing and Machine Learning Principals, recent advances, and applications," IEEE SIGNAL PROCESSING MAGAZINE, 9/1/2020, https://doi.org/10.1109/MSP.2020.3003837
- Jiao Z, Sun H, Wang X, Manchester W, Gombosi T, Hero A, Chen Y, "Solar Flare Intensity Prediction With Machine Learning Models," Space Weather, 7/1/2020, https://doi.org/10.1029/2020SW002440
- LeBlanc JW, Thelen BJ, Hero AO, "Testing that a Local Optimum of the Likelihood is Globally Optimum Using Reparameterized Embeddings: Applications to Wavefront Sensing," Journal of Mathematical Imaging and Vision, 7/1/2020, https://doi.org/10.1007/s10851-020-00979-0

- Charalambides N, Mahdavifar H, Hero AO, "Numerically Stable Binary Gradient Coding," IEEE International Symposium on Information Theory - Proceedings, 6/1/2020, https://doi.org/10.1109/ISIT44484.2020.9174512
- Zhou L, Hero A, "Resolution Limits of Non-Adaptive Querying for Noisy 20 Questions Estimation," IEEE International Symposium on Information Theory - Proceedings, 6/1/2020, https://doi.org/10.1109/ISIT44484.2020.9174277
- Magner A, Baranwal M, Hero AO, "The Power of Graph Convolutional Networks to Distinguish Random Graph Models," IEEE International Symposium on Information Theory - Proceedings, 6/1/2020, https://doi.org/10.1109/ISIT44484.2020.9174092
- Sabeti E, Song PXK, Hero AO, "Pattern-Based Analysis of Time Series: Estimation," IEEE International Symposium on Information Theory - Proceedings, 6/1/2020, https://doi.org/10.1109/ISIT44484.2020.917452 9
- Wang X, Chen Y, Toth G, Manchester WB, Gombosi TI, Hero AO, Jiao Z, Sun H, Jin M, Liu Y, "Predicting Solar Flares with Machine Learning: Investigating Solar Cycle Dependence," Astrophysical Journal, 5/20/2020, https://doi.org/10.3847/1538-4357/ab89ac
- Charalambides N, Pilanci M, Hero AO, "Weighted Gradient Coding with Leverage Score Sampling," ICASSP, IEEE International Conference on Acoustics, Speech and Signal Processing - Proceedings, 5/1/2020, https://doi.org/10.1109/ICASSP40776.2020.9054153
- Baranwal M, Magner A, Elvati P, Saldinger J, Violi A, Hero AO, "A deep learning architecture for metabolic pathway prediction," Bioinformatics, 4/15/2020, https://doi.org/10.1093/bioinformatics/btz954
- Sekeh SY, Oselio B, Hero AO, "Learning to bound the multi-class bayes error," IEEE Transactions on Signal Processing, 1/1/2020, https://doi.org/10.1109/TSP.2020.2994807

Current Graduate Students Advised

- Neophytos Charalambides, ECE PhD
- Conrad Hougen, ECE PhD
- Byoung Jang, Statistics PhD
- Oliver Knitter, Applied and Interdisiplinary Mathematics (AIM) PhD (co-advised)
- Robert Malinas, ECE PhD
- Zeyu Sun, ECE PhD
- Yu Wang, Statistics PhD
- Audelia Wittbrodt, Applied Physics PhD
- Can Yaras, ECE PhD (co-advised)
- Haonan Zhu, ECE PhD

Hiskens, Ian A.

Website: https://web.eecs.umich.edu/~hiskens/

Research Interests: Power system analysis, Analysis and control of nonlinear non-smooth dynamical systems. Areas of specialty: Power system dynamics and control, Wind power, Grid controllability, Inverse problems.

Recent Publications

- Shelar D, Amin S, Hiskens IA, "Evaluating Resilience of Electricity Distribution Networks via a Modification of Generalized Benders Decomposition Method," IEEE Transactions on Control of Network Systems, 9/1/2021, https://doi.org/10.1109/TCNS.2021.3061671
- Hatziargyriou, N; Milanovic, J; Rahmann, C; Ajjarapu, V; Canizares, C; Erlich, I; Hill, D; Hiskens, I; Kamwa, I; Pal, B; Pourbeik, P; Sanchez-Gasca, J; Stankovic, A; Van Cutsem, T; Vittal, V; Vournas, C, "Definition and Classification of Power System Stability - Revisited & Extended," IEEE Transactions on Power Systems, 7/1/2021, https://doi.org/10.1109/TPWRS.2020.3041774
- Yao M, Hiskens IA, Mathieu JL, "Mitigating Voltage Unbalance Using Distributed Solar Photovoltaic Inverters," IEEE Transactions on Power Systems, 5/1/2021, https://doi.org/10.1109/TPWRS.2020.3039405
- Nazir MS, Hiskens I, "Analysis of synchronization in load ensembles," Electric Power Systems Research, 1/1/2021, https://doi.org/10.1016/j.epsr.2020.106779
- Fisher MW, Hiskens I, "Comments on "Stability Regions of Nonlinear Autonomous Dynamical Systems"," IEEE Transactions on Automatic Control, 1/1/2021, https://doi.org/10.1109/TAC.2021.3061674
- Lei S, Hong D, Mathieu JL, Hiskens IA, "Baseline estimation of commercial building HVAC fan power using tensor completion," Electric Power Systems Research, 12/1/2020, https://doi.org/10.1016/j.epsr.2020.106624
- Geng S, Vrakopoulou M, Hiskens IA, "Chance-constrained optimal capacity design for a renewable-only islanded microgrid," Electric Power Systems Research, 12/1/2020, https://doi.org/10.1016/j.epsr.2020.106564
- Skinner B, Mancarella P, Vrakopoulou M, Hiskens I, "Incorporating new power system security paradigms into low-carbon electricity markets," Electricity Journal, 11/1/2020, https://doi.org/10.1016/j.tej.2020.106837

- Geng S, Vrakopoulou M, Hiskens IA, "Optimal Capacity Design and Operation of Energy Hub Systems," Proceedings of the IEEE, 9/1/2020, https://doi.org/10.1109/JPROC.2020.3009323
- Luo H, Hiskens IA, Hu Z, "Stability Analysis of Load Frequency Control Systems with Sampling and Transmission Delay," IEEE Transactions on Power Systems, 9/1/2020, https://doi.org/10.1109/TPWRS.2020.2980883
- Keskar A, Anderson D, Johnson JX, Hiskens IA, Mathieu JL, "Do commercial buildings become less efficient when they provide grid ancillary services?" Energy Efficiency, 3/1/2020, https://doi.org/10.1007/s12053-019-09787-x
- Geng S, Hiskens IA, "Reach-set estimation for DAE systems under uncertainty and disturbances using trajectory sensitivity and logarithmic norm," IFAC-PapersOnLine, 1/1/2020, https://doi.org/10.1016/j.ifacol.2020.12.2553

Current Graduate Students Advised

- Sijia Geng, ECE PhD
- Ioannis Marios Granitsas, ECE PhD (co-advised)
- Oluwagbemileke Oyefeso, ECE PhD (co-advised)

Hofmann, Heath

Website: https://hofmann.engin.umich.edu/

Research Interests: Power electronics and systems.

Recent Publications

- Yi C, Hofmann H, Epureanu BI, "Reduced-order models for electro-magnetic-structural coupling phenomena," Mechanical Systems and Signal Processing, 10/1/2021, https://doi.org/10.1016/j.ymssp.2021.107752
- Drallmeier JA, Hofmann H, Middleton R, Siegel J, Stefanopoulou A, Salvi A, "Work Extraction Efficiency in a Series Hybrid Opposed Piston Engine," SAE Technical Papers, 9/21/2021, https://doi.org/10.4271/2021-01-1242
- Song Z, Yang XG, Yang N, Delgado FP, Hofmann H, Sun J, "A study of cell-to-cell variation of capacity in parallel-connected lithium-ion battery cells," eTransportation, 2/1/2021, https://doi.org/10.1016/j.etran.2020.100091
- Hou J, Song Z, Hofmann HF, Sun J, "Control Strategy for Battery/Flywheel Hybrid Energy Storage in Electric Shipboard Microgrids," IEEE Transactions on Industrial Informatics, 2/1/2021, https://doi.org/10.1109/TII.2020.2973409
- Song Z, Park H, Delgado FP, Wang H, Li Z, Hofmann HF, Sun J, Hou J, "Simultaneous identification and control for hybrid energy storage system using model predictive control and active signal injection," IEEE Transactions on Industrial Electronics, 11/1/2020, https://doi.org/10.1109/TIE.2019.2952825
- Song Z, Delgado FP, Hou J, Hofmann H, Sun J, "Individual Cell Fault Detection for Parallel-Connected Battery Cells Based on the Statistical Model and Analysis," Proceedings of the American Control Conference, 7/1/2020, https://doi.org/10.23919/ACC45564.2020.9147423
- Song Z, Wang H, Hou J, Hofmann HF, Sun J, "Combined State and Parameter Estimation of Lithium-Ion Battery with Active Current Injection," IEEE Transactions on Power Electronics, 4/1/2020, https://doi.org/10.1109/TPEL.2019.2945513
- Wang Y, Pries J, Zhou K, Hofmann H, Rizzo D, "Computationally Efficient AC Resistance Model for Stator Winding with Rectangular Conductors," IEEE Transactions on Magnetics, 4/1/2020, https://doi.org/10.1109/TMAG.2020.2968870
- Zhu H, Song Z, Hou J, Hofmann HF, Sun J, "Simultaneous Identification and Control Using Active Signal Injection for Series Hybrid Electric Vehicles Based on Dynamic

Programming," IEEE Transactions on Transportation Electrification, 3/1/2020, https://doi.org/10.1109/TTE.2020.2969811

- Song Z, Hou J, Li X, Wu X, Hu X, Hofmann H, Sun J, "The sequential algorithm for combined state of charge and state of health estimation of lithium-ion battery based on active current injection," Energy, 2/15/2020, https://doi.org/10.1016/j.energy.2019.116732
- Song Z, Hofmann H, Li J, Wang Y, Lu D, Ouyang M, Du J, "Torque Distribution Strategy for Multi-PMSM Applications and Optimal Acceleration Control for Four-Wheel-Drive Electric Vehicles," Journal of Dynamic Systems, Measurement and Control, Transactions of the ASME, 2/1/2020, https://doi.org/10.1115/1.4045321
- Delgado FP, Song Z, Hofmann HF, Sun J, "Modeling and parameter identification for condition monitoring of surface-mount permanent magnet machines under magnet demagnetization," ASME 2020 Dynamic Systems and Control Conference, DSCC 2020, 1/1/2020, https://doi.org/10.1115/DSCC2020-3186

Recent U.S. Patents

- Brushless, self-excited synchronous field-winding machine, #10770999, 2020

Current Graduate Students Advised

- Jake Chung, ECE PhD
- Ali Najmabadi, ECE PhD
- Fanny Pinto Delgado, ECE PhD (co-advised)
- Aunnasha Sengupta, ECE PhD
- Kishan Srinivasan, ECE PhD

Islam, Mohammed N.

Website: https://islam.engin.umich.edu/

Research Interests: Mid- and near-infrared laser sources and their applications in defense and healthcare. On the defense side, applications include infrared countermeasures, explosives detection, and active remote sensing. On the healthcare side, his research relates to using fiber lasers in cardiology, dentistry, non-invasive glucose monitoring and blood analyte measurements, and selective ablation of visceral fat for diabetes treatment.

Recent Publications

- Memmini AK, Sun X, Hu X, Kim J, Herzog NK, Islam MN, Weissman DH, Rogers AJ, Kovelman I, Broglio SP, "Persistent alterations of cortical hemodynamic response in asymptomatic concussed patients," Concussion, 3/1/2021, https://doi.org/10.2217/cnc-2020-0014
- Zhai T, Ash-Rafzadeh A, Hu X, Kim J, San Juan JD, Filipiak C, Guo K, Islam MN, Kovelman I, Basura GJ, "Tinnitus and auditory cortex; Using adapted functional near-infrared-spectroscopy to expand brain imaging in humans," Laryngoscope Investigative Otolaryngology, 2/1/2021, https://doi.org/10.1002/lio2.510
- Martinez RA, Guo K, Terry FL, Zhai T, Islam MN, Ifarraguerri AI, "Long-wave infrared scattering spectra and modeling of trace particles on surfaces for standoff detection," Journal of Applied Physics, 6/28/2020, https://doi.org/10.1063/5.0009463
- Islam, M; Guo, K; Zhai, T; Memmini, A; Martinez, R; Meah, C; Kovelman, I; Weissman, D; Hu, X; Kim, J; Broglio, S; Beard, D; Van Den Bergh, F; Alam, H; Russo, R, "Brain metabolism monitoring through CCO measurements using all-fiber-integrated super-continuum source," Progress in Biomedical Optics and Imaging - Proceedings of SPIE, 1/1/2020, https://doi.org/10.1117/12.2550137
- Martinez RA, Guo K, Terry FL, Zhai T, Islam MN, Ifarraguerri AI, "Scattering spectra from trace particles actively illuminated by a mid-infrared supercontinuum FTIR sensor," Progress in Biomedical Optics and Imaging - Proceedings of SPIE, 1/1/2020, https://doi.org/10.1117/12.2550334
- Guo K, Zhai T, Demory B, Meah S, Martinez R, Islam MN, Terry F, Maynard R, "Stand-off non-destructive determination of protein level in wheat flour with a super-continuum laser," Progress in Biomedical Optics and Imaging - Proceedings of SPIE, 1/1/2020, https://doi.org/10.1117/12.2550400
- San Juan JD, Zhai T, Ash-Rafzadeh A, Hu XS, Kim J, Filipak C, Guo K, Islam MN, Kovelman I, Basura GJ, "Tinnitus and auditory cortex: Using adapted functional near-infrared

spectroscopy to measure resting-state functional connectivity," NeuroReport, 1/1/2020, https://doi.org/10.1097/WNR.0000000000001561

Recent U.S. Patents

- Near-infrared time--of-flight imaging using laser diodes with Bragg reflectors [OMNI-125-PUSP5], #10660526, 2020
- Near-infrared time-of-flight cameras and imaging [OMNI-124-PUSA6], #10677774, 2020
- Time-of-flight measurement of skin or blood using array of laser diodes with Bragg reflectors [OMNI-131-PUSA6], #10820807, 2020
- Semiconductor source based near infrared measurement device with improved signal-to-noise ratio [OMNI-102-PUSA6], #10874304, 2020

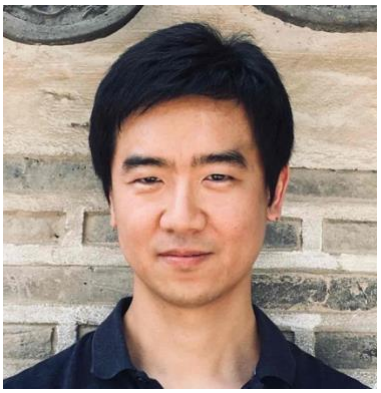
Current Graduate Students Advised

- Kaiwen Guo, EE PhD
- Yanwen Jing, ECE PhD (co-advised)
- Tianqu Zhai, ECE PhD

Kanicki, Jerzy

Website: http://vhosts.eecs.umich.edu/omelab/

Research Interests: Metal oxide semiconductors thin-film devices and circuits; Transmissive, reflective and emissive flat panel displays; Electrochromic devices; Detectors and active pixel sensors for digital breast tomosynthesis; Biodegradable hydrogels for various applications.



Kim, Hun-Seok

Website: https://kim.engin.umich.edu/

Research Interests: Digital communication algorithm and systems; Ultra low power / ultra high performance VLSI SoC architecture; Computer vision and multimedia signal processing.

Recent Publications

- Lim J, Lee J, Moon E, Barrow M, Atzeni G, Letner J, Costello J, Nason SR, Patel PR, Patil PG, Kim HS, Chestek C, Phillips J, Blaauw D, Sylvester D, Jang T, "A Light Tolerant Neural Recording IC for Near-Infrared-Powered Free Floating Motes," IEEE Symposium on VLSI Circuits, Digest of Technical Papers, 6/13/2021, https://doi.org/10.23919/VLSICircuits52068.2021.9492459
- Kim, S; Fayazi, M; Daftardar, A; Chen, K; Tan, J; Pal, S; Ajayi, T; Xiong, Y; Mudge, T; Chakrabarti, C; Blaauw, D; Dreslinski, R; Kim, H, "Versa: A Dataflow-Centric Multiprocessor with 36 Systolic ARM Cortex-M4F Cores and a Reconfigurable Crossbar-Memory Hierarchy in 28nm," IEEE Symposium on VLSI Circuits, Digest of Technical Papers, 6/13/2021, https://doi.org/10.23919/VLSICircuits52068.2021.9492391
- Yang M, Bian C, Kim H-S, "Deep Joint Source Channel Coding for Wireless Image Transmission with OFDM," ICC 2021 - IEEE International Conference on Communications, 6/1/2021, https://doi.org/10.1109/icc42927.2021.9500996
- Moon, E; Barrow, M; Lim, J; Lee, J; Nason, S; Costello, J; Kim, H; Chestek, C; Jang, T; Blaauw, D; Phillips, J, "Bridging the "last Millimeter" Gap of Brain-Machine Interfaces via Near-Infrared Wireless Power Transfer and Data Communications," ACS Photonics, 5/19/2021, https://doi.org/10.1021/acsphotonics.1c00160
- Ebrahimi N, Kim HS, Blaauw D, "Physical Layer Secret Key Generation Using Joint Interference and Phase Shift Keying Modulation," IEEE Transactions on Microwave Theory and Techniques, 5/1/2021, https://doi.org/10.1109/TMTT.2021.3058183
- An H, Schiferl S, Venkatesan S, Wesley T, Zhang Q, Wang J, Choo KD, Liu S, Liu B, Li Z, Gong L, Zhong H, Blaauw D, Dreslinski R, Kim HS, Sylvester D, "An Ultra-Low-Power Image Signal Processor for Hierarchical Image Recognition with Deep Neural Networks," IEEE Journal of Solid-State Circuits, 4/1/2021, https://doi.org/10.1109/JSSC.2020.3041858
- Li, Z; Wang, Z; Xu, L; Dong, Q; Liu, B; Su, C; Chu, W; Tsou, G; Chih, Y; Chang, T; Sylvester, D; Kim, H; Blaauw, D, "RRAM-DNN: An RRAM and Model-Compression Empowered All-

Weights-On-Chip DNN Accelerator," IEEE Journal of Solid-State Circuits, 4/1/2021, https://doi.org/10.1109/JSSC.2020.3045369

- Yang M, Hsiao R, Carichner G, Ernst K, Lim J, Green DA, Lee I, Blaauw D, Kim HS, "Migrating monarch butterfly localization using multi-modal sensor fusion neural networks," European Signal Processing Conference, 1/24/2021, https://doi.org/10.23919/Eusipco47968.2020.9287842
- Chen Y, Liu B, Abillama P, Kim H-S, IEEE, "HTNN: Deep Learning in Heterogeneous Transform Domains with Sparse-Orthogonal Weights," 2021 IEEE/ACM INTERNATIONAL SYMPOSIUM ON LOW POWER ELECTRONICS AND DESIGN (ISLPED), 1/1/2021, https://doi.org/10.1109/ISLPED52811.2021.9502477
- Wang J, An H, Zhang Q, Kim HS, Blaauw D, Sylvester D, "A 40-nm Ultra-Low Leakage Voltage-Stacked SRAM for Intelligent IoT Sensors," IEEE Solid-State Circuits Letters, 1/1/2021, https://doi.org/10.1109/LSSC.2020.3043461
- Jinia AJ, Maurer TE, Meert CA, Hua MY, Clarke SD, Kim HS, Wentzloff DD, Pozzi SA, "An Artificial Neural Network System for Photon-Based Active Interrogation Applications," IEEE Access, 1/1/2021, https://doi.org/10.1109/ACCESS.2021.3108406
- Hsu CW, Kim HS, "Non-Orthogonal Modulation for Short Packets in Massive Machine Type Communications," 2020 IEEE Global Communications Conference, GLOBECOM 2020 - Proceedings, 12/1/2020, https://doi.org/10.1109/GLOBECOM42002.2020.9348238
- Jinia AJ, Laferty KE, Clarke SD, Kim H-S, Wentzloff DD, Pozzi SA, "Development of an Artificial Neural Network for Special Nuclear Material Detection in a Mixed Photon-Neutron Environment," 2020 IEEE Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC), 10/31/2020, https://doi.org/10.1109/nss/mic42677.2020.9507886
- Lu P, Lim J, Graf R, Kim HS, "IGYM: An Inclusive Augmented Reality Exergame for People of All Abilities," IEEE Workshop on Signal Processing Systems, SiPS: Design and Implementation, 10/1/2020, https://doi.org/10.1109/SiPS50750.2020.9195226
- Nason SR, Vaskov AK, Willsey MS, Welle EJ, An H, Vu PP, Bullard AJ, Nu CS, Kao JC, Shenoy KV, Jang T, Kim HS, Blaauw D, Patil P, Chestek C, "A low-power band of neuronal spiking activity dominated by local single units improves the performance of brainmachine interfaces," Nature Biomedical Engineering, 10/1/2020, https://doi.org/10.1038/s41551-020-0591-0
- Pal, S; Feng, S; Park, D; Kim, S; Amarnath, A; Yang, C; He, X; Beaumont, J; May, K; Xiong, Y; Kaszyk, K; Morton, J; Sun, J; O'Boyle, M; Cole, M; Chakrabarti, C; Blaauw, D; Kim, H; Mudge, T; Dreslinski, R, "Transmuter: Bridging the efficiency gap using memory and dataflow reconfiguration," Parallel Architectures and Compilation Techniques - Conference Proceedings, PACT, 9/30/2020, https://doi.org/10.1145/3410463.3414627

- Feng Z, Chuo LX, Shi Y, Kim Y, Kim HS, Blaauw D, "A mm-Scale Sensor Node with a 2.7GHz 1.3W Transceiver Using Full-Duplex Self-Coherent Backscattering Achieving 3.5m Range," Digest of Papers - IEEE Radio Frequency Integrated Circuits Symposium, 8/1/2020, https://doi.org/10.1109/RFIC49505.2020.9218394
- Lim J, Choi M, Liu B, Kang T, Li Z, Wang Z, Zhang Y, Yang K, Blaauw D, Kim HS, Sylvester D, "AA-ResNet: Energy Efficient All-Analog ResNet Accelerator," Midwest Symposium on Circuits and Systems, 8/1/2020, https://doi.org/10.1109/MWSCAS48704.2020.9184587
- Wang J, An H, Zhang Q, Kim HS, Blaauw D, Sylvester D, "1.03pW/b Ultra-Low Leakage Voltage-Stacked SRAM for Intelligent Edge Processors," IEEE Symposium on VLSI Circuits, Digest of Technical Papers, 6/1/2020, https://doi.org/10.1109/VLSICircuits18222.2020.9162843
- An H, Venkatesan S, Schiferl S, Wesley T, Zhang Q, Wang J, Choo K, Liu S, Liu B, Li Z, Zhong H, Gong L, Blaauw D, Dreslinski R, Sylvester D, Kim HS, "A 170W Image Signal Processor Enabling Hierarchical Image Recognition for Intelligence at the Edge," IEEE Symposium on VLSI Circuits, Digest of Technical Papers, 6/1/2020, https://doi.org/10.1109/VLSICircuits18222.2020.9162810
- Wang Z, Li Z, Xu L, Dong Q, Su CI, Chu WT, Tsou G, Chih YD, Chang TYJ, Sylvester D, Kim HS, Blaauw D, "An All-Weights-on-Chip DNN Accelerator in 22nm ULL Featuring 24x1 Mb eRRAM," IEEE Symposium on VLSI Circuits, Digest of Technical Papers, 6/1/2020, https://doi.org/10.1109/VLSICircuits18222.2020.9162811
- Soorishetty A, Zhou J, Pal S, Blaauw D, Kim H, Mudge T, Dreslinski R, Chakrabarti C, "Accelerating Linear Algebra Kernels on a Massively Parallel Reconfigurable Architecture," ICASSP, IEEE International Conference on Acoustics, Speech and Signal Processing - Proceedings, 5/1/2020, https://doi.org/10.1109/ICASSP40776.2020.9054126
- Chuo, L; Feng, Z; Kim, Y; Chiotellis, N; Yasuda, M; Miyoshi, S; Kawaminami, M; Grbic, A; Wentzloff, D; Blaauw, D; Kim, H, "Millimeter-Scale Node-to-Node Radio Using a Carrier Frequency-Interlocking if Receiver for a Fully Integrated 4 Wireless Sensor Node," IEEE Journal of Solid-State Circuits, 5/1/2020, https://doi.org/10.1109/JSSC.2019.2959505
- Park DH, Pal S, Feng S, Gao P, Tan J, Rovinski A, Xie S, Zhao C, Amarnath A, Wesley T, Beaumont J, Chen KY, Chakrabarti C, Taylor M, Mudge T, Blaauw D, Kim HS, Dreslinski R, "A 7.3 M Output Non-Zeros/J, 11.7 M Output Non-Zeros/GB Reconfigurable Sparse Matrix-Matrix Multiplication Accelerator," IEEE Journal of Solid-State Circuits, 4/1/2020, https://doi.org/10.1109/JSSC.2019.2960480
- Lim J, Moon E, Barrow M, Nason SR, Patel PR, Patil PG, Oh S, Lee I, Kim HS, Sylvester D, Blaauw D, Chestek C, Phillips J, Jang T, "A 0.19x0.17mm^2 Wireless Neural Recording IC for Motor Prediction with Near-Infrared-Based Power and Data Telemetry," Digest of Technical Papers - IEEE International Solid-State Circuits Conference, 2/1/2020, https://doi.org/10.1109/ISSCC19947.2020.9063005

- Lim J, Kim HS, Park HM, "Minimax particle filtering for tracking a highly maneuvering target," International Journal of Robust and Nonlinear Control, 1/25/2020, https://doi.org/10.1002/rnc.4785
- Lim J, Kim HS, Park HM, "Interactive-Multiple-Model Algorithm Based on Minimax Particle Filtering," IEEE Signal Processing Letters, 1/1/2020, https://doi.org/10.1109/LSP.2019.2954000

Recent U.S. Patents

- Low-Power Receiver for FSK Back-Channel Embedded in 5.8GHz Wi-Fi OFDM Packets, #10541843, 2020

Current Graduate Students Advised

- L'Emir Pierre Abillama, ECE PhD
- Andrea Bejarano, ECE PhD (co-advised)
- Chenghong Bian, ECE PhD
- Yu Chen, ECE PhD
- Alhad Daftardar, ECE PhD (co-advised)
- Chin-Wei Hsu, ECE PhD
- Sung Kim, ECE PhD
- Demba Komma, ECE PhD (co-advised)
- Changwoo Lee, ECE PhD
- Bowen Liu, ECE PhD
- Sara Shoouri, ECE PhD
- Mingyu Yang, ECE PhD
- Yufan Yue, ECE PhD

Kira, Mackillo

Website: https://qstl.engin.umich.edu/

Research Interests: Quantum optoelectronics, semiconductor quantum optics, quantum optics, condensed-matter theory, terahertz spectroscopy, many-body interactions, photon correlations, coherent and ultrafast phenomena, and cluster-expansion approach.

Recent Publications

- Schmid, C; Kastner, L; Roelcke, C; Schlauderer, S; Lange, C; Repp, J; Reimann, J; Gudde, J; Hofer, U; Koch, S; Kira, M; Huber, R, "Controlling condensed matter with lightwave fields and forces," , 7/13/1905, https://doi.org/10.1109/CLEO/Europe-EQEC52157.2021.9542621
- Kira M, "Importance of quantum memory in lightwave electronics," Ultrafast Phenomena and Nanophotonics XXV, 3/5/2021, https://doi.org/10.1117/12.2578364
- Borsch M, Schmid CP, Weigl L, Schlauderer S, Hofmann N, Lange C, Steiner JT, Koch SW, Huber R, Kira M, "Super-resolution lightwave tomography of electronic bands in quantum materials," Science, 12/4/2020, https://doi.org/10.1126/science.abe2112
- Wu Y, Laleyan DA, Deng Z, Ahn C, Aiello AF, Pandey A, Liu X, Wang P, Sun K, Ahmadi E, Sun Y, Kira M, Bhattacharya P, Kioupakis E, Mi Z, "Controlling Defect Formation of Nanoscale AlN: Toward Efficient Current Conduction of Ultrawide-Bandgap Semiconductors," Advanced Electronic Materials, 9/1/2020, https://doi.org/10.1002/aelm.202000337
- Cong K, Jiang W, Anthonio BE, Noe GT, Liu H, Kataura H, Kira M, Kono J, Kono J, "Quantum-Memory-Enabled Ultrafast Optical Switching in Carbon Nanotubes," ACS Photonics, 6/17/2020, https://doi.org/10.1021/acsphotonics.0c00315
- Smith RP, Martin EW, Kira M, Cundiff ST, "Toward direct optical excitation of excitonic many-body effects using intense thermal states," OSA Continuum, 5/15/2020, https://doi.org/10.1364/OSAC.392972
- Wen Q, Wu Y, Wang P, Laleyan D, Bayerl D, Kioupakis E, Mi Z, Kira M, "Hyperspectral absorption of semiconductor monolayer crystals," Applied Physics Letters, 5/4/2020, https://doi.org/10.1063/5.0004119
- Wu Y, Liu X, Wang P, Laleyan DA, Sun K, Sun Y, Ahn C, Kira M, Kioupakis E, Mi Z, "Monolayer GaN excitonic deep ultraviolet light emitting diodes," Applied Physics Letters, 1/6/2020, https://doi.org/10.1063/1.5124828

- Kira M, Roumpos G, Cundiff ST, "Quantum-light shaping and quantum spectroscopy in semiconductors," chapter in Semiconductors and Semimetals, 1/1/2020, https://doi.org/10.1016/bs.semsem.2020.10.006
- Wen Q, Lu X, Wu Y, Wang P, Laleyan D, Bayerl D, Kioupakis E, Mi Z, Kira M, "Hyperspectral absorption of semiconductor monolayer crystals," Optics InfoBase Conference Papers, 1/1/2020, https://doi.org/10.1364/CLEO_QELS.2020.FF3B.3
- OHara S, Costello J, Wu Q, Valovcin D, Pfeiffer L, Kira M, Sherwin MS, "Reconstructing bloch wavefunctions in GaAs through high-order sideband polarimetry," Optics InfoBase Conference Papers, 1/1/2020, https://doi.org/10.1364/CLEO_QELS.2020.FF2Q.3
- Wu Q, Liu H, Wang P, Mi Z, Cundiff ST, Kira M, "Two-photon absorption in semiconductor monolayers," Optics InfoBase Conference Papers, 1/1/2020, https://doi.org/10.1364/CLEO_QELS.2020.FTu3Q.2
- Jiang W, Cong K, Anthonio BE, Timothy Noe G, Liu H, Kataura H, Kono J, Kira M, "Ultrafast quantum-memory effects in carbon nanotubes," Optics InfoBase Conference Papers, 1/1/2020, https://doi.org/10.1364/CLEO_QELS.2020.FTh1Q.1

Current Graduate Students Advised

- Markus Borsch, ECE PhD
- Aaditya Hambarde, ECE PhD
- Josey Hanish, ECE PhD (co-advised)
- Weiwei Jiang, ECE PhD
- Yanwen Jing, ECE PhD (co-advised)
- Patrick Kezer, ECE PhD (co-advised)
- Woncheol Lee, ECE PhD (co-advised)
- You Wu, ECE PhD

Ku, Pei-Cheng

Website: http://web.eecs.umich.edu/~peicheng/

Research Interests: Optoelectronic devices and materials with current focus on integrated photonics, semiconductor light sources (both classical and quantum) and their applications.

Recent Publications

- Kim J, Mastropietro D, Steel D, Shen JT, Ku PC, “Proposal for Chip-Scale Generation and Verification of Photonic Dimers,” Applied Physics Letters, 2021. (in print)
- Kim J, Croft Z, Steel D, Ku PC, “Enhanced Coulomb Interaction Between Two GaN Quantum Dots for Deterministic Spin-Spin Gate,” Applied Physics Letters, 2021.
- Kim J, Cheekati S, Sarwar T, Ku PC, "Designing an ultrathin film spectrometer based on iii-nitride light-absorbing nanostructures," Micromachines, 7/1/2021, **https://doi.org/10.3390/mi12070760**
- Chen Z, Zhou Y, Shen JT, Ku PC, Steel D, "Two-photon controlled-phase gates enabled by photonic dimers," Physical Review A, 5/1/2021, **https://doi.org/10.1103/PhysRevA.103.052610**
- Kim J, Croft Z, Steel D, Ku P-C, "Controlled Phase Gate of Spin Qubits in Two Quantum-Dot Single-Photon Emitters," Conference on Lasers and Electro-Optics, 1/1/2021, **https://doi.org/10.1364/cleo_at.2021.jtu3a.61**
- Dvorak NA, Chung K, Muller K, Ku PC, "Mapping tensorial shear stress with light-emitting GaN nanopillars," Proceedings of SPIE - The International Society for Optical Engineering, 1/1/2021, **https://doi.org/10.1117/12.2577640**
- Kim J, Cheekati S, Sarwar T, Ku PC, "Optics-free ultrathin-film spectrometers based on GaN light absorbers," Proceedings of SPIE - The International Society for Optical Engineering, 1/1/2021, **https://doi.org/10.1117/12.2578585**
- Dvorak N, Chung K, Mueller K, Ku P-C, "Toward Artificial Fingertips Based on GaN Optical Tactile Sensors," Conference on Lasers and Electro-Optics, 1/1/2021, **https://doi.org/10.1364/cleo_si.2021.sm3o.7**
- Sarwar T, Kim J, Cheekati S, Ku P-C, "Ultracompact Optics-Free Chip-Scale Spectrometer with Integrated LEDs," Conference on Lasers and Electro-Optics, 1/1/2021, **https://doi.org/10.1364/cleo_si.2021.sth1h.4**

- Dvoak N, Chung K, Mueller K, Ku PC, "Ultrathin Tactile Sensors with Directional Sensitivity and a High Spatial Resolution," Nano Letters, 1/1/2021, **https://doi.org/10.1021/acs.nanolett.1c02837**
- Ku P, "GaN Optoelectronic Devices Based on Local Strain Engineering," ECS Meeting Abstracts, 11/23/2020, **https://doi.org/10.1149/ma2020-02241740mtgabs**
- Roberts B, Ghosh M, Ku PC, "Variable transmission optical filter based on an actuated origami structure," Applied Optics, 4/1/2020, **https://doi.org/10.1364/AO.385443**
- Sarwar T, Cheekati S, Chung K, Ku PC, "On-chip optical spectrometer based on GaN wavelength-selective nanostructural absorbers," Applied Physics Letters, 2/24/2020, **https://doi.org/10.1063/1.5143114**
- Chung K, Pandey A, Sarwar T, Aiello A, Mi Z, Bhattacharya P, Ku PC, "Wavelength tuning in the purple wavelengths using strain-controlled $Al_xGa_{1-x}N$/GaN disk-in-wire structures," Applied Physics Letters, 1/27/2020, **https://doi.org/10.1063/1.5140996**
- Chung K, Pandey A, Sarwar T, Aiello A, Mi Z, Bhattacharya P, Ku PC, "Design chip-scale integration of tunable short-wavelength photonic devices," Optics InfoBase Conference Papers, 1/1/2020, **https://doi.org/10.1364/CLEO_SI.2020.SF1O.4**
- Ku PC, "Gallium nitride optoelectronic devices based on local strain engineering," ECS Transactions, 1/1/2020, **https://doi.org/10.1149/09805.0415ecst**
- Sarwar T, Cheekati S, Chung K, Ku PC, "On-chip optical spectrometer based on InGaN/GaN wavelength-selective nanostructural absorbers," Optics InfoBase Conference Papers, 1/1/2020, **https://doi.org/10.1364/CLEO_SI.2020.SM4R.3**
- Kim J, Mastropietro D, Steel D, Shen JT, Ku PC, "Proposal of chip-scale generation and verification of photonic dimers," Optics InfoBase Conference Papers, 1/1/2020, **https://doi.org/10.1364/CLEO_AT.2020.JTh2A.24**
- Sui J, Ku PC, "An empirical model for GaN light emitters with dot-in-wire polar nanostructures," Micromachines, 1/1/2020, **https://doi.org/10.3390/mi11010082**
- Ku PC, Sarwar T, Demory B, Teng CH, "Toward scalable III-nitride quantum dot structures for quantum photonics," Semiconductors and Semimetals, 1/1/2020, **https://doi.org/10.1016/bs.semsem.2020.09.002**

Recent U.S. Patents

- Color mixing monolithically integrated light-emitting diode pixels, #10708995, 2020

Current Graduate Students Advised

- Nathan Dvorak, ECE PhD
- Juhyeon Kim, ECE PhD
- Tuba Sarwar, ECE PhD

Kushner, Mark J.

Website: http://uigelz.eecs.umich.edu/

Research Interests: Computational plasma science and engineering with applications to materials processing, microelectronics, photonics and lasers, biotechnology and medicine, and environment.

Recent Publications

- Wang X, Lee H, Nam SK, Kushner MJ, "Erosion of focus rings in capacitively coupled plasma etching reactors," Journal of Vacuum Science and Technology A: Vacuum, Surfaces and Films, 12/1/2021, https://doi.org/10.1116/6.0001225
- Chaubey N, Goree J, Lanham SJ, Kushner MJ, "Positive charging of grains in an afterglow plasma is enhanced by ions drifting in an electric field," Physics of Plasmas, 10/1/2021, https://doi.org/10.1063/5.0069141
- Qu C, Sakiyama Y, Agarwal P, Kushner MJ, "Plasma-enhanced atomic layer deposition of SiO_2 film using capacitively coupled Ar/O_2 plasmas: A computational investigation," Journal of Vacuum Science and Technology A: Vacuum, Surfaces and Films, 9/1/2021, https://doi.org/10.1116/6.0001121
- Kruger F, Lee H, Nam SK, Kushner MJ, "Electric field reversals resulting from voltage waveform tailoring in Ar/O_2 capacitively coupled plasmas sustained in asymmetric systems," Plasma Sources Science and Technology, 8/1/2021, https://doi.org/10.1088/1361-6595/ac14a7
- Bruggeman, P; Frontiera, R; Kortshagen, U; Kushner, M; Linic, S; Schatz, G; Andaraarachchi, H; Exarhos, S; Jones, L; Mueller, C; Rich, C; Xu, C; Yue, Y; Zhang, Y, "Plasma-driven solution electrolysis," Journal of Applied Physics, 5/28/2021, https://doi.org/10.1063/5.0044261
- Wang X, Wang M, Biolsi P, Kushner MJ, "Scaling of atomic layer etching of SiO_2 in fluorocarbon plasmas: Transient etching and surface roughness," Journal of Vacuum Science and Technology A: Vacuum, Surfaces and Films, 5/1/2021, https://doi.org/10.1116/6.0000941
- Kruszelnicki J, Ma R, Kushner MJ, "Propagation of atmospheric pressure plasmas through interconnected pores in dielectric materials," Journal of Applied Physics, 4/14/2021, https://doi.org/10.1063/5.0045706
- Kruszelnicki J, Engeling KW, Foster JE, Kushner MJ, "Interactions between atmospheric pressure plasmas and metallic catalyst particles in packed bed reactors," Journal of Physics D: Applied Physics, 3/11/2021, https://doi.org/10.1088/1361-6463/abcc92

- Parsey G, Lietz AM, Kushner MJ, "Guided plasma jets directed onto wet surfaces: Angular dependence and control," Journal of Physics D: Applied Physics, 1/1/2021, https://doi.org/10.1088/1361-6463/abbf1a
- Ning W, Lai J, Kruszelnicki J, Foster JE, Dai D, Kushner MJ, "Propagation of positive discharges in an air bubble having an embedded water droplet," Plasma Sources Science and Technology, 1/1/2021, https://doi.org/10.1088/1361-6595/abc830
- Zhu Y, Starikovskaia SM, Babaeva NY, Kushner MJ, "Scaling of pulsed nanosecond capillary plasmas at different specific energy deposition," Plasma Sources Science and Technology, 12/1/2020, https://doi.org/10.1088/1361-6595/abc413
- Mohades S, Lietz AM, Kushner MJ, "Generation of reactive species in water film dielectric barrier discharges sustained in argon, helium, air, oxygen and nitrogen," Journal of Physics D: Applied Physics, 10/21/2020, https://doi.org/10.1088/1361-6463/aba21a
- Lietz AM, Barnat EV, Foster JE, Kushner MJ, "Ionization wave propagation in a He plasma jet in a controlled gas environment," Journal of Applied Physics, 8/28/2020, https://doi.org/10.1063/5.0020264
- Qu C, Nam SK, Kushner MJ, "Transients using low-high pulsed power in inductively coupled plasmas," Plasma Sources Science and Technology, 8/1/2020, https://doi.org/10.1088/1361-6595/aba113
- Qu C, Lanham SJ, Shannon SC, Nam SK, Kushner MJ, "Power matching to pulsed inductively coupled plasmas," Journal of Applied Physics, 4/7/2020, https://doi.org/10.1063/5.0002522
- Mohades S, Lietz AM, Kruszelnicki J, Kushner MJ, "Helium plasma jet interactions with water in well plates," Plasma Processes and Polymers, 3/1/2020, https://doi.org/10.1002/ppap.201900179
- Volynets V, Barsukov Y, Kim G, Jung JE, Nam SK, Han K, Huang S, Kushner MJ, "Highly selective $Si_3N_4SiO_2$ etching using an $NF_3N_2O_2/H_2$ remote plasma. I. Plasma source and critical fluxes," Journal of Vacuum Science and Technology A: Vacuum, Surfaces and Films, 3/1/2020, https://doi.org/10.1116/1.5125568
- Jung JE, Barsukov Y, Volynets V, Kim G, Nam SK, Han K, Huang S, Kushner MJ, "Highly selective $Si_3N_4SiO_2$ etching using an NF_3N_2/O_2H_2 remote plasma. II. Surface reaction mechanism," Journal of Vacuum Science and Technology A: Vacuum, Surfaces and Films, 3/1/2020, https://doi.org/10.1116/1.5125569
- Huang S, Shim S, Nam SK, Kushner MJ, "Pattern dependent profile distortion during plasma etching of high aspect ratio features in SiO_2, Journal of Vacuum Science and Technology A: Vacuum, Surfaces and Films, 3/1/2020, https://doi.org/10.1116/1.5132800

- Mujahid ZUI, Kruszelnicki J, Hala A, Kushner MJ, "Formation of surface ionization waves in a plasma enhanced packed bed reactor for catalysis applications," Chemical Engineering Journal, 2/15/2020, https://doi.org/10.1016/j.cej.2019.123038

Current Graduate Students Advised

- Florian Krueger, ECE PhD

Lafortune, Stéphane

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Research Interests: System and control theory; Discrete event systems; Application to computer and communication systems.

Recent Publications

- Meira-Goes R, Lafortune S, Marchand H, "Synthesis of Supervisors Robust against Sensor Deception Attacks," IEEE Transactions on Automatic Control, 10/1/2021, https://doi.org/10.1109/TAC.2021.3051459
- Mohajerani S, Malik R, Wintenberg A, Lafortune S, Ozay N, "Divergent stutter bisimulation abstraction for controller synthesis with linear temporal logic specifications," Automatica, 8/1/2021, https://doi.org/10.1016/j.automatica.2021.109723
- Ji Y, Yin X, Lafortune S, "Local Mean Payoff Supervisory Control for Discrete Event Systems," IEEE Transactions on Automatic Control, 1/1/2021, https://doi.org/10.1109/TAC.2021.3075186
- Ji Y, Yin X, Lafortune S, "Optimal supervisory control with mean payoff objectives and under partial observation," Automatica, 1/1/2021, https://doi.org/10.1016/j.automatica.2020.109359
- Meira-Goes R, Kang E, Kwong RH, Lafortune S, "Synthesis of sensor deception attacks at the supervisory layer of CyberPhysical Systems," Automatica, 11/1/2020, https://doi.org/10.1016/j.automatica.2020.109172
- Mohajerani S, Ji Y, Lafortune S, "Compositional and Abstraction-Based Approach for Synthesis of Edit Functions for Opacity Enforcement," IEEE Transactions on Automatic Control, 8/1/2020, https://doi.org/10.1109/TAC.2019.2946165
- Giua A, Lafortune S, Seatzu C, "Divergence Properties of Labeled Petri Nets and Their Relevance for Diagnosability Analysis," IEEE Transactions on Automatic Control, 7/1/2020, https://doi.org/10.1109/TAC.2019.2947650
- Mohajerani S, Lafortune S, "Transforming Opacity Verification to Nonblocking Verification in Modular Systems," IEEE Transactions on Automatic Control, 4/1/2020, https://doi.org/10.1109/TAC.2019.2934708

- Rawlings BC, Lafortune S, Ydstie BE, "Supervisory Control of Labeled Transition Systems Subject to Multiple Reachability Requirements via Symbolic Model Checking," IEEE Transactions on Control Systems Technology, 3/1/2020, https://doi.org/10.1109/TCST.2018.2877621
- Mohajerani S, Meira-Goes R, Lafortune S, "Efficient Synthesis of Sensor Deception Attacks Using Observation Equivalence-Based Abstraction," IFAC-PapersOnLine, 1/1/2020, https://doi.org/10.1016/j.ifacol.2021.04.069
- Wang ZY, Meira-Goes R, Lafortune S, Kwong RH, "Mitigation of Classes of Attacks using a Probabilistic Discrete Event System Framework," IFAC-PapersOnLine, 1/1/2020, https://doi.org/10.1016/j.ifacol.2021.04.003
- Meira-Goes R, Lafortune S, "Moving Target Defense based on Switched Supervisory Control: A New Technique for Mitigating Sensor Deception Attacks," IFAC-PapersOnLine, 1/1/2020, https://doi.org/10.1016/j.ifacol.2021.04.031
- Meira-Goes R, Keroglou C, Lafortune S, "Towards probabilistic intrusion detection in supervisory control of discrete event systems," IFAC-PapersOnLine, 1/1/2020, https://doi.org/10.1016/j.ifacol.2020.12.2321
- Keroglou C, Lafortune S, "Embedded Insertion Functions for Opacity Enforcement," IEEE Transactions on Automatic Control, 1/1/2020, https://doi.org/10.1109/TAC.2020.3037891

Current Graduate Students Advised

- Andrew Wintenberg, ECE PhD (co-advised)

Lee, Somin Eunice

Website: http://bioplasmonics.org/

Research Interests: Use of nanoscale-dependent properties to enable unique spatial and temporal capabilities needed for quantification in bioscience and medicine; Areas of expertise include plasmonics, nanophotonics, bionanotechnologies.

Recent Publications

- Saha, T; Mondal, J; Khiste, S; Lusic, H; Hu, Z; Jayabalan, R; Hodgetts, K; Jang, H; Sengupta, S; Lee, S; Park, Y; Lee, L; Goldman, A, "Nanotherapeutic approaches to overcome distinct drug resistance barriers in models of breast cancer," Nanophotonics, 9/2/2021, https://doi.org/10.1515/nanoph-2021-0142
- Liu Y, Zhang Z, Park Y, Lee SE, "Ultraprecision Imaging and Manipulation of Plasmonic Nanostructures by Integrated Nanoscopic Correction," Small, 5/1/2021, https://doi.org/10.1002/smll.202007610
- Murphy E, Liu Y, Krueger D, Prasad M, Lee SE, Park Y, "Visible-Light Induced Sustainable Water Treatment Using Plasmo-Semiconductor Nanogap Bridge Array, PNA," Small, 2/1/2021, https://doi.org/10.1002/smll.202006044
- Lin WK, Cui G, Burns Z, Zhao X, Liu Y, Zhang Z, Wang Y, Ye X, Park Y, Lee SE, "Optically and Structurally Stabilized Plasmo-Bio Interlinking Networks," Advanced Materials Interfaces, 1/1/2021, https://doi.org/10.1002/admi.202001370
- Liu Y, Lee SE, "High signal-to-noise, non-bleaching imaging with plasmonic nanoparticles," Progress in Biomedical Optics and Imaging - Proceedings of SPIE, 1/1/2020, https://doi.org/10.1117/12.2546362
- Lin WK, Lee SE, "Universal and quantitative measure of colloidal stability of plasmonic nanoparticles via comprehensive stability parameter method," Progress in Biomedical Optics and Imaging - Proceedings of SPIE, 1/1/2020, https://doi.org/10.1117/12.2546244

Current Graduate Students Advised

- Chu, Yanan, ECE MS
- Guangjie Cui, ECE PhD
- Hyeonsu Do, ECE MS
- Zhijia Zhang, ECE PhD
- Xintao Zhao, ECE PhD
- Di Zu, Biomedical Engineering, MS

Liu, Mingyan

Website: https://liu.engin.umich.edu/

Research Interests: Resource allocation, performance modeling, sequential decision and learning theory, game theory and incentive mechanisms, with applications to large-scale networked systems, cybersecurity and cyber risk quantification.

Recent Publications

- Jin K, Yin T, Kamhoua C, Liu M, “Network Games with Strategic Machine Learning”, *Conference on Decision and Game Theory for Security (GameSec)*, July 2021.
- Jin K, Liu M, “Multi-planner intervention in network games with community structures,” *IEEE Conference on Decision and Control (CDC)*, December 2021.
- Wang C, Moharrami M, Jin K, Kempe D, Brantingham PJ, Liu M, “Structural Stability of a Family of Group Formation Games,” *IEEE Conference on Decision and Control (CDC)*, December 2021.
- Sun M, Li Z, Xiao C, Qiu H, Kailkhura B, Liu M, Li B, “Can Shape Structure Features Improve Model Robustness under Diverse Adversarial Settings?”, *International Conference on Computer Vision (ICCV)*, October 2021.
- Yin T, Sarabi A, Liu M, “Deterrence, Backup, or Insurance: A Game-Theoretic Analysis of Ransomware”, *The Annual Workshop on the Economics of Information Security (WEIS)*, June 2021.
- Jin K, Vorobeychik Y, Liu M, “Multi-Scale Games: Representing and Solving Games on Networks with Group Structure”, *the Thirty-Fifth AAAI Conference on Artificial Intelligence (AAAI- 21)*, February 2021.
- Cao Y, Wang N, Xiao C, Yang D, Fang J, Yang R, Chen QA, Liu M, Li B, "Invisible for both Camera and LiDAR: Security of multi-sensor fusion based perception in autonomous driving under physical-world attacks," Proceedings - IEEE Symposium on Security and Privacy, May 2021. **https://doi.org/10.1109/SP40001.2021.00076**
- Zhang X, Liu M, "Fairness in Learning-Based Sequential Decision Algorithms: A Survey," chapter in Handbook of Reinforcement Learning and Control, January 2021. **https://doi.org/10.1007/978-3-030-60990-0_18**
- Khalili MM, Zhang X, Liu M, "Designing Contracts for Trading Private and Heterogeneous Data Using a Biased Differentially Private Algorithm," IEEE Access, January 2021. **https://doi.org/10.1109/ACCESS.2021.3074478**

- X. Zhang, R. Tu, Y. Liu, M. Liu, J. Kjellstrom, K. Zhang, and C. Zhang, “How do fair decisions fare in long-term qualification”, *The 34th Conference on Neural Information Processing Systems (NeurIPS)*, December 2020.
- H. Zhang, J. Chen, C. Xiao, B. Li, M. Liu, D. Boning, and C.-J. Hsieh, “Robust Deep Reinforcement Learning against Adversarial Perturbations on State Observations”, *The 34th Conference on Neural Information Processing Systems (NeurIPS)*, December 2020.
- Jin K, Khalili MM, Liu M, "Games on Networks with Community Structure: Existence, Uniqueness and Stability of Equilibria," Proceedings of the American Control Conference, July 2020. **https://doi.org/10.23919/ACC45564.2020.9147822**
- Zhang X, Khalili MM, Liu M, "Long-Term Impacts of Fair Machine Learning," Ergonomics in Design, July 2020. **https://doi.org/10.1177/1064804619884160**
- Zhang K, Liu Y, Liu J, Liu M, Baar T, "Distributed learning of average belief over networks using sequential observations," Automatica, May 2020. **https://doi.org/10.1016/j.automatica.2020.108857**
- Zhang X, Khalili MM, Liu M, "Recycled ADMM: Improving the Privacy and Accuracy of Distributed Algorithms," IEEE Transactions on Information Forensics and Security, January 2020. **https://doi.org/10.1109/TIFS.2019.2947867**
- Khalili MM, Zhang X, Liu M, "Resource Pooling for Shared Fate: Incentivizing Effort in Interdependent Security Games through Cross-investments," IEEE Transactions on Control of Network Systems, January 2020. **https://doi.org/10.1109/TCNS.2020.3042710**
- Naghizadeh P, Liu M, "Using Private and Public Assessments in Security Information Sharing Agreements," IEEE Transactions on Information Forensics and Security, January 2020. **https://doi.org/10.1109/TIFS.2019.2950125**

Current Graduate Students Advised

- Ziyuan Huang, ECE PhD (co-advised)
- Kun Jin, ECE PhD
- Demba Komma, ECE PhD (co-advised)
- Chenlan Wang, ECE PhD
- Tongxin Yin, ECE PhD (co-advised)

Liu, Zhongming

Website: https://libi.engin.umich.edu/

Research Interests: Brain-Inspired Artificial Intelligence, Neural Engineering, Magnetic Resonance Imaging, Precision Health

Recent Publications

- Zhang, Yizhen; Choi, Minkyu; Han, Kuan; Liu, Zhongming, “Explainable semantic space by grounding language to vision with cross-modal contrastive learning,” Advances in Neural Information Processing System (NeurIPS), 11/05/2021, https://proceedings.neurips.cc/paper/2021/file/9a1335ef5ffebb0de9d089c4182e4868-Paper.pdf
- Di Natale, Madeleine; Patten, Lauren; Molero, Juan; Stebbing, Martin; Hunne, Billie; Wang, Xiaokai; Liu, Zhongming; Furness, John, “Organization of the musculature of the rat stomach,” Journal of Anatomy, 11/07/2021, https://doi.org/10.1111/joa.13587
- Kim, Jung-Hoon; Zhang, Yizhen; Han, Kuan; Wen, Zheyu; Choi, Minkyu; Liu, Zhongming, "Representation learning of resting state fMRI with variational autoencoder," NEUROIMAGE, 11/1/2021, https://doi.org/10.1016/j.neuroimage.2021.118423
- Cao, Jiayue; Wang, Xiaokai; Powley, Terry; Liu, Zhongming, "Gastric neurons in the nucleus tractus solitarius are selective to the orientation of gastric electrical stimulation.," Journal of neural engineering, 10/11/2021, https://doi.org/10.1088/1741-2552/ac2ec6
- Zhang, Y; Kim, J; Brang, D; Liu, Z, "Naturalistic stimuli: A paradigm for multiscale functional characterization of the human brain," Current Opinion in Biomedical Engineering, 9/1/2021, https://doi.org/10.1016/j.cobme.2021.100298
- Race, Nicholas; Andrews, Katharine; Lungwitz, Elizabeth; Alvarez, Sasha; Warner, Timothy; Acosta, Glen; Cao, Jiayue; Lu, Kun-han; Liu, Zhongming; Dietrich, Amy; Majumdar, Sreeparna; Shekhar, Anantha; Truitt, William; Shi, Riyi, "Psychosocial impairment following mild blast-induced traumatic brain injury in rats," Behavioural Brain Research, 8/27/2021, https://doi.org/10.1016/j.bbr.2021.113405
- Liu, Zhongming; He, Bin, “Editorial overview: converging frontiers in functional brain imaging,” Current Opinion in Biomedical Engineering, 07/30/2021, https://doi.org/10.1016/j.cobme.2021100325.

- Lu, Kun-Han; Liu, Zhongming; Jaffey, Deborah; Wo, John; Mosier, Kristine; Cao, Jiayue; Wang, Xiaokai; Hermann, Fred; Powley, Terry, "Su594 Automated MRI-based Assessment of Human Gastric Emptying and Motility in Health and Gastroparesis," Gastroenterology, 5/1/2021, https://doi.org/10.1016/s0016-5085(21)02500-2
- Cheng, Leo; Nagahawatte, Nipuni; Avci, Recep; Du, Peng; Liu, Zhongming; Paskaranandavadivel, Niranchan, "Strategies to Refine Gastric Stimulation and Pacing Protocols: Experimental and Modeling Approaches," Frontiers in Neuroscience, 4/22/2021, https://doi.org/10.3389/fnins.2021.645472
- Lu, K; Liu, Z; Jaffey, D; Wo, J; Mosier, K; Cao, J; Wang, X; Powley, T, "Automatic assessment of human gastric motility and emptying from dynamic 3D magnetic resonance imaging," Neurogastroenterology and Motility, 1/1/2021, https://doi.org/10.1111/nmo.14239
- Karthik, G; Plass, J; Beltz, A; Liu, Z; Grabowecky, M; Suzuki, S; Stacey, W; Wasade, V; Towle, V; Tao, J; Wu, S; Issa, N; Brang, D, "Visual speech differentially modulates beta, theta, and high gamma bands in auditory cortex," European Journal of Neuroscience, 1/1/2021, https://doi.org/10.1111/ejn.15482
- Zhang, Y; Han, K; Worth, R; Liu, Z, "Connecting concepts in the brain by mapping cortical representations of semantic relations," Nature Communications, 12/1/2020, https://doi.org/10.1038/s41467-020-15804-w
- Lu, K; Cao, J; Phillips, R; Powley, T; Liu, Z, "Acute effects of vagus nerve stimulation parameters on gastric motility assessed with magnetic resonance imaging," Neurogastroenterology and Motility, 7/1/2020, https://doi.org/10.1111/nmo.13853
- Lu, Kun-Han; Wang, Xiaokai; Cao, Jiayue; Wang, James; Jaffey, Deborah; Mosier, Kristine; Wo, John; Powley, Terry; Liu, Zhongming, "SPARC: Simultaneous Assessment of Gastric Emptying and Motility with Contrast Enhanced Magnetic Resonance Imaging in Humans," The FASEB Journal, 4/1/2020, https://doi.org/10.1096/fasebj.2020.34.s1.08932
- Sclocco, Roberta; Nguyen, Christopher; Staley, Rowan; Fisher, Harrison; Velez, Christopher; Mendez, April; Lu, Kun-Han; Liu, Zhongming; Ward, Matthew; Powley, Terry; Kettner, Norman; Kuo, Braden; Napadow, Vitaly, "SPARC: Respiratory-Gated Transcutaneous Vagus Nerve Stimulation Modulates Gastric Function in Functional Dyspepsia," The FASEB Journal, 4/1/2020, https://doi.org/10.1096/fasebj.2020.34.s1.02939
- Cao, Jiayue; Wang, Xiaokai; Lu, Kun-Han; Tan, Zhenjun; Phillips, Robert; Jaffey, Deborah; Wo, John; Mosier, Kristine; Powley, Terry; Liu, Zhongming, "SPARC: Brain-stomach Synchrony Observed with Functional Magnetic Resonance Imaging and Electrogastrogram in Rats," The FASEB Journal, 4/1/2020, https://doi.org/10.1096/fasebj.2020.34.s1.03197

- Phillips, Robert; Tan, Zhenjun; Zhang, Xueguo; Ward, Matthew; Cao, Jiayue; Lu, Kun-Han; Liu, Zhongming; Albors, Gabriel; Ganesh, Vivek; Sofronici, Sydney; Irazoqui, Pedro; Rajwa, Bartek; Jaffey, Deborah; Powley, Terry, "SPARC: Chronic Simultaneous Recording of Gastric Motility and Ad Libitum Feeding Behavior in Awake, Freely Moving Rats with Vagal Nerve Simulation," The FASEB Journal, 4/1/2020, https://doi.org/10.1096/fasebj.2020.34.s1.08841
- Wang, Xiaokai; Lu, Kun-Han; Choi, Minkyu; Cao, Jiayue; Jaffey, Deborah; Powley, Terry; Liu, Zhongming, "SPARC: Deep Learning for Stomach Segmentation with Contrast Enhanced Magnetic Resonance Imaging of the Gastrointestinal Tract," The FASEB Journal, 4/1/2020, https://doi.org/10.1096/fasebj.2020.34.s1.03483
- Oleson, S; Cox, A; Liu, Z; Sivasankar, M; Lu, K, "In Vivo Magnetic Resonance Imaging of the Rat Vocal Folds After Systemic Dehydration and Rehydration," Journal of speech, language, and hearing research: JSLHR, 1/22/2020, https://doi.org/10.1044/2019_JSLHR-19-00062
- Liu, Zhongming; Cao, Jiayue, "Functional Magnetic Resonance Imaging," chapter in Neural Engineering, 1/1/2020, https://doi.org/10.1007/978-3-030-43395-6_11

Current Graduate Students Advised

- Minkyu Choi, ECE PhD
- Kuan Han, ECE PhD
- Amaya Murguia, ECE PhD (co-advised)
- Javier Salazar Cavazos, ECE PhD (co-advised)
- Xiaokai Wang, BME PhD
- Fatimah Alkaabi, BME PhD
- Ana Cecilia Saavedra Bazan, BME PhD

Lu, Wei

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Research Interests: Neuromorphic computing systems, in-memory computing architecture, AI accelerator, new memory devices such as resistive-random access memory (RRAM), memristor-based logic circuits, aggressively scaled transistor devices, electrical transport in low-dimensional systems.

Recent Publications

- Wu Y, Moon J, Zhu X, Lu WD, "Neural Functional Connectivity Reconstruction with Second-Order Memristor Network," ADVANCED INTELLIGENT SYSTEMS, 8/1/2021, https://doi.org/10.1002/aisy.202000276
- Moon J, Wu Y, Zhu X, Lu WD, "Neural connectivity inference with spike-timing dependent plasticity network," Science China Information Sciences, 6/1/2021, https://doi.org/10.1007/s11432-021-3217-0
- Lammie C, Eshraghian JK, Lu WD, Azghadi MR, "Memristive Stochastic Computing for Deep Learning Parameter Optimization," IEEE Transactions on Circuits and Systems II: Express Briefs, 5/1/2021, https://doi.org/10.1109/TCSII.2021.3065932
- Ahn M, Park Y, Lee SH, Chae S, Lee J, Heron JT, Kioupakis E, Lu WD, Phillips JD, "Memristors Based on (Zr, Hf, Nb, Ta, Mo, W) High-Entropy Oxides," Advanced Electronic Materials, 5/1/2021, https://doi.org/10.1002/aelm.202001258
- Wang Q, Park Y, Lu WD, "Device non-ideality effects and architecture-aware training in RRAM In-memory computing modules," Proceedings - IEEE International Symposium on Circuits and Systems, 1/1/2021, https://doi.org/10.1109/ISCAS51556.2021.9401307
- Wang X, Zidan MA, Lu WD, "A Crossbar-Based In-Memory Computing Architecture," IEEE Transactions on Circuits and Systems I: Regular Papers, 12/1/2020, https://doi.org/10.1109/TCSI.2020.3000468
- Lin CY, Tseng YT, Chen PH, Chang TC, Eshraghian JK, Wang Q, Lin Q, Tan YF, Tai MC, Hung WC, Huang HC, Lu W, Sze S, "A high-speed MIM resistive memory cell with an inherent vanadium selector," Applied Materials Today, 12/1/2020, https://doi.org/10.1016/j.apmt.2020.100848
- Zhu X, Wang Q, Lu WD, "Memristor networks for real-time neural activity analysis," Nature Communications, 12/1/2020, https://doi.org/10.1038/s41467-020-16261-1
- Li, Y; Fuller, E; Sugar, J; Yoo, S; Ashby, D; Bennett, C; Horton, R; Bartsch, M; Marinella, M; Lu, W; Talin, A, "Filament-Free Bulk Resistive Memory Enables Deterministic Analogue Switching," Advanced Materials, 11/1/2020, https://doi.org/10.1002/adma.202003984

- Li, Y; Fuller, E; Sugar, J; Yoo, S; Ashby, D; Bennett, C; Horton, R; Bartsch, M; Marinella, M; Lu, W; Talin, A, "Memory Devices: FilamentFree Bulk Resistive Memory Enables Deterministic Analogue Switching (Adv. Mater. 45/2020)," Advanced Materials, 11/1/2020, https://doi.org/10.1002/adma.202070339
- Lin CY, Chen J, Chen PH, Chang TC, Wu Y, Eshraghian JK, Moon J, Yoo S, Wang YH, Chen WC, Wang ZY, Huang HC, Li Y, Miao X, Lu W, Sze S, "Adaptive Synaptic Memory via Lithium Ion Modulation in RRAM Devices," Small, 10/1/2020, https://doi.org/10.1002/smll.202003964
- Baek S, Eshraghian JK, Thio W, Sandamirskaya Y, Iu HHC, Lu WD, "A Real-Time Retinomorphic Simulator Using a Conductance-Based Discrete Neuronal Network," Proceedings - 2020 IEEE International Conference on Artificial Intelligence Circuits and Systems, AICAS 2020, 8/1/2020, https://doi.org/10.1109/AICAS48895.2020.9073963
- Wang X, Wang Q, Meng FH, Lee SH, Lu WD, "Deep Neural Network Mapping and Performance Analysis on Tiled RRAM Architecture," Proceedings - 2020 IEEE International Conference on Artificial Intelligence Circuits and Systems, AICAS 2020, 8/1/2020, https://doi.org/10.1109/AICAS48895.2020.9073942
- Baek S, Eshraghian JK, Thio W, Sandamirskaya Y, Iu HHC, Lu WD, "Live Demonstration: Video-to-Spike Conversion Using a Real-Time Retina Cell Network Simulator," Proceedings - 2020 IEEE International Conference on Artificial Intelligence Circuits and Systems, AICAS 2020, 8/1/2020, https://doi.org/10.1109/AICAS48895.2020.9073790
- Cai, F; Kumar, S; Van Vaerenbergh, T; Sheng, X; Liu, R; Li, C; Liu, Z; Foltin, M; Yu, S; Xia, Q; Yang, J; Beausoleil, R; Lu, W; Strachan, J, "Power-efficient combinatorial optimization using intrinsic noise in memristor Hopfield neural networks," Nature Electronics, 7/1/2020, https://doi.org/10.1038/s41928-020-0436-6
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Recent U.S. Patents

- Techniques for computing dot products with memory devices, #10812083, 2020
- Memory processing unit, #10943652, 2021

Current Graduate Students Advised

- Eric Yeu-Jer Lee, ECE PhD
- Fan-Hsuan Meng, ECE PhD
- Yongmo Park, ECE PhD
- Qiwen Wang, ECE PhD
- Xinxin Wang, ECE PhD
- Ziyu Wang, ECE PhD
- Yuting Wu, ECE PhD
- Sangmin Yoo, ECE PhD

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Research Interests: Coding and information theory and their interplay with communication and learning systems including reliability, security, and privacy of these systems.

Recent Publications

- M. V. Jamali and H. Mahdavifar, “Covert Millimeter-Wave Communication: Design Strategies and Performance Analysis," IEEE Transactions on Wireless Communications, accepted for publication.
- M. Soleymani, M. V. Jamali, H. Mahdavifar, “Coded Computing via Binary Linear Codes: Designs and Performance Limits," IEEE Journal on Selected Areas in Information Theory, vol. 2, pp. 879-892, September 2021.
- M. Soleymani, R. E. Ali, H. Mahdavifar, and A. S. Avestimehr, “List-Decodable Coded Computing: Breaking the Adversarial Toleration Barrier," IEEE Journal on Selected Areas in Information Theory, vol. 2, pp. 867-878, September 2021.
- M. V. Jamali and H. Mahdavifar, “Massive Coded-NOMA for Low-Capacity Channels: A Low-Complexity Recursive Approach," IEEE Transactions on Communications, vol. 69, pp. 3664-3681, June 2021.
- N. Aldaghri, H. Mahdavifar, and A. Beirami “Coded Machine Unlearning", IEEE Access, vol. 9, pp. 88137-88150, June 2021.
- M. Soleymani and H. Mahdavifar, and A. S. Avestimehr “Analog Lagrange Coded Computing," IEEE Journal on Selected Areas in Information Theory, vol. 2, pp. 283-295, March 2021.
- N. Aldaghri and H. Mahdavifar, “Threshold-Secure Coding with Shared Key," IEEE Journal on Selected Areas in Information Theory, vol. 2, pp. 95-105, March 2021.
- M. Soleymani and H. Mahdavifar, “Distributed Multi-User Secret Sharing," IEEE Transactions on Information Theory, vol. 67, pp. 164-178, January 2021.
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- F. Abbasi, H. Mahdavifar, E. Viterbo, “Hybrid Non-Binary Repeated Polar Codes For Low-SNR Regime," Proceedings of IEEE International Symposium on Information Theory (ISIT), July 2021.
- M. Soleymani, R. E. Ali, H. Mahdavifar, A. S. Avestimehr, “List-Decodable Coded Computing: Breaking the Adversarial Toleration Barrier," Proceedings of IEEE International Symposium on Information Theory (ISIT), July 2021.
- M. Soleymani, H. Mahdavifar, A. S. Avestimehr, “Analog Privacy-Preserving Coded Computing," Proceedings of IEEE International Symposium on Information Theory (ISIT), July 2021.
- M. Soleymani, H. Mahdavifar “New Packings in Grassmannian Space," Proceedings of IEEE International Symposium on Information Theory (ISIT), July 2021.
- M. V. Jamali, X. Liu, A. V. Makkuva, H. Mahdavifar, S. Oh, P. Viswanath “Reed-Muller Subcodes: Machine Learning-Aided Design of E cient Soft Recursive Decoding," Proceedings of IEEE International Symposium on Information Theory (ISIT), July 2021.
- F. Abbasi, H. Mahdavifar, E. Viterbo, “Polar Coded Repetition for Low-Capacity Channels," Proceedings of IEEE Information Theory Workshop (ITW), April 2021.
- N. Aldaghri, H. Mahdavifar, A. Beirami, “Coded Machine Unlearning," Association for the Advancement of Arti cial Intelligence (AAAI) Workshop on Robust, Secure and E cient Machine Learning (Oral Presentation), February 2021.
- N. Aldaghri and H. Mahdavifar, “Physical Layer Secret Key Generation in Static Environments," IEEE Transactions on Information Forensics and Security, vol. 15, pp. 2692-2705, December 2020.
- H. Mahdavifar, “Polar Coding for Non-Stationary Channels," IEEE Transactions on Information Theory, vol. 66, pp. 6920-6938, November 2020.
- M. V. Jamali and H. Mahdavifar, “Uplink Non-Orthogonal Multiple Access over Mixed RF-FSO Systems," IEEE Transactions on Wireless Communications, vol. 19, pp. 3558-3774, May 2020.
- Y.Wang, H. Mahdavifar, K. Entesari, and S. Shahrampour, “Cell Association via Boundary Detection: A Scalable Approach Based on Data-Driven Random Features," Proceedings of Asilomar Conference on Signals, Systems, and Computers, November 2020.
- M. Soleymani and H. Mahdavifar, “Analog Subspace Coding: A New Approach to Coding for Non-Coherent Wireless Networks," Proceedings of the IEEE International Symposium on Information Theory (ISIT), June 2020.

- N. Charalambides, H. Mahdavifar, A. O. Hero III, “Numerically Stable Binary Gradient Coding," Proceedings of the IEEE International Symposium on Information Theory (ISIT), June 2020.
- J.Pang, H. Mahdavifar, and S. S. Pradhan, “Capacity-achieving Polar-based LDGM Codes with Crowdsourcing Applications," Proceedings of the IEEE International Symposium on Information Theory (ISIT), June 2020.

Current Graduate Students Advised

- Talha Akyildiz, ECE PhD
- Nasser Abdulrahman N Aldaghri, ECE PhD
- Utkarsh Gupta, ECE PhD
- Mohammad Vahid Jamali, ECE PhD, Data Science Cert
- Hsuan-Po Liu, ECE PhD
- Chin-Jen Pang, ECE PhD (co-advised)
- Samin Riasat, CSE PhD (co-advised)
- Mahdi Soleymani, ECE PhD

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Research Interests: Modeling, estimation, and control of electric loads and storage; Operational and control strategies that reduce the environmental impact, cost, and inefficiency of the power system.

Recent Publications

- Ross S, Mathieu J, "Strategies for Network-Safe Load Control with a Third-Party Aggregator and a Distribution Operator," IEEE Transactions on Power Systems, 7/1/2021, https://doi.org/10.1109/TPWRS.2021.3052958
- Jang S, Ozay N, Mathieu JL, "Large-Scale Invariant Sets for Safe Coordination of Thermostatic Loads," Proceedings of the American Control Conference, 5/25/2021, https://doi.org/10.23919/ACC50511.2021.9483385
- Yao M, Hiskens IA, Mathieu JL, "Mitigating Voltage Unbalance Using Distributed Solar Photovoltaic Inverters," IEEE Transactions on Power Systems, 5/1/2021, https://doi.org/10.1109/TPWRS.2020.3039405
- Lei S, Mathieu JL, Jain RK, "Performance of Existing Methods in Baselining Demand Response From Commercial Building HVAC Fans," ASME Journal of Engineering for Sustainable Buildings and Cities, 5/1/2021, https://doi.org/10.1115/1.4050999
- Jang S, Ozay N, Mathieu J, "Large-Scale Invariant Sets for Safe Coordination of Thermostatic Loads," American Control Conference 2021, 3/22/2021, https://doi.org/10.7302/391
- Ross SC, Mathieu JL, "A Method for Ensuring a Load Aggregator's Power Deviations Are Safe for Distribution Networks," Electric Power Systems Research, 12/1/2020, https://doi.org/10.1016/j.epsr.2020.106781
- Lei S, Hong D, Mathieu JL, Hiskens IA, "Baseline estimation of commercial building HVAC fan power using tensor completion," Electric Power Systems Research, 12/1/2020, https://doi.org/10.1016/j.epsr.2020.106624
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- Stuhlmacher A, Mathieu JL, "Chance-Constrained Water Pumping to Manage Water and Power Demand Uncertainty in Distribution Networks," Proceedings of the IEEE, 9/1/2020, https://doi.org/10.1109/JPROC.2020.2997520
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- Mathieu JL, "Demand Response: Coordination of Flexible Electric Loads," chapter in Encyclopedia of Systems and Control, 1/1/2020, https://doi.org/10.1007/978-1-4471-5102-9_100128-1

Current Graduate Students Advised

- Joshua Brooks, ECE PhD
- Sunny Chen, ECE PhD (co-advised)
- Xavier Farrell, ECE PhD
- Ioannis Marios Granitsas, ECE PhD (co-advised)
- Sunho Jang, ECE PhD (co-advised)
- Austin Lin, ECE PhD (co-advised)
- Hannah Moring, ECE PhD
- Oluwagbemileke Oyefeso, ECE PhD (co-advised)
- Jing Peng, ECE PhD
- Anna Stuhlmacher, ECE PhD

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Research Interests: VLSI circuit design, VLSI testing, and VLSI layout tools

Recent Publications

- Yu, Y; Favour, E; Mazumder, P, "Convolutional Neural Network Design for Breast Cancer Medical Image Classification," International Conference on Communication Technology Proceedings, ICCT, 10/28/2020, https://doi.org/10.1109/ICCT50939.2020.9295909
- Erementchouk, M; Mazumder, P, "Continuous-variable quantum key distribution with discretized modulations in the strong noise regime," Physical Review A, 6/1/2020, https://doi.org/10.1103/PhysRevA.101.062313
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- Ottaviani, C; Woolley, M; Erementchouk, M; Federici, J; Mazumder, P; Pirandola, S; Weedbrook, C, "Terahertz Quantum Cryptography," IEEE Journal on Selected Areas in Communications, 3/1/2020, https://doi.org/10.1109/JSAC.2020.2968973
- Zeng, H; Lan, F; Zhang, Y; Liang, S; Wang, L; Yin, J; Song, T; Wang, L; Zhang, T; Shi, Z; Yang, Z; Mazumder, P, "Broadband terahertz reconfigurable metasurface based on 1-bit asymmetric coding metamaterial," Optics Communications, 3/1/2020, https://doi.org/10.1016/j.optcom.2019.124770
- Bari, M; Roy Joy, S; Baten, M; Mazumder, P, "Process Variation in Spoof Plasmon Interconnect: Consequences and Compensations," IEEE Radio and Wireless Symposium, RWS, 1/1/2020, https://doi.org/10.1109/RWS45077.2020.9050129
- Wang, X; Yu, Y; Cai, J; Zhong, S; Yang, N; Shi, K; Mazumder, P; Tashi, N, "Dynamic Pinning Synchronization of Fuzzy-dependent-switched Coupled Memristive Neural Networks with Mismatched Dimensions on Time Scales," IEEE Transactions on Fuzzy Systems, 1/1/2020, https://doi.org/10.1109/TFUZZ.2020.3048576

Current Graduate Students Advised

- Aditya Shukla, ECE PhD (co-advised)

Meerkov, Semyon M.

Research Interests: Control of systems with nonlinear sensors and actuators, Resilient monitoring and control under malicious attacks; Smart production systems: theory and industrial applications in the framework of Industry 4.0.

Recent Publications

- Alavian P, Eun Y, Liu K, Meerkov SM, Zhang L, "The (,)-Precise Estimates of MTBF and MTTR: Definition, Calculation, and Observation Time," IEEE Transactions on Automation Science and Engineering, 7/1/2021, https://doi.org/10.1109/TASE.2020.3017134
- Eun Y, Liu K, Meerkov SM, "Production systems with cycle overrun: modelling, analysis, improvability and bottlenecks," International Journal of Production Research, 1/1/2021, https://doi.org/10.1080/00207543.2021.1968528
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- Alavian P, Eun Y, Meerkov SM, Zhang L, "Smart production systems: automating decision-making in manufacturing environment," International Journal of Production Research, 2/1/2020, https://doi.org/10.1080/00207543.2019.1600765

Current Graduate Students Advised

- Kang Liu, ECE MS

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Research Interests: Low dimensional semiconductors and their applications in photonic, optoelectronic, clean energy, and quantum devices and systems.

Recent Publications

- Kang D, Kong X, Michaud-Rioux V, Chen YC, Mi Z, Guo H, "Electronic structure of aqueous two-dimensional photocatalyst," npj Computational Materials, 12/1/2021, https://doi.org/10.1038/s41524-021-00516-6
- Song P, Fu H, Wang Y, Chen C, Ou P, Rashid RT, Duan S, Song J, Mi Z, Liu X, "A microfluidic field-effect transistor biosensor with rolled-up indium nitride microtubes," Biosensors and Bioelectronics, 10/15/2021, https://doi.org/10.1016/j.bios.2021.113264
- Liu X, Sun Y, Malhotra Y, Wu Y, Mi Z, "Monolithic integration of multicolor InGaN LEDs with uniform luminescence emission," Optics Express, 10/11/2021, https://doi.org/10.1364/OE.435871
- Liu X, Sun Y, Malhotra Y, Pandey A, Wu Y, Sun K, Mi Z, "High efficiency InGaN nanowire tunnel junction green micro-LEDs," Applied Physics Letters, 10/4/2021, https://doi.org/10.1063/5.0059701
- Wang D, Wang P, Wang B, Mi Z, "Fully epitaxial ferroelectric ScGaN grown on GaN by molecular beam epitaxy," Applied Physics Letters, 9/13/2021, https://doi.org/10.1063/5.0060021
- Wang D, Liu X, Kang Y, Wang X, Wu Y, Fang S, Yu H, Memon MH, Zhang H, Hu W, Mi Z, Fu L, Sun H, Long S, "Bidirectional photocurrent in pn heterojunction nanowires," Nature Electronics, 9/1/2021, https://doi.org/10.1038/s41928-021-00640-7
- Wang P, Wang D, Wang B, Mohanty S, Diez S, Wu Y, Sun Y, Ahmadi E, Mi Z, "N-polar ScAlN and HEMTs grown by molecular beam epitaxy," Applied Physics Letters, 8/23/2021, https://doi.org/10.1063/5.0055851
- Lim C, Mi Z, Zhou W, Dagenais D, "Special Issue on IEEE Photonics Conference 2020 (IPC2020)," IEEE Photonics Technology Letters, 8/15/2021, https://doi.org/10.1109/LPT.2021.3092475
- Zeng G, Pham TA, Vanka S, Liu G, Song C, Cooper JK, Mi Z, Ogitsu T, Toma FM, "Development of a photoelectrochemically self-improving Si/GaN photocathode for

efficient and durable H_2 production," Nature Materials, 8/1/2021, https://doi.org/10.1038/s41563-021-00965-w

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- Nikoobakht B, Johnston-Peck AC, Laleyan D, Wang P, Mi Z, "Surface-directed ZnGa2O4 and beta-Ga2O3 nanofins coated with a non-polar GaN shell based on the Kirkendall effect," CRYSTENGCOMM, 7/14/2021, https://doi.org/10.1039/d1ce00744k
- Chae, S; Mengle, K; Bushick, K; Lee, J; Sanders, N; Deng, Z; Mi, Z; Poudeu, P; Paik, H; Heron, J; Kioupakis, E, "Toward the predictive discovery of ambipolarly dopable ultra-wide-band-gap semiconductors: The case of rutile GeO_2, Applied Physics Letters, 6/28/2021, https://doi.org/10.1063/5.0056674
- Pandey A, Gim J, Hovden R, Mi Z, "Electron overflow of AlGaN deep ultraviolet light emitting diodes," Applied Physics Letters, 6/14/2021, https://doi.org/10.1063/5.0055326
- Navid IA, Vanka S, Awni RA, Xiao Y, Song Z, Yan Y, Mi Z, "On the design and performance of InGaN/Si double-junction photocathodes," Applied Physics Letters, 6/14/2021, https://doi.org/10.1063/5.0050708
- Wang P, Wang D, Vu NM, Chiang T, Heron JT, Mi Z, "Fully epitaxial ferroelectric ScAlN grown by molecular beam epitaxy," Applied Physics Letters, 5/31/2021, https://doi.org/10.1063/5.0054539
- Osterloh F, Doughty R, Chowdhury F, Mi Z, "Surface Photovoltage Spectroscopy Observes Junctions and Carrier Separation in Gallium Nitride Nanowire Arrays for Overall Water-Splitting," ECS Meeting Abstracts, 5/30/2021, https://doi.org/10.1149/ma2021-0115707mtgabs
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- Wang P, Wang B, Laleyan DA, Pandey A, Wu Y, Sun Y, Liu X, Deng Z, Kioupakis E, Mi Z, "Oxygen defect dominated photoluminescence emission of $Sc_xAl_{1-x}N$ grown by molecular beam epitaxy," Applied Physics Letters, 1/18/2021, https://doi.org/10.1063/5.0035026

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- Wu Y, Wang P, Kioupakis E, Mi Z, "Nanoscale AlGaN and BN: Molecular beam epitaxy, properties, and device applications," chapter in Semiconductors and Semimetals, 1/1/2021, https://doi.org/10.1016/bs.semsem.2021.04.005
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- Stevenson M, Laleyan D, Mi Z, Coe-Sullivan S, "Display technology responds to covid-19 challenges," Digest of Technical Papers - SID International Symposium, 1/1/2021, https://doi.org/10.1002/sdtp.14820
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- Qu J, Wang R, Pan P, Du L, Mi Z, Sun Y, Liu X, "An SEM-based nanomanipulation system for multi-physical characterization of single InGaN/GaN Nanowires," IEEE International Conference on Intelligent Robots and Systems, 10/24/2020, https://doi.org/10.1109/IROS45743.2020.9340779
- Zhou B, Ou P, Rashid RT, Vanka S, Sun K, Yao L, Sun H, Song J, Mi Z, "Few-Atomic-Layers Iron for Hydrogen Evolution from Water by Photoelectrocatalysis," iScience, 10/23/2020, https://doi.org/10.1016/j.isci.2020.101613

- Doughty RM, Chowdhury FA, Mi Z, Osterloh FE, "Surface photovoltage spectroscopy observes junctions and carrier separation in gallium nitride nanowire arrays for overall water-splitting," Journal of Chemical Physics, 10/14/2020, https://doi.org/10.1063/5.0021273
- Sun, Y; Shin, W; Aalizadeh, M; Wang, P; Laleyan, D; Pandey, A; Liu, X; Wu, Y; Singh, A; Soltani, M; Mi, Z, "Demonstration of High Quality Factor Aluminum Nitride on Sapphire Microring Resonators at near Infrared and Green Wavelengths," 2020 IEEE Photonics Conference, IPC 2020 - Proceedings, 9/1/2020, https://doi.org/10.1109/IPC47351.2020.9252488
- Liu X, Wu Y, Malhotra Y, Sun Y, Mi Z, "InGaN Photonic Crystal Green Micro LEDs with Ultra-Stable Operation," 2020 IEEE Photonics Conference, IPC 2020 - Proceedings, 9/1/2020, https://doi.org/10.1109/IPC47351.2020.9252293
- Pandey A, Aiello A, Gim J, Hovden R, Kioupakis E, Bhattacharya P, Mi Z, "On the Origin of Efficiency Droop of AlGaN Deep Ultraviolet Light Emitting Diodes," 2020 IEEE Photonics Conference, IPC 2020 - Proceedings, 9/1/2020, https://doi.org/10.1109/IPC47351.2020.9252278
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- Cheng, S; Wu, Z; Langelier, B; Kong, X; Coenen, T; Hari, S; Ra, Y; Rashid, R; Pofelski, A; Yuan, H; Li, X; Mi, Z; Guo, H; Botton, G, "Nanoscale Structural and Emission Properties within Russian Doll-Type InGaN/AlGaN Quantum Wells," Advanced Optical Materials, 9/1/2020, https://doi.org/10.1002/adom.202000481
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Recent U.S. Patents

- High efficiency visible and ultraviolet nanowire emitters, #10553751, 2020
- Methods and systems relating to photochemical water splitting, #10576447, 2020
- Dilute-Antimonide group-III-Nitride nanostructure optoelectronic devices, #10727372, 2020
- Monolithically Integrated InGaN/GaN Quantum Nanowire Devices, #10734545, 2020

Current Graduate Students Advised

- Hadba Alqahtani, ECE PhD
- Josey Hanish, ECE PhD (co-advised)

- Jiangnan Liu, ECE PhD
- Yakshita Malhotra, ECE PhD
- Shubham Mondal, ECE PhD
- Ishtiaque Ahmed Navid, ECE PhD
- Ayush Pandey, EE MS (co-advised)
- Sritoma Paul, ECE PhD
- Walter Jin Shin, ECE PhD
- Yixin Xiao, ECE PhD
- Zhengwei Ye, ECE PhD

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Research Interests: Computational, applied, and theoretical electromagnetics; antennas; microwave and millimeter wave circuits and packaging.

Current Graduate Students Advised

- Max Bright, ECE PhD
- Jack Hamel, ECE PhD

Mortazawi, Amir

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Research Interests: RF and microwave circuits including: microwave and millimeter-wave power amplifiers, spatial power combining and thin film ferroelectric based frequency agile circuits.

Recent Publications

- Chai R, Mortazawi A, "A new coupling insensitive nonlinear capacitive resonant wireless power transfer circuit," 2021 IEEE Wireless Power Transfer Conference, WPTC 2021, 6/1/2021, https://doi.org/10.1109/WPTC51349.2021.9458093
- Nam S, Koohi MZ, Peng W, Mortazawi A, "A Switchless Quad Band Filter Bank Based on Ferroelectric BST FBARs," IEEE Microwave and Wireless Components Letters, 6/1/2021, https://doi.org/10.1109/LMWC.2021.3069880
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- Chai R, Mortazawi A, "A coupling factor independent wireless power transfer system employing two nonlinear circuits," IEEE MTT-S International Microwave Symposium Digest, 8/1/2020, https://doi.org/10.1109/IMS30576.2020.9224088
- Akbar F, Mortazawi A, "A K-Band low-complexity modular scalable wide-scan phased array," IEEE MTT-S International Microwave Symposium Digest, 8/1/2020, https://doi.org/10.1109/IMS30576.2020.9224071
- Koohi MZ, Peng W, Mortazawi A, "An intrinsically switchable balanced ferroelectric FBAR filter at 2 GHz," IEEE MTT-S International Microwave Symposium Digest, 8/1/2020, https://doi.org/10.1109/IMS30576.2020.9223799
- Koohi MZ, Nam S, Mortazawi A, "Intrinsically Switchable and Bandwidth Reconfigurable Ferroelectric Bulk Acoustic Wave Filters," IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control, 5/1/2020, https://doi.org/10.1109/TUFFC.2019.2958675

- Zolfagharloo Koohi M, Mortazawi A, "Reconfigurable Radios Employing Ferroelectrics: Recent Progress on Reconfigurable RF Acoustic Devices Based on Thin-Film Ferroelectric Barium Strontium Titanate," IEEE Microwave Magazine, 5/1/2020, https://doi.org/10.1109/MMM.2020.2971376

Recent U.S. Patents

- Nonlinear resonance circuit for wireless power transmission and wireless power harvesting, #10784723, 2020

Current Graduate Students Advised

- Abdullah Abdulaziz M Alothman, ECE PhD
- Hersh Desai, ECE PhD
- Andrew Devries, ECE PhD
- Suhyun Nam, ECE PhD
- Wenhao Peng, ECE PhD

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Research Interests: Statistical signal processing, random matrix theory, random graphs and light transport through opaque random media.

Recent Publications

- Iyer K, Najarian CP, Fattah AA, Arthurs CJ, Soroushmehr SMR, Subban V, Sankardas MA, Nadakuditi RR, Nallamothu BK, Figueroa CA, "AngioNet: a convolutional neural network for vessel segmentation in X-ray angiography," Scientific Reports, 12/1/2021, https://doi.org/10.1038/s41598-021-97355-8
- Moore BE, Ravishankar S, Nadakuditi RR, Fessler JA, "Online Adaptive Image Reconstruction (OnAIR) Using Dictionary Models," IEEE TRANSACTIONS ON COMPUTATIONAL IMAGING, 1/1/2020, https://doi.org/10.1109/TCI.2019.2931092
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- Prasadan A, Nadakuditi RR, "Time series source separation using dynamic mode decomposition," SIAM Journal on Applied Dynamical Systems, 1/1/2020, https://doi.org/10.1137/19M1273256

Current Graduate Students Advised

- Parker Koch, ECE PhD (co-advised)

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Research Interests: Solid-state integrated sensors, microactuators, micromechanics, analog and digital integrated circuits.

Recent Publications

- Asgarian F, Najafi K, "BlueSync: Time Synchronization in Bluetooth Low Energy with Energy Efficient Calculations," IEEE Internet of Things Journal, 1/1/2021, https://doi.org/10.1109/JIOT.2021.3116921
- Cho JY, Singh S, Woo JK, He G, Najafi K, "0.00016 deg/hr Angle Random Walk (ARW) and 0.0014 deg/hr Bias Instability (BI) from a 5.2M-Q and 1-cm Precision Shell Integrating (PSI) Gyroscope," INERTIAL 2020 - 7th IEEE International Symposium on Inertial Sensors and Systems, Proceedings, 3/1/2020, https://doi.org/10.1109/INERTIAL48129.2020.9090086
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- Singh S, Cho JY, Najafi K, "Low-Cost, High-Throughput Process Using HF Acid to Singulate Fused-Silica Shell Resonators with High-Q," INERTIAL 2020 - 7th IEEE International Symposium on Inertial Sensors and Systems, Proceedings, 3/1/2020, https://doi.org/10.1109/INERTIAL48129.2020.9090084
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- Singh S, Woo JK, He G, Cho JY, Najafi K, "0.0062°/hr Angle Random Walk and 0.027 °/*hr* Bias Instability from a Micro-Shell Resonator Gyroscope with Surface Electrodes," Proceedings of the IEEE International Conference on Micro Electro Mechanical Systems (MEMS), 1/1/2020, https://doi.org/10.1109/MEMS46641.2020.9056391

Recent U.S. Patents

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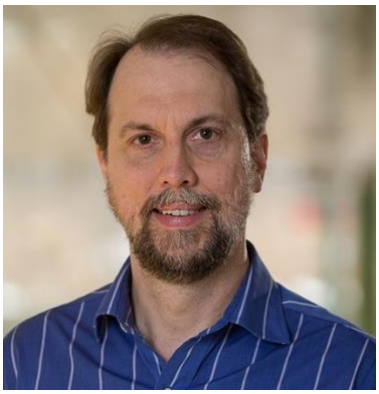
- K. Najafi, Luis Bernal, S.A. Sandoughsaz, A. Besharatian, "Modular stacked variable-compression micropump and method of making same," US Patent 10,563,642, Issued February 18, 2020
- K. Najafi, A. Darvishian, "Stacked Balanced Resonators," US Patent 10,598,491, Issued March 24, 2020
- K. Najafi, and J.Y. Cho, "Assembly processes for three-dimensional microstructures," US Patent 10,612,925, issued April 7, 2020
- K. Najafi, T. Nagourney, J.Y. Cho, "Three Dimensional Microstructures and Fabrication Process," US Patent 10,730,748, Issued August 4, 2020
- I. Shahosseini, K. Najafi, R.L. Peterson, "Electromagnetic energy transducer," US Patent 10,734,877, Issued August 4, 2020
- I. Shahossseni, K. Najafi, "Vibrational energy harvester with amplifier having gear assembly," US Patent 10,985,633, April 20, 2021
- K. Najafi, J.Y. Cho, Thermal control mold for making three-dimensional microstructures, US Patent 11,027,479, issued June 8, 2021

Current Graduate Students Advised

- Farzad Asgarian, ECE PhD
- Kimberly Beers, ECE PhD
- Christopher Boyd, EE PhD
- Ester Lomeli, ECE PhD
- Behnoush Rostami, ECE PhD



Norris, Ted

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Research Interests: Application of femtosecond optical techniques to the physics of semiconductor nanostructures, in developing new ultrafast optical and optoelectronic measurement techniques, THz generation and measurement, plasmonics in nanostructures, and novel methods for biological imaging and in vivo sensing.

Recent Publications

- Zhang, D; Xu, Z; Huang, Z; Gutierrez, A; Blocker, C; Liu, C; Lien, M; Cheng, G; Liu, Z; Chun, I; Fessler, J; Zhong, Z; Norris, T, "Neural network based 3D tracking with a graphene transparent focal stack imaging system," Nature Communications, 12/1/2021, https://doi.org/10.1038/s41467-021-22696-x
- Xu Z, Liu Z, Zhang D, Zhong Z, Norris TB, "Ultrafast dynamics of charge transfer in CVD grown MoS_2 graphene heterostructure," Applied Physics Letters, 8/30/2021, https://doi.org/10.1063/5.0060256
- Estakhri NM, Norris TB, "Tunable quantum two-photon interference with reconfigurable metasurfaces using phase-change materials," Optics Express, 5/10/2021, https://doi.org/10.1364/OE.419892
- Estakhri NM, Norris TB, "Reconfigurable metasurfaces for rapid control over quantum interference using GeTe as phase-change material," Optics InfoBase Conference Papers, 9/14/2020, https://doi.org/10.1364/FIO.2020.JM6A.28
- Estakhri NM, Norris TB, "Switching quantum interference with phase-change reconfigurable metasurfaces," Optics InfoBase Conference Papers, 9/14/2020, https://doi.org/10.1364/FIO.2020.FM7E.7
- Huang Z, Fessler JA, Norris TB, Chun IY, "Light-Field Reconstruction and Depth Estimation from Focal Stack Images Using Convolutional Neural Networks," ICASSP, IEEE International Conference on Acoustics, Speech and Signal Processing - Proceedings, 5/1/2020, https://doi.org/10.1109/ICASSP40776.2020.9053586
- Lien MB, Liu CH, Chun IY, Ravishankar S, Nien H, Zhou M, Fessler JA, Zhong Z, Norris TB, "Ranging and light field imaging with transparent photodetectors," Nature Photonics, 3/1/2020, https://doi.org/10.1038/s41566-019-0567-3
- Zhang D, Xu Z, Cheng G, Liu Z, Gutierrez AR, Norris TB, Zhong Z, "Strong enhancement of THz emission in a metal-graphene-silicon heterostructure," Optics InfoBase Conference Papers, 1/1/2020, https://doi.org/10.1364/CLEO_SI.2020.SM1F.2

- Xu Z, Liu Z, Zhong Z, Norris TB, "Ultrafast charge transfer in a CVD-grown graphene/MoS_2 heterostructure," Optics InfoBase Conference Papers, 1/1/2020, https://doi.org/10.1364/CLEO_QELS.2020.FF3B.8

Recent U.S. Patents

- Kirigami chiroptical modulators for circular dichroism measurements in terahertz and other parts of electromagnetic spectrum, #10935432, 2020

Current Graduate Students Advised

- Liangqing Cui, ECE PhD
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- Yifan Shen, ECE PhD
- Zhen Xu, ECE PhD

Owens, Andrew

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Research Interests: Computer vision

Recent Publications

- Chen Z, Hu X, Owens A, Structure from Silence: Learning Scene Structure from Ambient Sound," Conference on Robot Learning, 2021, accepted.
- Wang SY, Wang O, Zhang R, Owens A, Efros AA, "CNN-Generated Images Are Surprisingly Easy to Spot… For Now," Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition, 1/1/2020, https://doi.org/10.1109/CVPR42600.2020.00872
- Afouras T, Owens A, Chung JS, Zisserman A, "Self-supervised Learning of Audio-Visual Objects from Video," Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 1/1/2020, https://doi.org/10.1007/978-3-030-58523-5_13

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- Nathan Louis, ECE PhD (co-advised)
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Research Interests: Computational aspects of control system design; hybrid and cyber-physical systems; system identification and validation; dynamics-based data analysis.

Recent Publications

- Yang L, Ozay N, "Synthesis-guided Adversarial Scenario Generation for Gray-box Feedback Control Systems with Sensing Imperfections," ACM Transactions on Embedded Computing Systems, 10/1/2021, https://doi.org/10.1145/3477033
- Chou G, Berenson D, Ozay N, "Learning constraints from demonstrations with grid and parametric representations," International Journal of Robotics Research, 9/1/2021, https://doi.org/10.1177/02783649211035177
- Mohajerani S, Malik R, Wintenberg A, Lafortune S, Ozay N, "Divergent stutter bisimulation abstraction for controller synthesis with linear temporal logic specifications," Automatica, 8/1/2021, https://doi.org/10.1016/j.automatica.2021.109723
- Knuth C, Chou G, Ozay N, Berenson D, "Planning with Learned Dynamics: Probabilistic Guarantees on Safety and Reachability via Lipschitz Constants," IEEE Robotics and Automation Letters, 7/1/2021, https://doi.org/10.1109/LRA.2021.3068889
- Anevlavis T, Liu Z, Ozay N, Tabuada P, "An enhanced hierarchy for (robust) controlled invariance," Proceedings of the American Control Conference, 5/25/2021, https://doi.org/10.23919/ACC50511.2021.9483217
- Jang S, Ozay N, Mathieu JL, "Large-Scale Invariant Sets for Safe Coordination of Thermostatic Loads," Proceedings of the American Control Conference, 5/25/2021, https://doi.org/10.23919/ACC50511.2021.9483385
- Liu Z, Ozay N, "On the Value of Preview Information for Safety Control," Proceedings of the American Control Conference, 5/25/2021, https://doi.org/10.23919/ACC50511.2021.9483092
- Rutledge KJ, Chou G, Ozay N, "Compositional safety rules for inter-triggering hybrid automata," HSCC 2021 - Proceedings of the 24th International Conference on Hybrid Systems: Computation and Control (part of CPS-IoT Week), 5/19/2021, https://doi.org/10.1145/3447928.3456659
- Weyns D, Schmerl B, Kishida M, Leva A, Litoiu M, Ozay N, Paterson C, Tei K, "Towards Better Adaptive Systems by Combining MAPE, Control Theory, and Machine Learning,"

Proceedings - 2021 International Symposium on Software Engineering for Adaptive and Self-Managing Systems, SEAMS 2021, 5/1/2021, https://doi.org/10.1109/SEAMS51251.2021.00036

- Knuth C, Chou G, Ozay N, Berenson D, "Inferring Obstacles and Path Validity from Visibility-Constrained Demonstrations," chapter in International Workshop on the Algorithmic Foundations of Robotics, 1/1/2021, https://doi.org/10.1007/978-3-030-66723-8_2
- Chen Y, Ozay N, "Data-Driven Computation of Robust Control Invariant Sets With Concurrent Model Selection," IEEE Transactions on Control Systems Technology, 1/1/2021, https://doi.org/10.1109/TCST.2021.3069759
- Chou G, Ozay N, Berenson D, "Learning temporal logic formulas from suboptimal demonstrations: theory and experiments," Autonomous Robots, 1/1/2021, https://doi.org/10.1007/s10514-021-10004-x
- Oymak S, Ozay N, "Revisiting Ho-Kalman based system identification: robustness and finite-sample analysis," IEEE Transactions on Automatic Control, 1/1/2021, https://doi.org/10.1109/TAC.2021.3083651
- Liu Z, Ozay N, "Safe Online Planning in Unknown Nonconvex Environments with Implicit Controlled Invariant Sets," IFAC-PapersOnLine, 1/1/2021, https://doi.org/10.1016/j.ifacol.2021.08.492
- Yang L, Ozay N, "Safety Control Synthesis for Systems with Missing Measurements," IFAC-PapersOnLine, 1/1/2021, https://doi.org/10.1016/j.ifacol.2021.08.481
- Yang L, Ozay N, "Efficient Safety Control Synthesis with Imperfect State Information," Proceedings of the IEEE Conference on Decision and Control, 12/14/2020, https://doi.org/10.1109/CDC42340.2020.9303780
- Wintenberg A, Ozay N, "Implicit Invariant Sets for High-Dimensional Switched Affine Systems," Proceedings of the IEEE Conference on Decision and Control, 12/14/2020, https://doi.org/10.1109/CDC42340.2020.9303986
- Yang L, Karnik A, Pence B, Waez MTB, Ozay N, "Fuel cell thermal management: Modeling, specifications, and correct-by-construction control synthesis," IEEE Transactions on Control Systems Technology, 9/1/2020, https://doi.org/10.1109/TCST.2019.2918747
- Xu X, Ozay N, Gupta V, "Passivity-based analysis of sampled and quantized control implementations," Automatica, 9/1/2020, https://doi.org/10.1016/j.automatica.2020.109064
- Arwashan M, Ge T, Liu Z, Ozay N, "Driving with guardian: Blending user inputs with safety ensuring barriers," CCTA 2020 - 4th IEEE Conference on Control Technology and Applications, 8/1/2020, https://doi.org/10.1109/CCTA41146.2020.9206270

- Sahin YE, Nilsson P, Ozay N, "Multirobot Coordination with Counting Temporal Logics," IEEE Transactions on Robotics, 8/1/2020, https://doi.org/10.1109/TRO.2019.2957669
- Yang L, Rizzo D, Castanier M, Ozay N, "Parameter Sensitivity Analysis of Controlled Invariant Sets via Value Iteration," Proceedings of the American Control Conference, 7/1/2020, https://doi.org/10.23919/ACC45564.2020.9147377
- Liu Z, Yang L, Ozay N, "Scalable Computation of Controlled Invariant Sets for Discrete-Time Linear Systems with Input Delays," Proceedings of the American Control Conference, 7/1/2020, https://doi.org/10.23919/ACC45564.2020.9147731
- Ersal T, Kolmanovsky I, Masoud N, Ozay N, Scruggs J, Vasudevan R, Orosz G, "Connected and automated road vehicles: state of the art and future challenges," Vehicle System Dynamics, 5/3/2020, https://doi.org/10.1080/00423114.2020.1741652
- Rutledge K, Yong SZ, Ozay N, "Finite horizon constrained control and bounded-error estimation in the presence of missing data," Nonlinear Analysis: Hybrid Systems, 5/1/2020, https://doi.org/10.1016/j.nahs.2020.100854
- Majumdar R, Ozay N, Schmuck AK, "On abstraction-based controller design with output feedback," HSCC 2020 - Proceedings of the 23rd International Conference on Hybrid Systems: Computation and Control, part of CPS-IoT Week, 4/22/2020, https://doi.org/10.1145/3365365.3382219
- Chou G, Ozay N, Berenson D, "Learning Constraints from Locally-Optimal Demonstrations under Cost Function Uncertainty," IEEE Robotics and Automation Letters, 4/1/2020, https://doi.org/10.1109/LRA.2020.2974427
- Nilsson P, Ozay N, "Control synthesis for permutation-symmetric high-dimensional systems with counting constraints," IEEE Transactions on Automatic Control, 2/1/2020, https://doi.org/10.1109/TAC.2019.2910949
- Zhang Y, Poupart-Lafarge G, Teng H, Wilhelm J, Jeannin J-B, Ozay N, Scholte E, "A software architecture for autonomous taxiing of aircraft," AIAA Scitech 2020 Forum, 1/6/2020, https://doi.org/10.2514/6.2020-0139

Current Graduate Students Advised

- Glen Chou, ECE PhD (co-advised)
- Zhe Du, ECE PhD (co-advised)
- Sunho Jang, ECE PhD (co-advised)
- Ruya Karagulle, ECE PhD
- Zexiang Liu, ECE PhD
- Daphna Raz, ROB PhD (co-advised)
- Kwesi Rutledge, ECE PhD

- Mohamad Louai Shehab, ROB PhD
- Andrew Wintenberg, ECE PhD (co-advised)
- Xiong Zeng, ECE PhD

Peterson, Becky

Website: https://www.eecs.umich.edu/~blpeters

Research Interests: Oxide semiconductor materials and devices; 3D-IC heterointegration of oxide-based thin film electronics with silicon CMOS; solution-processed inorganic electronic materials; crystalline gallium oxide for power devices.

Recent Publications

- Masten HN, Phillips JD, Peterson RL, "Charge trapping and recovery in ALD HfO_2/β-Ga_2 $O_3$010) MOS capacitors," Semiconductor Science and Technology, 4/1/2021, https://doi.org/10.1088/1361-6641/abe880
- Cho TH, Farjam N, Allemang CR, Pannier CP, Kazyak E, Huber C, Rose M, Trejo O, Peterson RL, Barton K, Dasgupta N, "Area-Selective Atomic Layer Deposition Patterned by Electrohydrodynamic Jet Printing for Additive Manufacturing of Functional Materials and Devices," ACS Nano, 12/22/2020, https://doi.org/10.1021/acsnano.0c07297
- Jo J, Lenef JD, Mashooq K, Trejo O, Dasgupta NP, Peterson RL, "Causes of the Difference between Hall Mobility and Field-Effect Mobility for p-Type RF Sputtered CuO Thin-Film Transistors," IEEE Transactions on Electron Devices, 12/1/2020, https://doi.org/10.1109/TED.2020.3033832
- Lee MH, Peterson RL, "Accelerated Aging Stability of β-Ga_2 O_3 Titanium/Gold Ohmic Interfaces," ACS applied materials & interfaces, 10/14/2020, https://doi.org/10.1021/acsami.0c10598
- Allemang CR, Cho TH, Trejo O, Ravan S, Rodriguez RE, Dasgupta NP, Peterson RL, "High-Performance Zinc Tin Oxide TFTs with Active Layers Deposited by Atomic Layer Deposition," Advanced Electronic Materials, 7/1/2020, https://doi.org/10.1002/aelm.202000195

Recent U.S. Patents

- Electromagnetic Energy Transducer, #10734877, 2020

Current Graduate Students Advised

- Baran Demir, ECE PhD
- Jaesung Jo, ECE PhD
- Tonglin Lu, ECE PhD

- Kishwar Mashooq, ECE PhD
- Hannah Masten, ECE PhD (co-advised)

Pradhan, S. Sandeep

Website: https://pradhan.engin.umich.edu/

Research Interests: Network information theory, coding theory, quantum information theory, quantum error correcting codes, quantum field theory, quantum physics.

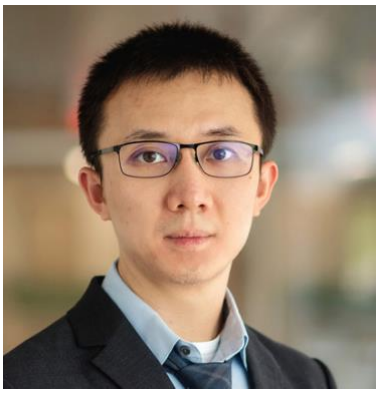
Recent Publications

- Atif TA, Padakandla A, Pradhan SS, "Achievable rate-region for 3 - User Classical-Quantum Interference Channel using Structured Codes," IEEE International Symposium on Information Theory - Proceedings, 7/12/2021, https://doi.org/10.1109/ISIT45174.2021.9518095
- Atif TA, Padakandla A, Pradhan SS, "Computing Sum of Sources over a Classical-Quantum MAC," IEEE International Symposium on Information Theory - Proceedings, 7/12/2021, https://doi.org/10.1109/ISIT45174.2021.9518261
- Atif TA, Pradhan SS, "Distributed Quantum Faithful Simulation and Function Computation Using Algebraic Structured Measurements," IEEE International Symposium on Information Theory - Proceedings, 7/12/2021, https://doi.org/10.1109/ISIT45174.2021.9518080
- Atif TA, Padakandla A, Pradhan SS, "Synthesizing Correlated Randomness using Algebraic Structured Codes," IEEE International Symposium on Information Theory - Proceedings, 7/12/2021, https://doi.org/10.1109/ISIT45174.2021.9517918
- Shirani F, Pradhan SS, "A new achievable rate-distortion region for distributed source coding," IEEE Transactions on Information Theory, 7/1/2021, https://doi.org/10.1109/TIT.2021.3084307
- Pradhan SS, Padakandla A, Shirani F, "An algebraic and probabilistic framework for network information theory," Foundations and Trends in Communications and Information Theory, 12/21/2020, https://doi.org/10.1561/0100000083
- Heidari M, Sandeep Pradhan S, "Structured Mappings and Conferencing Common Information for Multiple-Access Channels," IEEE Transactions on Information Theory, 7/1/2020, https://doi.org/10.1109/TIT.2020.2980550
- Pang JCJ, Mahdavifar H, Pradhan SS, "Capacity-achieving Polar-based LDGM Codes with Crowdsourcing Applications," IEEE International Symposium on Information Theory - Proceedings, 6/1/2020, https://doi.org/10.1109/ISIT44484.2020.9174358

- Anwar Atif T, Padakandla A, Sandeep Pradhan S, "Source Coding for Synthesizing Correlated Randomness," 2020 IEEE International Symposium on Information Theory (ISIT), 6/1/2020, https://doi.org/10.1109/isit44484.2020.9174002
- Anastasopoulos A, Pradhan S, "Decentralized sequential active hypothesis testing and the MAC feedback capacity," IEEE International Symposium on Information Theory - Proceedings, 6/1/2020, https://doi.org/10.1109/ISIT44484.2020.9174166
- Anastasopoulos A, Pradhan S, "New perspectives on MAC feedback capacity using decentralized sequential active hypothesis testing paradigm," 2020 Information Theory and Applications Workshop, ITA 2020, 2/2/2020, https://doi.org/10.1109/ITA50056.2020.9244995
- Pradhan SS, Padakandla A, Shirani F, An Algebraic and Probabilistic Framework for Network Information Theory (book), 1/1/2020, https://doi.org/10.1561/9781680837674
- Choi S, Pradhan SS, Akhoury R, "Supertranslation hair of Schwarzschild black hole: a Wilson line perspective," Journal of High Energy Physics, 1/1/2020, https://doi.org/10.1007/JHEP01(2020)013

Current Graduate Students Advised

- Touheed Anwar Atif, ECE PhD
- Chin-Jen Pang, ECE PhD (co-advised)
- Mohammad Aamir Sohail, ECE PhD



Qu, Qing

Website: https://qingqu.engin.umich.edu/

Research Interests: High dimensional data analysis, machine learning, signal processing, numerical optimization, computational imaging.

Recent Publications

- Zhihui Zhu (equal), Tianyu Ding (equal), Jinxin Zhou, Xiao Li, Chong You, Jeremias Sulam, **Qing Qu** (2021). A Geometric Analysis of Neural Collapse with Unconstrained Features. *Neural Information Processing Systems (NeurIPS'21)*, 2021. (**spotlight, top 3%**)
- Sheng Liu (equal), Xiao Li (equal), Yuexiang Zhai, Chong You, Zhihui Zhu, Carlos Fernandez-Granda, **Qing Qu** (2021). Convolutional Normalization: Improving Deep Convolutional Network Robustness and Training. *Neural Information Processing Systems (NeurIPS'21)*, 2021.
- Lijun Ding (equal), Liwei Jiang (equal), Yudong Chen, **Qing Qu**, Zhihui Zhu (2021). Rank Overspecified Robust Matrix Recovery: Subgradient Method and Exact Recovery. *Neural Information Processing Systems (NeurIPS'21)*, 2021.
- Chong You (equal), Zhihui Zhu (equal), **Qing Qu**, Yi Ma (2020). Robust Recovery via Implicit Bias of Discrepant Learning Rates for Double Over-parameterization. *Neural Information Processing Systems (NeurIPS'20),* 2020. (**spotlight, top 4%**)
- **Qing Qu**, Yuexiang Zhai, Xiao Li, Yuqian Zhang, and Zhihui Zhu (2020). Geometric Analysis of Nonconvex Optimization Landscapes for Overcomplete Learning. *International Conference on Learning Representations (ICLR'20)*, 2020. (**oral, top 1.9%**)
- Yenson Lau (equal), **Qing Qu (equal)**, Han-wen Kuo, Pengcheng Zhou, Yuqian Zhang, and John Wright (2020). Short and Sparse Deconvolution — A Geometric Approach. *International Conference on Learning Representations (ICLR'20)*, 2020.
- Xiao Li (equal), Shixiang Chen (equal), Zengde Deng, **Qing Qu**, Zhihui Zhu, Anthony Man Cho So (2021). Weakly Convex Optimization over Stiefel Manifold Using Riemannian Subgradient-Type Methods. *SIAM Journal on Optimization*, 2021.
- Qu Q, Li X, Zhu Z, "Exact recovery of multichannel sparse blind deconvolution via gradient descent," SIAM Journal on Imaging Sciences, 1/1/2020, https://doi.org/10.1137/19M1291327

Current Graduate Students Advised

- Xiao Li, ECE PhD
- Can Yaras, ECE PhD (co-advised)

Revzen, Shai

Website: http://www.birds.eecs.umich.edu/

Research Interests: Bio-inspired control; dynamical systems; biomechanics; legged locomotion; modular robotics.

Recent Publications

- Kvalheim MD, Revzen S, "Existence and uniqueness of global Koopman eigenfunctions for stable fixed points and periodic orbits," Physica D: Nonlinear Phenomena, 11/1/2021, https://doi.org/10.1016/j.physd.2021.132959
- Zhao D, Revzen S, "Multi-legged steering and slipping with low DoF hexapod robots," Bioinspiration and Biomimetics, 7/1/2020, https://doi.org/10.1088/1748-3190/ab84c0
- Sarin A, Abbot D, Revzen S, Avestruz AT, "Bidirectional Capacitive Wireless Power Transfer for Energy Balancing in Modular Robots," Conference Proceedings - IEEE Applied Power Electronics Conference and Exposition - APEC, 3/1/2020, https://doi.org/10.1109/APEC39645.2020.9124139

Current Graduate Students Advised

- Lee Anderson, ECE PhD

Sarabandi, Kamal

Website: https://radlab.engin.umich.edu/people/faculty/kamal-sarabandi/

Research Interests: Microwave and millimeter wave radar technology; geoscience and remote sensing; antennas and wave propagation; metamaterials.

Recent Publications

- Douglas TJ, Nashashibi AY, Shaman HN, Sarabandi K, "Sub-Millimeter-Wave Polarization-Independent Spatial Power Divider for a Two-Port Dual-Polarized Antenna," IEEE Transactions on Terahertz Science and Technology, 9/1/2021, https://doi.org/10.1109/TTHZ.2021.3088310
- Aljurbua A, Sarabandi K, "A Fast Full-Wave Simulation Method for Characterization of Deeply Buried Targets in Bistatic SAR Imaging," IEEE Geoscience and Remote Sensing Letters, 8/1/2021, https://doi.org/10.1109/LGRS.2020.3000196
- Zaky MM, Sarabandi K, "Fully Coherent Electromagnetic Scattering Computation for Snowpacks Based on Statistical S-Matrix Approach," IEEE Transactions on Geoscience and Remote Sensing, 8/1/2021, https://doi.org/10.1109/TGRS.2020.3026206
- Barani N, Kashanianfard M, Sarabandi K, "A Mechanical Antenna with Frequency Multiplication and Phase Modulation Capability," IEEE Transactions on Antennas and Propagation, 7/1/2021, https://doi.org/10.1109/TAP.2020.3044385
- Luo S, Sarabandi K, Tong L, Pierce LE, "Probability Assessment of Rainfall-Induced Landslides Based on Safety Factors Using Soil Moisture Estimation from SAR Images," IEEE Transactions on Geoscience and Remote Sensing, 7/1/2021, https://doi.org/10.1109/TGRS.2020.3025996
- Geroski DJ, Sarabandi K, "Full-Wave Calculation of Complex Propagation Constant for a Medium of Conducting Wires," IEEE Transactions on Antennas and Propagation, 6/1/2021, https://doi.org/10.1109/TAP.2020.3037712
- Benson ML, Pierce L, Bergen K, Sarabandi K, "Model-Based Estimation of Forest Canopy Height and Biomass in the Canadian Boreal Forest Using Radar, LiDAR, and Optical Remote Sensing," IEEE Transactions on Geoscience and Remote Sensing, 6/1/2021, https://doi.org/10.1109/TGRS.2020.3018638
- Singh M, Ghosh B, Sarabandi K, "Directivity enhancement and characteristics of space-wave, leaky-wave and creeping-waves for an impedance cylinder coated with

dielectric," IET Microwaves, Antennas and Propagation, 2/1/2021, https://doi.org/10.1049/mia2.12038

- Radpour H, Pourziad A, Sarabandi K, "Four-dimensional relativistic scattering of electromagnetic waves from an arbitrary collection of moving lossy dielectric spheres," IET Microwaves, Antennas and Propagation, 2/1/2021, https://doi.org/10.1049/mia2.12022
- Akbar F, Yektakhah B, Xu H, Sarabandi K, "A Low-Complexity Time-Domain Method for a Fast and Accurate Measurement of Q-Factor and Resonant Frequency of RF and Microwave Resonators," IEEE Access, 1/1/2021, https://doi.org/10.1109/ACCESS.2021.3094409
- Choi J, Dagefu FT, Sadler BM, Sarabandi K, "A Miniature Actively Matched Antenna for Power-Efficient and Bandwidth-Enhanced Operation at Low VHF," IEEE Transactions on Antennas and Propagation, 1/1/2021, https://doi.org/10.1109/TAP.2020.3004990
- Cai X, Giallorenzo M, Sarabandi K, "Machine Learning-Based Target Classification for MMW Radar in Autonomous Driving," IEEE Transactions on Intelligent Vehicles, 1/1/2021, https://doi.org/10.1109/TIV.2020.3048944
- Salim M, Tan S, De Roo RD, Colliander A, Sarabandi K, "Passive and Active Multiple Scattering of Forests Using Radiative Transfer Theory With an Iterative Approach and Cyclical Corrections," IEEE Transactions on Geoscience and Remote Sensing, 1/1/2021, https://doi.org/10.1109/TGRS.2021.3082137
- Amjadi M, Sarabandi K, "Ultra-Wideband, Compact, and High-Gain Two-Port Antenna System for Full-Duplex Applications," IEEE Transactions on Antennas and Propagation, 1/1/2021, https://doi.org/10.1109/TAP.2021.3076266
- Nasr AMH, Nashashibi AY, Sarabandi K, "Ultrawideband Characterization of Complex Dielectric Constant of Planar Materials for 5G Applications," IEEE Transactions on Instrumentation and Measurement, 1/1/2021, https://doi.org/10.1109/TIM.2021.3102742
- Salim M, Mousavi S, Nieuwstadt LV, De Roo R, Sarabandi K, "A Novel Frequency Tunable RF Comb Filter," IEEE Microwave and Wireless Components Letters, 12/1/2020, https://doi.org/10.1109/LMWC.2020.3031287
- Amjadi SM, Rao M, Sarabandi K, "Wideband Near-Zone Radiative System for Exploring the Existence of Electromagnetic Emission from Biological Samples," IEEE Transactions on Instrumentation and Measurement, 10/1/2020, https://doi.org/10.1109/TIM.2020.2994433
- Akbar F, Yektakhah BH, Xu H, Sarabandi K, "An Accurate Low-Cost Method for Q-Factor and Resonance Frequency Measurements of RF and Microwave Resonators," International Geoscience and Remote Sensing Symposium (IGARSS), 9/26/2020, https://doi.org/10.1109/IGARSS39084.2020.9323277

- Aljurbua A, Sarabandi K, "An Algorithm for Buried Pipeline Detection Using a 3-D Bistatic Imaging Radar," International Geoscience and Remote Sensing Symposium (IGARSS), 9/26/2020, https://doi.org/10.1109/IGARSS39084.2020.9324649
- Zaky M, Sarabandi K, "Electromagnetic Scattering Computation of a Snow Layer over Rough Surface Using SSWAP-SD Technique," International Geoscience and Remote Sensing Symposium (IGARSS), 9/26/2020, https://doi.org/10.1109/IGARSS39084.2020.9324562
- Mousavi S, De Roo R, Sarabandi K, England AW, "Error Estimation of the Measured Time Delay using Wideband Autocorrelation Radiometry," International Geoscience and Remote Sensing Symposium (IGARSS), 9/26/2020, https://doi.org/10.1109/IGARSS39084.2020.9324211
- Alaqeel A, Nashashibi A, Sarabandi K, Shaman H, "Improved Detection Techniques for New Millimeter Wave Automotive Radars," International Geoscience and Remote Sensing Symposium (IGARSS), 9/26/2020, https://doi.org/10.1109/IGARSS39084.2020.9324520
- Benson M, Pierce L, Sarabandi K, "Quantifying the Effect of the Wind on Forest Canopy Height Estimation Using Interferometric Synthetic Aperture Radar Systems," International Geoscience and Remote Sensing Symposium (IGARSS), 9/26/2020, https://doi.org/10.1109/IGARSS39084.2020.9324727
- Salim M, Mousavi S, De Roo R, Sarabandi K, "RFI Mitigation Using a New Comb Filter for Wideband Autocorrelation Radiometry," International Geoscience and Remote Sensing Symposium (IGARSS), 9/26/2020, https://doi.org/10.1109/IGARSS39084.2020.9323684
- Ebrahimi N, Sarabandi K, Buckwalter J, "A 71-76/81-86 GHz, E-band,16-Element Phased-Array Transceiver Module with Image Selection Architecture for Low EVM Variation," Digest of Papers - IEEE Radio Frequency Integrated Circuits Symposium, 8/1/2020, https://doi.org/10.1109/RFIC49505.2020.9218300
- Rao M, Sarabandi K, "A Dual-band Dual-polarized 5G Antenna for Smartphones," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9330072
- Cai X, Sarabandi K, "A Fast Analytic Multiple-Sources Angle-of-Arrival Estimation Algorithm for Automotive MIMO Radars," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9330287
- Aljurbua A, Shaman H, Sarabandi K, "A Fast Full-Wave Data Generation Method for Bistatic Subsurface SAR," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9329522

- Wu J, Nashashibi AY, Kashanianfard M, Sarabandi K, "A Low-loss Waveguide Filter for Harmonic Rejection in a Polarimetric Automotive Radar," 2020 USNC-URSI Radio Science Meeting (Joint with AP-S Symposium), USNC/URSI 2020 - Proceedings, 7/5/2020, https://doi.org/10.23919/USNC/URSI49741.2020.9321613
- Barani N, Sarabandi K, "A Phase Modulation Scheme for Super-Low Frequency Handheld Mechanical Antennas," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9329922
- Honari MM, Ghaffarian MS, Mousavi P, Sarabandi K, "A Wideband High-Gain Planar Corrugated Antenna," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9330020
- Barani N, Sarabandi K, "Biological Cell Communication: Quorum Sensing Versus Electromagnetic Signaling," 2020 USNC-URSI Radio Science Meeting (Joint with AP-S Symposium), USNC/URSI 2020 - Proceedings, 7/5/2020, https://doi.org/10.23919/USNC/URSI49741.2020.9321612
- Salim M, Mousavi S, De Roo R, Sarabandi K, "Calibration of Wideband Autocorrelation Radiometer with a Comb Filter for RFI Mitigation," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9329570
- Nashashibi AY, Douglas TJ, Sarabandi K, Shaman H, "Design and Fabrication of Orthomode Transducer for Compact Polarimetric J-Band Radars," 2020 USNC-URSI Radio Science Meeting (Joint with AP-S Symposium), USNC/URSI 2020 - Proceedings, 7/5/2020, https://doi.org/10.23919/USNC/URSI49741.2020.9321674
- Geroski DJ, Sarabandi K, "Existence of Effective Media Properties for Clouds of Metallic and Magnetic Particles," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9330300
- Geroski DJ, Sarabandi K, "Full-Wave Estimate of the Extinction and Phase Matrices of Collections of Metallic Particles," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9330229
- Nashashibi AY, Kashanianfard M, Douglas TJ, Sarabandi K, Decker SW, "Fully Polarimetric E-Band Instrumentation Radar in Support of Autonomous Vehicle Research," 2020 USNC-URSI Radio Science Meeting (Joint with AP-S Symposium), USNC/URSI 2020 - Proceedings, 7/5/2020, https://doi.org/10.23919/USNC/URSI49741.2020.9321601
- Douglas TJ, Sarabandi K, "High-Isolation Common-Aperture Antenna System Based on Spatial Power Divider for Use in E-Band Fully Polarimetric Radar," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio

Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9330227

- Nasr A, Sarabandi K, Takla M, "Multi-beam Dual-Polarized Windshield Antenna with Wide Elevation Coverage for 5G V2X Applications," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9329767
- Barani N, Sarabandi K, "Signaling and Quorum Sensing within Biofilms: Which Mechanism Is the Most Probable Means of Communication?" Proceedings of the Annual International Conference of the IEEE Engineering in Medicine and Biology Society, EMBS, 7/1/2020, https://doi.org/10.1109/EMBC44109.2020.9176068
- Cai X, Sarabandi K, "Broadband Omnidirectional Circularly Polarized Antenna with Asymmetric Power Divider," IEEE Transactions on Antennas and Propagation, 7/1/2020, https://doi.org/10.1109/TAP.2020.2977725
- Honari MM, Sarabandi K, Mousavi P, "Design and Analysis of Corrugated Antennas Based on Surface Susceptance of a Single Cell of Corrugation," IEEE Transactions on Antennas and Propagation, 7/1/2020, https://doi.org/10.1109/TAP.2020.2979278
- Yektakhah B, Chiu J, Alsallum F, Sarabandi K, "Low-Profile, Low-Frequency, UWB Antenna for Imaging of Deeply Buried Targets," IEEE Geoscience and Remote Sensing Letters, 7/1/2020, https://doi.org/10.1109/LGRS.2019.2942007
- Mousavi S, De Roo R, Sarabandi K, England AW, "Retrieval of Snow or Ice Pack Thickness Variation within a Footprint of Correlation Radiometers," IEEE Geoscience and Remote Sensing Letters, 7/1/2020, https://doi.org/10.1109/LGRS.2019.2940584
- Deng C, Liu D, Yektakhah B, Sarabandi K, "Series-Fed Beam-Steerable Millimeter-Wave Antenna Design with Wide Spatial Coverage for 5G Mobile Terminals," IEEE Transactions on Antennas and Propagation, 5/1/2020, https://doi.org/10.1109/TAP.2019.2963583
- Luo S, Sarabandi K, Tong L, Guo S, "An Improved Fuzzy Region Competition-Based Framework for the Multiphase Segmentation of SAR Images," IEEE Transactions on Geoscience and Remote Sensing, 4/1/2020, https://doi.org/10.1109/TGRS.2019.2949742
- Honari MM, Mousavi P, Sarabandi K, "Miniaturized-Element Frequency Selective Surface Metamaterials: A Solution to Enhance Radiation of RFICs," IEEE Transactions on Antennas and Propagation, 3/1/2020, https://doi.org/10.1109/TAP.2019.2948508
- Luo S, Sarabandi K, Tong L, Guo S, "Unsupervised Multiregion Partitioning of Fully Polarimetric SAR Images with Advanced Fuzzy Active Contours," IEEE Transactions on Geoscience and Remote Sensing, 2/1/2020, https://doi.org/10.1109/TGRS.2019.2947376

- Honari MM, Sarabandi K, Mousavi P, "Dual-Band High-Gain Planar Corrugated Antennas with Integrated Feeding Structure," IEEE Access, 1/1/2020, https://doi.org/10.1109/ACCESS.2020.2986328

Current Graduate Students Advised

- Abdulrahman Alaqeel, ECE PhD
- Abdulrahman Abdulaziz S Aljurbua, ECE PhD
- Michael Benson, EE PhD (co-advised)
- Tanner Douglas, ECE PhD
- Zachary Fritts, ECE PhD (co-advised)
- Ehsan Hafeziasl, ECE PhD
- Duncan Madden, ECE PhD
- Aditya Varma Muppala, ECE PhD (co-advised)
- Abdelhamid Nasr, ECE PhD
- Menglou Rao, ECE PhD
- Adam Roberts, ECE PhD
- Puneeth Yogananda, ECE PhD (co-advised)

Scott, Clayton D.

Website: http://web.eecs.umich.edu/~cscott/

Research Interests: Machine learning theory, methods, and applications.

Recent Publications

- Thong T, Wang Y, Brooks MD, Lee CT, Scott C, Balzano L, Wicha MS, Colacino JA, "Hybrid Stem Cell States: Insights Into the Relationship Between Mammary Development and Breast Cancer Using Single-Cell Transcriptomics," Frontiers in Cell and Developmental Biology, 5/8/2020, https://doi.org/10.3389/fcell.2020.00288

Current Graduate Students Advised

- Amaya Murguia, ECE PhD (co-advised)
- Alexander Ritchie, ECE PhD (co-advised)
- Yutong Wang, ECE PhD
- Jianxin Zhang, ECE PhD
- Yilun Zhu, ECE PhD

Seiler, Peter

Website: https://seiler.engin.umich.edu

Research Interests: Robust control theory; Numerical methods for control design; Applications to wind turbines, safety-critical systems and disk drives.

Recent Publications

- Buch J, Arcak M, Seiler P, "An Efficient Algorithm to Compute Norms for Finite Horizon, Linear Time-Varying Systems," IEEE Control Systems Letters, 11/1/2021, https://doi.org/10.1109/LCSYS.2020.3042075
- Schweidel KS, Buch JR, Seiler PJ, Arcak M, "Computing Worst-Case Disturbances for Finite-Horizon Linear Time-Varying Approximations of Uncertain Systems," IEEE Control Systems Letters, 11/1/2021, https://doi.org/10.1109/LCSYS.2020.3043843
- Seiler P, Carrasco J, "Construction of Periodic Counterexamples to the Discrete-Time Kalman Conjecture," IEEE Control Systems Letters, 10/1/2021, https://doi.org/10.1109/LCSYS.2020.3033443
- Ossmann D, Seiler P, Milliren C, Danker A, "Field testing of multi-variable individual pitch control on a utility-scale wind turbine," Renewable Energy, 6/1/2021, https://doi.org/10.1016/j.renene.2021.02.039
- Buch J, Seiler P, "Finite horizon robust synthesis using integral quadratic constraints," International Journal of Robust and Nonlinear Control, 5/25/2021, https://doi.org/10.1002/rnc.5431
- Hu B, Seiler P, Lessard L, "Analysis of biased stochastic gradient descent using sequential semidefinite programs," Mathematical Programming, 5/1/2021, https://doi.org/10.1007/s10107-020-01486-1
- Yin H, Seiler P, Arcak M, "Backward Reachability Using Integral Quadratic Constraints for Uncertain Nonlinear Systems," IEEE Control Systems Letters, 4/1/2021, https://doi.org/10.1109/LCSYS.2020.3005315
- Zhang J, Seiler P, Carrasco J, "Zames-Falb multipliers for convergence rate: motivating example and convex searches," International Journal of Control, 10/2/2020, https://doi.org/10.1080/00207179.2020.1823484
- Seiler P, Packard A, Gahinet P, "An Introduction to Disk Margins," IEEE CONTROL SYSTEMS MAGAZINE, 10/1/2020, https://doi.org/10.1109/MCS.2020.3005277

- Yin H, Packard A, Arcak M, Seiler P, "Reachability analysis using dissipation inequalities for uncertain nonlinear systems," Systems & Control Letters, 8/1/2020, https://doi.org/10.1016/j.sysconle.2020.104736

Recent U.S. Patents

- Fault-tolerant aircraft flight control using a subset of aerodynamic control surfaces, #10604236, 2020

Current Graduate Students Advised

- Sunny Chen, ECE PhD (co-advised)
- Shih-Chi Liao, ECE PhD
- Rachel Rhoades, ECE PhD (co-advised)

Stark, Wayne E.

Website: https://stark.engin.umich.edu/

Research Interests: Wireless Communications; mobile communications; spread-spectrum communications; coding theory.

Steel, Duncan

Website: https://dsteel.engin.umich.edu/

Research Interests: Laser spectroscopy, optical physics, condensed matter physics, biophysics, quantum computing.

Recent Publications

- Chen Z, Zhou Y, Shen JT, Ku PC, Steel D, "Two-photon controlled-phase gates enabled by photonic dimers," Physical Review A, 5/1/2021, https://doi.org/10.1103/PhysRevA.103.052610
- Kim J, Croft Z, Steel D, Ku P-C, "Controlled Phase Gate of Spin Qubits in Two Quantum-Dot Single-Photon Emitters," Conference on Lasers and Electro-Optics, 1/1/2021, https://doi.org/10.1364/cleo_at.2021.jtu3a.61
- Ross AM, Bracker AS, Yakes MK, Gammon D, Sham LJ, Steel DG, "Direct high-resolution resonant Raman scattering measurements of dynamic nuclear spin polarization states of an InAs quantum dot," Physical Review B, 12/21/2020, https://doi.org/10.1103/PhysRevB.102.235425
- Kim J, Mastropietro D, Steel D, Shen JT, Ku PC, "Proposal of chip-scale generation and verification of photonic dimers," Optics InfoBase Conference Papers, 1/1/2020, https://doi.org/10.1364/CLEO_AT.2020.JTh2A.24

Current Graduate Students Advised

- Yuze Liu, ECE PhD (co-advised)

Subramanian, Vijay

Website: https://subramanian.engin.umich.edu/

Research Interests: Social networks, network economics, random graphs, communication networks, information theory, stochastic modeling, and applied probability.

Recent Publications

- D. Tang, H. Tavafoghi, V. G. Subramanian, A. Nayyar and D. Tenketzis, “Private Information Com- pression in Dynamic Games among Teams,” accepted to 2021 IEEE Conference on Decision and Control (CDC).
- S.-T. Su, V. Subramanian and G. Schoenebeck, “Bayesian Persuasion in Sequential Trials,” accepted to 17th Conference on Web and Internet Economics (WINE), 2021.
- S.-T. Su, V. Subramanian and D. Kempe, “On the benefits of being constrained when receiving signals,” accepted to 17th Conference on Web and Internet Economics (WINE), 2021.
- Vial D, Subramanian V, "Empirical Policy Evaluation With Supergraphs," IEEE Journal on Selected Areas in Information Theory, 6/1/2021, https://doi.org/10.1109/jsait.2021.3073257
- Berry R, Honig M, Nguyen T, Subramanian V, Vohra R, "The value of sharing intermittent spectrum," Management Science, 11/1/2020, https://doi.org/10.1287/mnsc.2019.3437
- Chen C, Berry RA, Honig ML, Subramanian VG, "Pricing, bandwidth allocation, and service competition in heterogeneous wireless networks," IEEE/ACM Transactions on Networking, 10/1/2020, https://doi.org/10.1109/TNET.2020.3008141
- Khan N, Moharrami M, Subramanian V, "Stable and Efficient Piece-Selection in Multiple Swarm BitTorrent-like Peer-to-Peer Networks," Proceedings - IEEE INFOCOM, 7/1/2020, https://doi.org/10.1109/INFOCOM41043.2020.9155253
- Chen C, Berry RA, Honig ML, Subramanian VG, "The Impact of Unlicensed Access on Small-Cell Resource Allocation," IEEE Journal on Selected Areas in Communications, 4/1/2020, https://doi.org/10.1109/JSAC.2020.2971897

Recent U.S. Patents

- Methods of load balancing, #10931583, Feb 2021

Current Graduate Students Advised

- Saghar Adler, ECE PhD
- Hossein Dabirian, ECE PhD
- Hsu Kao, EES PhD
- Nouman Khan, ECE PhD
- Shih-Tang Su, ECE PhD
- Dengwang Tang, ECE PhD

Sylvester, Dennis

Website: http://web.eecs.umich.edu/faculty/sylvester/

Research Interests: Low power integrated circuit design, computer-aided design for VLSI.

Recent Publications

- Seol JH, Choo K, Blaauw D, Sylvester D, Jang T, "Reference Oversampling PLL Achieving -256-dB FoM and -78-dBc Reference Spur," IEEE Journal of Solid-State Circuits, 10/1/2021, https://doi.org/10.1109/JSSC.2021.3089930
- Rothe R, Cho M, Choo K, Jeong S, Sylvester D, Blaauw D, "A 192 nW 0.02 Hz High Pass Corner Acoustic Analog Front-End with Automatic Saturation Detection and Recovery," IEEE Symposium on VLSI Circuits, Digest of Technical Papers, 6/13/2021, https://doi.org/10.23919/VLSICircuits52068.2021.9492374
- Park S, Seol JH, Xu L, Sylvester D, Blaauw D, "A 43nW 32kHz Pulsed Injection TCXO with 4.2ppm Accuracy Using Modulated Load Capacitance," IEEE Symposium on VLSI Circuits, Digest of Technical Papers, 6/13/2021, https://doi.org/10.23919/VLSICircuits52068.2021.9492484
- Lim J, Lee J, Moon E, Barrow M, Atzeni G, Letner J, Costello J, Nason SR, Patel PR, Patil PG, Kim HS, Chestek C, Phillips J, Blaauw D, Sylvester D, Jang T, "A Light Tolerant Neural Recording IC for Near-Infrared-Powered Free Floating Motes," IEEE Symposium on VLSI Circuits, Digest of Technical Papers, 6/13/2021, https://doi.org/10.23919/VLSICircuits52068.2021.9492459
- Xu L, Lee J, Saligane M, Blaauw D, Sylvester D, "Design Techniques of Integrated Power Management Circuits for Low Power Edge Devices," Proceedings of the Custom Integrated Circuits Conference, 4/1/2021, https://doi.org/10.1109/CICC51472.2021.9431508
- An H, Schiferl S, Venkatesan S, Wesley T, Zhang Q, Wang J, Choo KD, Liu S, Liu B, Li Z, Gong L, Zhong H, Blaauw D, Dreslinski R, Kim HS, Sylvester D, "An Ultra-Low-Power Image Signal Processor for Hierarchical Image Recognition with Deep Neural Networks," IEEE Journal of Solid-State Circuits, 4/1/2021, https://doi.org/10.1109/JSSC.2020.3041858
- Li, Z; Wang, Z; Xu, L; Dong, Q; Liu, B; Su, C; Chu, W; Tsou, G; Chih, Y; Chang, T; Sylvester, D; Kim, H; Blaauw, D, "RRAM-DNN: An RRAM and Model-Compression Empowered All-Weights-On-Chip DNN Accelerator," IEEE Journal of Solid-State Circuits, 4/1/2021, https://doi.org/10.1109/JSSC.2020.3045369

- Choo K, An H, Sylvester D, Blaauw D, "14.1-ENOB 184.9dB-FoM Capacitor-Array-Assisted Cascaded Charge-Injection SAR ADC," Digest of Technical Papers - IEEE International Solid-State Circuits Conference, 2/13/2021, https://doi.org/10.1109/ISSCC42613.2021.9365863
- Ajayi T, Kamineni S, Fayazi M, Cherivirala YK, Kwon K, Gupta S, Duan W, Lee J, Chen CH, Saligane M, Sylvester D, Blaauw D, Dreslinski R, Calhoun B, Wentzloff D, "Fully-Autonomous SoC Synthesis Using Customizable Cell-Based Analog and Mixed-Signal Circuits Generation," chapter in IFIP Advances in Information and Communication Technology, 1/1/2021, https://doi.org/10.1007/978-3-030-81641-4_4
- Wang J, An H, Zhang Q, Kim HS, Blaauw D, Sylvester D, "A 40-nm Ultra-Low Leakage Voltage-Stacked SRAM for Intelligent IoT Sensors," IEEE Solid-State Circuits Letters, 1/1/2021, https://doi.org/10.1109/LSSC.2020.3043461
- Xu L, Jang T, Lim J, Choo KD, Blaauw D, Sylvester D, "A 510-pW 32-kHz Crystal Oscillator With High Energy-to-Noise-Ratio Pulse Injection," IEEE Journal of Solid-State Circuits, 1/1/2021, https://doi.org/10.1109/jssc.2021.3092424
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- Ajayi T, Kamineni S, Cherivirala YK, Fayazi M, Kwon K, Saligane M, Gupta S, Chen CH, Sylvester D, Blaauw D, Dreslinski R, Calhoun B, Wentzloff D, "An Open-source Framework for Autonomous SoC Design with Analog Block Generation," IEEE/IFIP International Conference on VLSI and System-on-Chip, VLSI-SoC, 10/5/2020, https://ieeexplore.ieee.org/document/9344104
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- Wang J, An H, Zhang Q, Kim HS, Blaauw D, Sylvester D, "1.03pW/b Ultra-Low Leakage Voltage-Stacked SRAM for Intelligent Edge Processors," IEEE Symposium on VLSI Circuits, Digest of Technical Papers, 6/1/2020, https://doi.org/10.1109/VLSICircuits18222.2020.9162843
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- Wang Z, Li Z, Xu L, Dong Q, Su CI, Chu WT, Tsou G, Chih YD, Chang TYJ, Sylvester D, Kim HS, Blaauw D, "An All-Weights-on-Chip DNN Accelerator in 22nm ULL Featuring 24x1 Mb eRRAM," IEEE Symposium on VLSI Circuits, Digest of Technical Papers, 6/1/2020, https://doi.org/10.1109/VLSICircuits18222.2020.9162811
- Rothe R, Oh S, Choo K, Jeong S, Cho M, Sylvester D, Blaauw D, "Sample and Average Common-Mode Feedback in a 101 nW Acoustic Amplifier," IEEE Symposium on VLSI Circuits, Digest of Technical Papers, 6/1/2020, https://doi.org/10.1109/VLSICircuits18222.2020.9162804
- Lim J, Moon E, Barrow M, Nason SR, Patel PR, Patil PG, Oh S, Lee I, Kim HS, Sylvester D, Blaauw D, Chestek C, Phillips J, Jang T, "A 0.19x0.17mm^2 Wireless Neural Recording IC for Motor Prediction with Near-Infrared-Based Power and Data Telemetry," Digest of Technical Papers - IEEE International Solid-State Circuits Conference, 2/1/2020, https://doi.org/10.1109/ISSCC19947.2020.9063005
- Xu L, Jang T, Lim J, Choo K, Blaauw D, Sylvester D, "A 0.51nW 32kHz Crystal Oscillator Achieving 2ppb Allan Deviation Floor Using High-Energy-to-Noise-Ratio Pulse Injection," Digest of Technical Papers - IEEE International Solid-State Circuits Conference, 2/1/2020, https://doi.org/10.1109/ISSCC19947.2020.9062906
- Lee J, Saligane M, Blaauw D, Sylvester D, "A 0.3-V to 1.8-3.3-V Leakage-Biased Synchronous Level Converter for ULP SoCs," IEEE Solid-State Circuits Letters, 1/1/2020, https://doi.org/10.1109/LSSC.2020.3007875
- Wang J, Wang X, Eckert C, Subramaniyan A, Das R, Blaauw D, Sylvester D, "A 28-nm Compute SRAM with Bit-Serial Logic/Arithmetic Operations for Programmable In-Memory Vector Computing," IEEE Journal of Solid-State Circuits, 1/1/2020, https://doi.org/10.1109/JSSC.2019.2939682
- Seol JH, Choo K, Blaauw D, Sylvester D, Jang T, "A 67-fs$_{rms}$ Jitter, -130 dBc/Hz In-Band Phase Noise, -256-dB FoM Reference Oversampling Digital PLL with Proportional Path Timing Control," IEEE Solid-State Circuits Letters, 1/1/2020, https://doi.org/10.1109/LSSC.2020.3025142o
- Lee J, Miyoshi S, Kawaminami M, Blaauw D, Sylvester D, Zhang Y, Dong Q, Lim W, Saligane M, Kim Y, Jeong S, Lim J, Yasuda M, Miyoshi S, Kawaminami M, Blaauw D, Sylvester D, "A Self-Tuning IoT Processor Using Leakage-Ratio Measurement for Energy-Optimal Operation," IEEE Journal of Solid-State Circuits, 1/1/2020, https://doi.org/10.1109/JSSC.2019.2939890

Recent U.S. Patents

- Analog-to-digital conversion circuit and image sensor including the same, #10594333, 2020
- Low-power, long-range RF localization system and method, #10746844, 2020

Current Graduate Students Advised

- Hyochan An, ECE PhD
- Zichen Fan, ECE PhD
- Yimai Peng, ECE PhD
- Jihwan Seol, ECE PhD (co-advised)
- Li Xu, ECE PhD
- Heejin Yang, ECE PhD
- Qirui Zhang, ECE PhD

Terry, Fred

Website: https://terry.engin.umich.edu/

Research Interests: Electronic properties of materials and their effects on devices; physics of solid state devices.

Recent Publications

- Martinez RA, Guo K, Terry FL, Zhai T, Islam MN, Ifarraguerri AI, "Long-wave infrared scattering spectra and modeling of trace particles on surfaces for standoff detection," Journal of Applied Physics, 6/28/2020, https://doi.org/10.1063/5.0009463
- Martinez RA, Guo K, Terry FL, Zhai T, Islam MN, Ifarraguerri AI, "Scattering spectra from trace particles actively illuminated by a mid-infrared supercontinuum FTIR sensor," Progress in Biomedical Optics and Imaging - Proceedings of SPIE, 1/1/2020, https://doi.org/10.1117/12.2550334
- Guo K, Zhai T, Demory B, Meah S, Martinez R, Islam MN, Terry F, Maynard R, "Stand-off non-destructive determination of protein level in wheat flour with a super-continuum laser," Progress in Biomedical Optics and Imaging - Proceedings of SPIE, 1/1/2020, https://doi.org/10.1117/12.2550400

Tsang, Leung

Website: http://web.eecs.umich.edu/~leutsang/

Research Interests: Wave propagation, random media, rough surfaces, electromagnetic theory and computational electromagnetics with applications in environmental remote sensing, signal integrity, electromagnetic compatibility, and photonic crystals.

Recent Publications

- Tsang, L., Liao, TH, and Tan, S, "Calculations of Bands and Band Field Solutions in Topological Acoustics Using the Broadband Green's Function-KKR-Multiple Scattering Method," Progress in Electromagnetic Research, Vol. 171, 137–158, 2021 https://www.jpier.org/PIER/pier171/07.21081706.pdf
- Tan S, Tsang L, Xu H, Johnson JT, Jezek KC, Yardim C, Durand M, Duan Y, "A Partially Coherent Approach for Modeling Polar Ice Sheet 0.5-2-GHz Thermal Emission," IEEE Transactions on Geoscience and Remote Sensing, 10/1/2021, https://doi.org/10.1109/TGRS.2020.3039057
- Gao R, Tsang L, Tan S, Liao TH, "Broadband Green's function-KKR-multiple scattering method for calculations of normalized band-field solutions in magneto-optics crystals," Journal of the Optical Society of America B: Optical Physics, 10/1/2021, https://doi.org/10.1364/JOSAB.422574
- Gu W, Tsang L, Colliander A, Yueh SH, "Wave propagation in vegetation field using a hybrid method," IEEE Transactions on Antennas and Propagation, 10/1/2021, https://doi.org/10.1109/TAP.2021.3069487
- Ren B, Zhu J, Bringer A, Tsang L, Johnson J, "Fine Scale Partial Coherent Model Based on lidar Elevation Measurements for GNSS-R Applications," 2021 XXXIVth General Assembly and Scientific Symposium of the International Union of Radio Science (URSI GASS), 8/28/2021, https://doi.org/10.23919/ursigass51995.2021.9560253
- Ren B, Zhu J, Tsang L, Xu H, "Analytical kirchhoff solutions (Aks) and numerical kirchhoff approach (nka) for first-principle calculations of coherent waves and incoherent waves at p band and l band in signals of opportunity (soop)," Progress in Electromagnetics Research, 8/16/2021, https://doi.org/10.2528/PIER21050607
- Siqueira P, Adam M, Kraatz S, Lagoy D, Torres MC, Tsang L, Zhu J, Derksen C, King J, "A Ku-Band Airborne InSAR for Snow Characterization at Trail Valley Creek," 2021 IEEE International Geoscience and Remote Sensing Symposium IGARSS, 7/11/2021, https://doi.org/10.1109/igarss47720.2021.9554888

- Campbell, James; Akbar, Ruzbeh; …; Ruf, Christopher; Tsang, Leung; Xu, Haokui; Zhu, Jiyue; Moghaddam, Mahta, "Intercomparison of Models for CYGNSS Delay-Doppler Maps at a Validation Site in the San Luis Valley of Colorado," 2021 IEEE International Geoscience and Remote Sensing Symposium IGARSS, 7/11/2021, https://doi.org/10.1109/igarss47720.2021.9553296
- Gu W, Tsang L, Colliander A, Yueh S, "Multi-Frequency NMM3D Simulations of Wave Propagation in Vegetation for Remote Sensing of Soil Moisture," 2021 IEEE International Geoscience and Remote Sensing Symposium IGARSS, 7/11/2021, https://doi.org/10.1109/igarss47720.2021.9553644
- Zhu J, Tsang L, Liao T-H, "Remote Sensing of Deep Snow With C Band Radar Data: Volume and Surface Scattering," 2021 IEEE International Geoscience and Remote Sensing Symposium IGARSS, 7/11/2021, https://doi.org/10.1109/igarss47720.2021.9554866
- Du Y, Yang J, Yang X, Tsang L, Chen KS, Johnson JT, Yin J, "Electromagnetic Scattering and Emission from Large Rough Surfaces with Multiple Elevations Using the MLSD-SMCG Method," IEEE Transactions on Geoscience and Remote Sensing, 7/1/2021, https://doi.org/10.1109/TGRS.2020.3016997
- Zhu J, Tan S, Tsang L, Kang DH, Kim E, "Snow Water Equivalent Retrieval Using Active and Passive Microwave Observations," Water Resources Research, 7/1/2021, https://doi.org/10.1029/2020WR027563
- Xu H, Zhu J, Tsang L, Kim SB, "A fine scale partially coherent patch model including topographical effects for gnss-r ddm simulations," Progress in Electromagnetics Research, 1/1/2021, https://doi.org/10.2528/PIER20121201
- Yardim, C; Johnson, J; Jezek, K; Andrews, M; Durand, M; Duan, Y; Tan, S; Tsang, L; Brogioni, M; Macelloni, G; Bringer, A, "Greenland Ice Sheet Subsurface Temperature Estimation Using Ultrawideband Microwave Radiometry," IEEE Transactions on Geoscience and Remote Sensing, 1/1/2021, https://doi.org/10.1109/TGRS.2020.3043954
- Huang H, Liao TH, Kim SB, Xu X, Tsang L, Jackson TJ, Yueh SH, "L-band radar scattering and soil moisture retrieval of wheat, canola and pasture fields for SMAP active algorithms," Progress in Electromagnetics Research, 1/1/2021, https://doi.org/10.2528/PIER21020702
- Johnson, J; Jezek, K; MacElloni, G; Brogioni, M; Tsang, L; Dinnat, E; Walker, J; Ye, N; Misra, S; Piepmeier, J; Bindlish, R; Levine, D; O'Neill, P; Kaleschke, L; Andrews, M; Yardim, C; Aksoy, M; Durand, M; Chen, C; Demir, O; Bringer, A; Miller, J; Brown, S; Kwok, R; Lee, T; Kerr, Y; Entekhabi, D; Peng, J; Colliander, A; Chan, S; MacGregor, J; Medley, B; Deroo, R; Drinkwater, M, "Microwave Radiometry at Frequencies from 500 to 1400 MHz: An Emerging Technology for Earth Observations," IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 1/1/2021, https://doi.org/10.1109/JSTARS.2021.3073286

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- Feng Z, Tan S, Li E, Tsang L, "Spurious Mode Free Broadband Green's Function Technique for Periodic Scatterers Using the Combined Field Integral Equation Formulation," 2020 IEEE MTT-S International Conference on Numerical Electromagnetic and Multiphysics Modeling and Optimization, NEMO 2020, 12/7/2020, https://doi.org/10.1109/NEMO49486.2020.9343640
- Gao R, Tsang L, Tan S, Liao TH, "Band calculations using broadband Greens functions and the KKR method with applications to magneto-optics and photonic crystals," Journal of the Optical Society of America B: Optical Physics, 12/1/2020, https://doi.org/10.1364/JOSAB.400824
- Liao TH, Tsang L, Kwek W, "Broadband Green's Function (BBGFL) Method with Imaginary Wavenumber Extractions for Simulations of Radiated Emissions from Irregular Shaped Printed Circuit Board," IEEE Transactions on Electromagnetic Compatibility, 10/1/2020, https://doi.org/10.1109/TEMC.2019.2939136
- Du Y, Tsang L, Yang J, Yin J, "A MLSD-SMCG METHOD for SCATTERING and EMISSION from OCEAN-SURFACES with FULL OCEAN SPECTRUM and LARGE RMS HEIGHTS," International Geoscience and Remote Sensing Symposium (IGARSS), 9/26/2020, https://doi.org/10.1109/IGARSS39084.2020.9323559
- Xu H, Zhu J, Tsang L, Kim SB, Nghiem SV, "A PHYSICAL PATCH MODEL for GNSS-R LAND APPLICATIONS with TOPOGRAPHY EFFECTS and DDM SIMULATIONS," International Geoscience and Remote Sensing Symposium (IGARSS), 9/26/2020, https://doi.org/10.1109/IGARSS39084.2020.9323570
- Gu W, Tsang L, Colliander A, Yueh S, "Full-Wave Simulations of Scattering in Vegetation for Microwave Remote Sensing of Soil Moisture," International Geoscience and Remote Sensing Symposium (IGARSS), 9/26/2020, https://doi.org/10.1109/IGARSS39084.2020.9324602
- Xu X, Shen H, Xu H, Tsang L, "Modeling Multi-Frequency Tomograms for Snow Stratigraphy," International Geoscience and Remote Sensing Symposium (IGARSS), 9/26/2020, https://doi.org/10.1109/IGARSS39084.2020.9324184
- Zhu J, Tsang L, Shen H, Xu X, "Snow Size Distribution and Aggregation Modeling Based on the Bicontinuous Model," International Geoscience and Remote Sensing Symposium (IGARSS), 9/26/2020, https://doi.org/10.1109/IGARSS39084.2020.9323210
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- Fujii H, Tsang L, Jiyue ZHU, Nomura K, Kobayashi K, Watanabe M, "Photon transport model for dense polydisperse colloidal suspensions using the radiative transfer equation combined with the dependent scattering theory," Optics Express, 7/20/2020, https://doi.org/10.1364/OE.398582
- Xu H, Tsang L, "A Physical Patch Model with Topography Effects for GNSS-R Land Applications and DDM Dimulations," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9329590
- Zhu J, Tsang L, "Modeling of Volume Scattering in Bicontinuous Random Medium for Remote Sensing of Terrestrial Snow from 4 to 18 GHz," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9330284
- Sanamzadeh M, Tsang L, "Vector Potential Dyadic Green's Function and Normal Modes in Cavity of Arbitrary Shape," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9330489
- Gu W, Tsang L, "Vegetation Effects for Remote Sensing of Soil Moisture Using NMM3D Full-wave Simulation," 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, IEEECONF 2020 - Proceedings, 7/5/2020, https://doi.org/10.1109/IEEECONF35879.2020.9329807
- Du Y, Tsang L, "Accurate Calculations of Emissivities of Polar Ocean Surfaces between 0.5 and 2 GHz Using an NIBC/Nystrom/SMCG Method," IEEE Transactions on Geoscience and Remote Sensing, 4/1/2020, https://doi.org/10.1109/TGRS.2019.2954886
- Sanamzadeh M, Tsang L, Johnson J, "Scattering and Emission of Electromagnetic Waves from Random Layered Media with Random Rough Interfaces: A Partially Coherent Cascading Approach," IEEE Transactions on Antennas and Propagation, 4/1/2020, https://doi.org/10.1109/TAP.2019.2957295
- Sanamzadeh M, Tsang L, "Fast and broadband computation of the Green's function in a cavity resonator of irregular shape using an imaginary wave number extraction technique," Journal of the Optical Society of America A: Optics and Image Science, and Vision, 3/1/2020, https://doi.org/10.1364/JOSAA.378022
- Xu H, Tsang L, Johnson JT, Jezek KC, Yan SJ, Gogineni P, "A combined active and passive method for the remote sensing of ice sheet temperature profiles," Progress in Electromagnetics Research, 1/1/2020, https://doi.org/10.2528/PIER20030601

- Huang H, Tsang L, Colliander A, Shah R, Xu X, Yueh S, "Multiple scattering of waves by complex objects using hybrid method of t-matrix and foldy-lax equations using vector spherical waves and vector spheroidal waves," Progress in Electromagnetics Research, 1/1/2020, https://doi.org/10.2528/PIER20080409

Recent U.S Patents

- Tsang, L. and S. Tan, "Full wave simulations of photonic crystals and metamaterials using the Broadband Green's functions," US patent number 11,087,043, August 10, 2021.

Current Graduate Students Advised

- Firoz Kanti Borah, ECE PhD
- Ruoxing Gao, ECE PhD
- Weihui Gu, ECE PhD
- Jongwoo Jeong, ECE PhD
- Haokui Xu, ECE PhD
- Jiyue Zhu, EE PhD

Wakefield, Greg

Website: http://www.eecs.umich.edu/eecs/etc/fac/ECEfaculty.html?uniqname=ghw

Research Interests: Audio and music processing, psychoacoustics, and sound quality engineering

Wentzloff, David

Website: https://wentzloff.engin.umich.edu/

Research Interests: RF circuits and systems; highly integrated energy- and volume-constrained wireless systems.

Recent Publications

- Moosavifar M, Wentzloff D, "A High-Efficiency Lens-Coupled 60GHz On-Chip Antenna Module for Millimeter-Scale Wireless Transmitters," 2021 International Conference on Electromagnetics in Advanced Applications, ICEAA 2021, 8/9/2021, https://doi.org/10.1109/ICEAA52647.2021.9539568
- Chen X, Alghaihab A, Shi Y, Truesdell DS, Calhoun BH, Wentzloff DD, "A Crystal-Less BLE Transmitter with Clock Recovery from GFSK-Modulated BLE Packets," IEEE Journal of Solid-State Circuits, 7/1/2021, https://doi.org/10.1109/JSSC.2020.3046610
- Abdelatty O, Alghaihab A, Cherivirala YK, Kamineni S, Calhoun B, Wentzloff DD, "A $300mu mathrm{W}$ Bluetooth-Low-Energy Backchannel Receiver Employing a Discrete-Time Differentiator-Based Coherent GFSK Demodulation," Digest of Papers - IEEE Radio Frequency Integrated Circuits Symposium, 6/7/2021, https://doi.org/10.1109/RFIC51843.2021.9490429
- Odelberg TJ, Im J, Wentzloff DD, "A 2.1mW -109dBm NB-IoT Wake-Up Receiver," Digest of Papers - IEEE Radio Frequency Integrated Circuits Symposium, 6/7/2021, https://doi.org/10.1109/RFIC51843.2021.9490494
- Abdelatty O, Chen X, Alghaihab A, Wentzloff D, "Bluetooth communication leveraging ultra-low power radio design," Journal of Sensor and Actuator Networks, 6/1/2021, https://doi.org/10.3390/jsan10020031
- Huang KK, Brown JK, Collins N, Sawyer RK, Yahya FB, Wang A, Roberts NE, Calhoun BH, Wentzloff DD, "A Fully Integrated 2.7W -70.2dBm-Sensitivity Wake-Up Receiver with Charge-Domain Analog Front-End, -16.5dB-SIR, FEC and Cryptographic Checksum," Digest of Technical Papers - IEEE International Solid-State Circuits Conference, 2/13/2021, https://doi.org/10.1109/ISSCC42613.2021.9365806
- Im J, Kim H, Abdelatty O, Wentzloff DD, "A Fully Integrated 62-to-69GHz Crystal-Less Transceiver with 12 Channels Tuned by a Transmission-Line- Referenced FLL in 0.13m BiCMOS," Digest of Technical Papers - IEEE International Solid-State Circuits Conference, 2/13/2021, https://doi.org/10.1109/ISSCC42613.2021.9365827

- Moosavifar M, Wentzloff D, "Analysis of Design Trade-Offs in Ultra-Low-Power FSK Receivers for Phase-Based Ranging," 2021 IEEE Topical Conference on Wireless Sensors and Sensor Networks, WiSNeT 2021, 1/17/2021, https://doi.org/10.1109/WiSNeT51848.2021.9413789
- Chen X, Wentzloff DD, "Design Considerations of Frequency Modulated Ultralow Power Transmitter," chapter in Handbook of Biochips, 1/1/2021, https://doi.org/10.1007/978-1-4614-6623-9_59-1
- Ajayi T, Kamineni S, Fayazi M, Cherivirala YK, Kwon K, Gupta S, Duan W, Lee J, Chen CH, Saligane M, Sylvester D, Blaauw D, Dreslinski R, Calhoun B, Wentzloff D, "Fully-Autonomous SoC Synthesis Using Customizable Cell-Based Analog and Mixed-Signal Circuits Generation," chapter in IFIP Advances in Information and Communication Technology, 1/1/2021, https://doi.org/10.1007/978-3-030-81641-4_4
- Jinia AJ, Maurer TE, Meert CA, Hua MY, Clarke SD, Kim HS, Wentzloff DD, Pozzi SA, "An Artificial Neural Network System for Photon-Based Active Interrogation Applications," IEEE Access, 1/1/2021, https://doi.org/10.1109/ACCESS.2021.3108406
- Wentzloff DD, Alghaihab A, Im J, Abdelatty O, Odelberg T, "Ultralow-Power Receivers: Overcoming Battery Limitations to Facilitate Self-Powered Operation," IEEE Solid-State Circuits Magazine, 1/1/2021, https://doi.org/10.1109/mssc.2021.3088967
- Moosavifar M, Wentzloff D, "A high gain lens-coupled on-chip antenna module for miniature-sized millimeter-wave wireless transceivers," Applied Computational Electromagnetics Society Journal, 11/1/2020, https://doi.org/10.47037/2020.ACES.J.351159
- Jinia AJ, Laferty KE, Clarke SD, Kim H-S, Wentzloff DD, Pozzi SA, "Development of an Artificial Neural Network for Special Nuclear Material Detection in a Mixed Photon-Neutron Environment," 2020 IEEE Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC), 10/31/2020, https://doi.org/10.1109/nss/mic42677.2020.9507886
- Ajayi T, Kamineni S, Cherivirala YK, Fayazi M, Kwon K, Saligane M, Gupta S, Chen CH, Sylvester D, Blaauw D, Dreslinski R, Calhoun B, Wentzloff D, "An Open-source Framework for Autonomous SoC Design with Analog Block Generation," IEEE/IFIP International Conference on VLSI and System-on-Chip, VLSI-SoC, 10/5/2020, https://ieeexplore.ieee.org/document/9344104
- Moosavifar M, Wentzloff D, "A High Gain Lens-Coupled On-Chip Antenna Module for Miniature-Sized Millimeter-Wave Wireless Transceivers," 2020 International Applied Computational Electromagnetics Society Symposium, ACES-Monterey 2020, 7/1/2020, https://doi.org/10.23919/ACES49320.2020.9196186
- Chuo, L; Feng, Z; Kim, Y; Chiotellis, N; Yasuda, M; Miyoshi, S; Kawaminami, M; Grbic, A; Wentzloff, D; Blaauw, D; Kim, H, "Millimeter-Scale Node-to-Node Radio Using a Carrier Frequency-Interlocking if Receiver for a Fully Integrated 4 Wireless Sensor Node," IEEE Journal of Solid-State Circuits, 5/1/2020, https://doi.org/10.1109/JSSC.2019.2959505

- Brown JK, Abdallah D, Boley J, Collins N, Craig K, Glennon G, Huang KK, Lukas CJ, Moore W, Sawyer RK, Shakhsheer, Y, Yahya F, Wang A, Roberts N, Wentzloff D, Calhoun B, "A 65nm Energy-Harvesting ULP SoC with 256kB Cortex-M0 Enabling an 89.1W Continuous Machine Health Monitoring Wireless Self-Powered System," Digest of Technical Papers - IEEE International Solid-State Circuits Conference, 2/1/2020, https://doi.org/10.1109/ISSCC19947.2020.9063067
- Alghaihab A, Chen X, Shi Y, Truesdell DS, Calhoun BH, Wentzloff DD, "A Crystal-Less BLE Transmitter with -86dBm Freq ency-Hopping Back-Channel WRX and Over-the-Air Clock Recovery from a GFSK-Modulated BLE Packet," Digest of Technical Papers - IEEE International Solid-State Circuits Conference, 2/1/2020, https://doi.org/10.1109/ISSCC19947.2020.9062935

Recent U.S. Patents

- "Systems And Methods For A Crystal-Less Bluetooth Low Energy Transceiver," Patent number 10,992,503, issued on April 27, 2021
- "Millimeter-Scale Bluetooth Low Energy Transmitter With Dual Purpose Loop Antenna," Patent number 10,911,078, issued on February 2, 2021
- "Ring oscillator based all-digital Bluetooth low energy transmitter," Patent number 10,567,154 on February 18, 2020
- "Millimeter-Scale Bluetooth Low Energy Transmitter With Dual Purpose Loop Antenna," Patent number 10,911,078, February 2, 2021
- "Low-Power Receiver for FSK Back-Channel Embedded in 5.8 GZ WI-FI OFDM Packets," Patent number 10541843, January 21, 2020

Current Graduate Students Advised

- Mohammed Abdelhafez, ECE PhD
- Li-Yu Chen, ECE PhD
- Yaswanth Kumar Cherivirala, ECE PhD
- Aman Gupta, ECE PhD
- Kyumin Kwon, ECE PhD
- Noah Michels, ECE PhD
- Seyed Milad Moosavifar, ECE PhD
- Trevor Odelberg, ECE PhD, Science, Tech & Pub Policy Cert
- Siyu Wang, ECE PhD

- Zhenqing Wang, ECE PhD
- Christine Weston, ECE PhD (co-advised)

Willingale, Louise

Website: https://willingale.engin.umich.edu/

Research Interests: Laser-driven electron and ion acceleration, relativistic laser propagation through underdense and near-critical density plasmas, laser-driven magnetic reconnection, and proton radiography to study electric and magnetic fields generated during the laser-plasma interactions.

Recent Publications

- Tubman, E; Joglekar,...; Thomas, A; Treadwell, P; Wilson, S; Willingale, L; Woolsey, N, "Observations of pressure anisotropy effects within semi-collisional magnetized plasma bubbles," Nature Communications, 12/1/2021, https://doi.org/10.1038/s41467-020-20387-7
- Shi T, Sun D, Jovanovic I, Kalinchenko G, Krushelnick K, Kuranz CC, Maksimchuk A, Nees J, Thomas AGR, Willingale L, "Optimization of the electron beam dump for a GeV-class laser electron accelerator," Applied Radiation and Isotopes, 10/1/2021, https://doi.org/10.1016/j.apradiso.2021.109853
- von der Linden J, Fiksel G, Peebles J, Edwards MR, Willingale L, Link A, Mastrosimone D, Chen H, "Confinement of relativistic electrons in a magnetic mirror en route to a magnetized relativistic pair plasma," Physics of Plasmas, 9/1/2021, https://doi.org/10.1063/5.0057582
- Russell BK, Campbell PT, R Thomas AG, Willingale L, "Multiple species laser-driven ion-shock acceleration," Plasma Physics and Controlled Fusion, 9/1/2021, https://doi.org/10.1088/1361-6587/ac1569
- Yeh IL, Tangtartharakul K, Rinderknecht HG, Willingale L, Arefiev A, "Strong interplay between superluminosity and radiation friction during direct laser acceleration," New Journal of Physics, 9/1/2021, https://doi.org/10.1088/1367-2630/ac2394
- Peebles JL, Fiksel G, Edwards MR, Von Der Linden J, Willingale L, Mastrosimone D, Chen H, "Magnetically collimated relativistic charge-neutral electron-positron beams from high-power lasers," Physics of Plasmas, 7/1/2021, https://doi.org/10.1063/5.0053557
- Von Der Linden J, Ramos-Mendez J, Faddegon B, Massin D, Fiksel G, Holder JP, Willingale L, Peebles J, Edwards MR, Chen H, "Dispersion calibration for the National Ignition Facility electron-positron-proton spectrometers for intense laser matter interactions," Review of Scientific Instruments, 3/1/2021, https://doi.org/10.1063/5.0040624
- Hussein, A; Arefiev, A; Batson, T; Chen, H; Craxton, R; Davies, A; Froula, D; Gong, Z; Haberberger, D; Ma, Y; Nilson, P; Theobald, W; Wang, T; Weichman, K; Williams, G;

Willingale, L, "Towards the optimisation of direct laser acceleration," New Journal of Physics, 2/1/2021, https://doi.org/10.1088/1367-2630/abdf9a

- Kim, J; Link, A; Canning, D; Fitzsimmons, P; Fooks, J; Kerr, S; Ma, T; Manuel, M; Mariscal, D; Wallace, R; Williams, G; Willingale, L; Beg, F; Chen, H, "Dynamic focusing of laser driven positron jets by self-generated fields," New Journal of Physics, 12/1/2020, https://doi.org/10.1088/1367-2630/abcc1f
- Tang H, Russell BK, Maksimchuk A, Campbell PT, Manuel MJE, Willingale L, "Scintillator detector characterization for laser-driven proton beam imaging," Review of Scientific Instruments, 12/1/2020, https://doi.org/10.1063/5.0022166
- Manuel, M; Tang, H; Russell, B; Willingale, L; Maksimchuk, A; Green, J; Alfonso, E; Jaquez, J; Carlson, L; Neely, D; Ma, T, "Enhanced spatial resolution of Eljen-204 plastic scintillators for use in rep-rated proton diagnostics," Review of Scientific Instruments, 10/1/2020, https://doi.org/10.1063/5.0014949
- Campbell PT, Walsh CA, Russell BK, Chittenden JP, Crilly A, Fiksel G, Nilson PM, Thomas AGR, Krushelnick K, Willingale L, "Magnetic Signatures of Radiation-Driven Double Ablation Fronts," Physical Review Letters, 9/28/2020, https://doi.org/10.1103/PhysRevLett.125.145001
- Williams, G; Link, A; Sherlock, M; Alessi, D; Bowers, M; Conder, A; Di Nicola, P; Fiksel, G; Fiuza, F; Hamamoto, M; Hermann, M; Herriot, S; Homoelle, D; Hsing, W; D'humieres, E; Kalantar, D; Kemp, A; Kerr, S; Kim, J; Lafortune, K; Lawson, J; Lowe-Webb, R; Ma, T; Mariscal, D; Martinez, D; Manuel, M; Nakai, M; Pelz, L; Prantil, M; Remington, B; Sigurdsson, R; Widmayer, C; Williams, W; Willingale, L; Zacharias, R; Youngblood, K; Chen, H, "Production of relativistic electrons at subrelativistic laser intensities," Physical Review E, 3/1/2020, https://doi.org/10.1103/PhysRevE.101.031201
- Nees, J; Maksimchuk, A; Kalinchenko, G; Hou, B; Ma, Y; Campbell, P; McKelvey, A; Willingale, L; Jovanovic, I; Kuranz, C; Thomas, A; Krushelnick, K, "ZEUS: A national science foundation mid-scale facility for laser-driven science in the QED regime," Optics InfoBase Conference Papers, 1/1/2020, https://doi.org/10.1364/CLEO_AT.2020.JW2B.9
- Stoneking MR, Pedersen TS, Helander P, Chen H, Hergenhahn U, Stenson EV, Fiksel G, Von Der Linden J, Saitoh H, Surko CM, Danielson J, Hugenschmidt C, Horn-Stanja J, Mishchenko A, Kennedy D, Deller A, Card A, Nisl S, Singer M, Singer M, Konig S, Willingale L, Peebles J, Edwards MR, Chin K, "A new frontier in laboratory physics: Magnetized electron-positron plasmas," Journal of Plasma Physics, 1/1/2020, https://doi.org/10.1017/S0022377820001385

Current Graduate Students Advised

- Brandon Russell, ECE PhD, Plasma Science & Engin Cert
- Brendan Stassel, Applied Physics PhD
- Hongmei Tang, ECE PhD

Winful, Herbert

Website: https://winful.engin.umich.edu/

Research Interests: Nonlinear optics and photonics; fiber laser arrays; nonlinear periodic structures; tunneling time; nanophotonics; semiconductor laser frequency combs.

Recent Publications

- Lee KF, Zhou G, Yun Y, Jiang J, Winful HG, Fermann ME, "Surpassing soliton compression limits in anomalous dispersion high-power erbium fiber comb," Optica, 6/1/2021, https://doi.org/10.1364/OPTICA.427977
- Lee KF, Zhou G, Winful HG, Jiang J, Fermann ME, "Megawatt single mode femtosecond erbium fiber laser," Proceedings of SPIE - The International Society for Optical Engineering, 1/1/2021, https://doi.org/10.1117/12.2577649
- Day MW, Dong M, Smith BC, Owen RC, Kerber GC, Ma T, Winful HG, Cundiff ST, "Simple single-section diode frequency combs," APL Photonics, 12/1/2020, https://doi.org/10.1063/5.0033211
- Dong M, Day MW, Winful HG, Cundiff ST, "Quantum-well laser diodes for frequency comb spectroscopy," Optics Express, 7/20/2020, https://doi.org/10.1364/OE.396899
- Sun C, Dong M, Mangan NM, Winful HG, Cundiff ST, Nathan Kutz J, "Frequency Comb Generation at 800 nm in Waveguide Array Quantum Well Diode Lasers," IEEE Journal of Quantum Electronics, 2/1/2020, https://doi.org/10.1109/JQE.2019.2960133

Ying, Lei

Website: https://leiying.engin.umich.edu/

Research Interests: Interplay of complex stochastic systems and big-data, including large-scale communication/computing systems for big-data processing, private data marketplaces, and large-scale graph mining

Recent Publications

- Liu Y, Liu X, Ying L, Srikant R, "Wireless scheduling with deadline and power constraints," Performance Evaluation, 3/1/2021, https://doi.org/10.1016/j.peva.2020.102166
- Wang Y, Zhou C, Ying L, Chan HP, Hadjiiski LM, Chughtai A, Kazerooni EA, "Reinforced learning from serial CT to improve the early diagnosis of lung cancer in screening," Progress in Biomedical Optics and Imaging - Proceedings of SPIE, 1/1/2021, https://doi.org/10.1117/12.2582232
- Liu X, Gong K, Ying L, "Steady-state analysis of load balancing with Coxian-2 distributed service times," Naval Research Logistics, 1/1/2021, https://doi.org/10.1002/nav.21986
- Narasimha D, Shakkottai S, Ying L, "A mean field game analysis of distributed MAC in ultra-dense multichannel wireless networks," IEEE/ACM Transactions on Networking, 10/1/2020, https://doi.org/10.1109/TNET.2020.3002912
- Lin S, Zhang J, Ying L, "Crowdsensing for Spectrum Discovery: A Waze-Inspired Design via Smartphone Sensing," IEEE/ACM Transactions on Networking, 4/1/2020, https://doi.org/10.1109/TNET.2020.2976927
- Jiang P, Ying L, "An Optimal Stopping Approach for Iterative Training in Federated Learning," 2020 54th Annual Conference on Information Sciences and Systems, CISS 2020, 3/1/2020, https://doi.org/10.1109/CISS48834.2020.1570616094
- Wang W, Ying L, "Learning Parallel Markov Chains over Unreliable Wireless Channels," 2020 54th Annual Conference on Information Sciences and Systems, CISS 2020, 3/1/2020, https://doi.org/10.1109/CISS48834.2020.1570614323
- Hu J, Yang X, Wang W, Wei P, Ying L, Liu Y, "Uas conflict resolution in continuous action space using deep reinforcement learning," AIAA AVIATION 2020 FORUM, 1/1/2020, https://doi.org/10.2514/6.2020-2909
- Zhao P, Wang W, Ying L, Sridhar B, Liu Y, "Online multiple-aircraft col lision avoidance method," Journal of Guidance, Control, and Dynamics, 1/1/2020, https://doi.org/10.2514/1.G005161

Current Graduate Students Advised

- Drew Hanover, ECE PhD, Robotics MS (co-advised)
- Yifan Wang, ECE PhD (co-advised)
- Honghao Wei, ECE PhD
- Zixian Yang, ECE PhD
- Qining Zhang, ECE PhD

Yoon, Euisik

Website: http://yoon.eecs.umich.edu/

Research Interests: Integrated circuits and microsystems; BioMEMS and lab-on-chips; implantable biomedical sensors; low-power mixed-mode circuits.

Recent Publications

- Voroslakos M, Miyawaki H, Royer S, Diba K, Yoon E, Petersen PC, Buzsaki G, "3d-printed recoverable microdrive and base plate system for rodent electrophysiology," Bio-protocol, 8/20/2021, https://doi.org/10.21769/BioProtoc.4137
- Sperry ZJ, Na K, Jun J, Madden LR, Socha A, Yoon E, Seymour JP, Bruns TM, "High-density neural recordings from feline sacral dorsal root ganglia with thin-film array," Journal of Neural Engineering, 8/1/2021, https://doi.org/10.1088/1741-2552/abe398
- Song H, Oh S, Salinas J, Park SY, Yoon E, "A 5.1ms Low-Latency Face Detection Imager with In-Memory Charge-Domain Computing of Machine-Learning Classifiers," IEEE Symposium on VLSI Circuits, Digest of Technical Papers, 6/13/2021, https://doi.org/10.23919/VLSICircuits52068.2021.9492432
- McKenzie S, Huszar R, English DF, Kim K, Christensen F, Yoon E, Buzsaki G, "Preexisting hippocampal network dynamics constrain optogenetically induced place fields," Neuron, 3/17/2021, https://doi.org/10.1016/j.neuron.2021.01.011
- Kim K, Wu F, Kampasi K, Seymour JP, Wise KD, Yoon E, "High-Density Fiberless Optoelectrodes with Integrated Waveguides and LEDs," chapter in Handbook of Neuroengineering, 1/1/2021, https://doi.org/10.1007/978-981-15-2848-4_22-2
- Park SY, Kyounghwan N, Voroslakos M, Song H, Slager N, Oh S, Seymour JP, Buzsaki G, Yoon E, "A Miniaturized 256-Channel Neural Recording Interface with Area-Efficient Hybrid Integration of Flexible Probes and CMOS Integrated Circuits," IEEE Transactions on Biomedical Engineering, 1/1/2021, https://doi.org/10.1109/TBME.2021.3093542
- Kim K, Wu F, Wise KD, Yoon E, "GaN-on-silicon MicroLEDs for neural interfaces," Semiconductors and Semimetals, 1/1/2021, https://doi.org/10.1016/bs.semsem.2021.01.002
- Kim K, Voroslakos M, Seymour JP, Wise KD, Buzsaki G, Yoon E, "Artifact-free and high-temporal-resolution in vivo opto-electrophysiology with microLED optoelectrodes," Nature Communications, 12/1/2020, https://doi.org/10.1038/s41467-020-15769-w

- Na K, Sperry ZJ, Lu J, Voroslakos M, Parizi SS, Bruns TM, Yoon E, Seymour JP, "Novel diamond shuttle to deliver flexible neural probe with reduced tissue compression," Microsystems and Nanoengineering, 12/1/2020, https://doi.org/10.1038/s41378-020-0149-z
- Lee SY, Pakela JM, Na K, Shi J, McKenna BJ, Simeone DM, Yoon E, Scheiman JM, Mycek MA, "Needle-compatible miniaturized optoelectronic sensor for pancreatic cancer detection," Science Advances, 11/20/2020, https://doi.org/10.1126/sciadv.abc1746
- Park, S; Namkoong, S; Friesen, L; Cho, C; Zhang, Z; Chen, Y; Yoon, E; Kim, C; Kwak, H; Kang, H; Lee, J, "Single-Cell Transcriptome Analysis of Colon Cancer Cell Response to 5-Fluorouracil-Induced DNA Damage," Cell Reports, 8/25/2020, https://doi.org/10.1016/j.celrep.2020.108077
- Sperry Z, Na K, Jun J, Madden L, Socha A, Yoon E, Seymour J, Bruns T, "High-density Neural Recordings from Feline Sacral Dorsal Root Ganglia with Thin-film Array," bioRxiv, 7/15/2020, https://doi.org/10.1101/2020.07.14.199653
- Humphries, B; Cutter, A; Buschhaus, J; Chen, Y; Chen, Y; Chen, Y; Qyli, T; Palagama, D; Eckley, S; Robison, T; Bevoor, A; Chiang, B; Haley, H; Sahoo, S; Spinosa, P; Neale, D; Boppisetti, J; Sahoo, D; Ghosh, P; Lahann, J; Ross, B; Ross, B; Yoon, E; Yoon, E; Luker, K; Luker, G, "Enhanced mitochondrial fission suppresses signaling and metastasis in triple-negative breast cancer," Breast Cancer Research, 6/5/2020, https://doi.org/10.1186/s13058-020-01301-x
- Chen YC, Chen YC, Zhang Z, Yoon E, "Early Prediction of Single-Cell Derived Sphere Formation Rate Using Convolutional Neural Network Image Analysis," Analytical Chemistry, 6/2/2020, https://doi.org/10.1021/acs.analchem.0c00710
- Cole AJ, Iyengar M, Panesso-Gomez S, O'Hayer P, Chan D, Delgoffe GM, Aird KM, Yoon E, Bai S, Buckanovich RJ, "NFATC4 promotes quiescence and chemotherapy resistance in ovarian cancer," JCI Insight, 3/17/2020, https://doi.org/10.1172/JCI.INSIGHT.131486
- Chen Y-C, Jung S, Choi Y, Yoon E, "Single-Cell Transcriptome Sequencing Using Microfluidics," chapter in Handbook of Single Cell Technologies, 1/1/2020, https://doi.org/10.1007/978-981-10-4857-9_42-1

Recent U.S. Patents

- Multicolor Neural Optoelectrode, #10695581, 2020
- Pixel circuit and method for optical sensing, #10976257, 2021
- System for analyzing tissue, #11076784, 2021

Current Graduate Students Advised

- Jeongtaek Chang, ECE PhD

- Lawrence Chen, ME PhD
- Yehyun Choi, ECE PhD
- Meng-Lin Hsieh, ECE PhD
- Eunah Ko, ECE PhD
- Sungjin Oh, ECE PhD
- Hyunsoo Song, ECE PhD
- Yi Tian, BME PhD
- Dongxiao Yan, ECE PhD

Zhang, Pei

Website: https://peizhang.engin.umich.edu/

Research Interests: Pei's research interest surrounds "Structures as Sensors", which utilizes the physical properties of devices and structures (e.g. cars, buildings, rooms) as a sensor to discover physical information that surrounds them (e.g. people, roads, animals). As part of this, his work focuses on combining machine learning-based data models, physics models, as well as heuristic models to improve the understanding of the physical systems. His approach is applied to many fields including medicine, eldercare, farming, smart buildings.

Recent Publications

- Codling JR, Bonde A, Dong Y, Cao S, Sangpetch A, Sangpetch O, Noh HY, Zhang P, "MassHog: Weight-Sensitive Occupant Monitoring for Pig Pens using Actuated Structural Vibrations," UbiComp/ISWC 2021 - Adjunct Proceedings of the 2021 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2021 ACM International Symposium on Wearable Computers, 9/21/2021, https://doi.org/10.1145/3460418.3480414
- Falcao JD, Baweja PSS, Wang Y, Sangpetch A, Noh HY, Sangpetch O, Zhang P, "PIWIMS: Physics Informed Warehouse Inventory Monitory via Synthetic Data Generation," UbiComp/ISWC 2021 - Adjunct Proceedings of the 2021 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2021 ACM International Symposium on Wearable Computers, 9/21/2021, https://doi.org/10.1145/3460418.3480415
- Falcão JD, Ruiz C, Bannis A, Noh HY, Zhang P, "ISACS: In-Store Autonomous Checkout System for Retail," Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies, 9/1/2021, https://doi.org/10.1145/3478086
- Li K, Lu N, Zheng J, Zhang P, Ni W, Tovar E, "A Practical Secret Key Management for Multihop Drone Relay Systems based on Bluetooth Low Energy," Annual IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks workshops, 7/6/2021, https://doi.org/10.1109/SECON52354.2021.9491599
- Li K, Lu N, Zheng J, Zhang P, Ni W, Tovar E, "BloothAir: A Secure Aerial Relay System Using Bluetooth Connected Autonomous Drones," ACM Transactions on Cyber-Physical Systems, 7/1/2021, https://doi.org/10.1145/3448254
- Bonde, A; Codling, J; Naruethep, K; Dong, Y; Siripaktanakon, W; Ariyadech, S; Sangpetch, A; Sangpetch, O; Pan, S; Noh, H; Zhang, P, "PigNet: Failure-tolerant pig activity

monitoring system using structural vibration," Proceedings of the 20th International Conference on Information Processing in Sensor Networks, IPSN 2021 (co-located with CPS-IoT Week 2021), 5/18/2021, https://doi.org/10.1145/3412382.3458902

- Dong Y, Fagert J, Zhang P, Noh HY, "Poster Abstract: Non-parametric bayesian learning for newcomer detection using footstep-induced floor vibration," Proceedings of the 20th International Conference on Information Processing in Sensor Networks, IPSN 2021 (co-located with CPS-IoT Week 2021), 5/18/2021, https://doi.org/10.1145/3412382.3458785
- Mirshekari M, Fagert J, Pan S, Zhang P, Noh HY, "Obstruction-invariant occupant localization using footstep-induced structural vibrations," Mechanical Systems and Signal Processing, 5/15/2021, https://doi.org/10.1016/j.ymssp.2020.107499
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Research Interests: VLSI architecture, digital systems, implementations of communication and signal processing systems.

Recent Publications

- Cho SG, Tang W, Liu C, Zhang Z, "PETRA: A 22nm 6.97TFLOPS/W AIB-Enabled Configurable Matrix and Convolution Accelerator Integrated with an Intel Stratix 10 FPGA," IEEE Symposium on VLSI Circuits, Digest of Technical Papers, 6/13/2021, https://doi.org/10.23919/VLSICircuits52068.2021.9492517
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- Pinkham R, Zeng S, Zhang Z, "QuickNN: Memory and Performance Optimization of k-d Tree Based Nearest Neighbor Search for 3D Point Clouds," Proceedings - 2020 IEEE International Symposium on High Performance Computer Architecture, HPCA 2020, 2/1/2020, https://doi.org/10.1109/HPCA47549.2020.00024

Recent U.S. Patents

- Sparse neuromorphic processor, #11042795, 2021
- Memory processing units and methods of computing dot products, #10,998,037, 2021
- Memory processing units and methods of computing DOT products including zero bit skipping, #10853066, 2020

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- Jacob Botimer, ECE PhD
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Recent Publications

- Zhang, D; Xu, Z; Huang, Z; Gutierrez, A; Blocker, C; Liu, C; Lien, M; Cheng, G; Liu, Z; Chun, I; Fessler, J; Zhong, Z; Norris, T, "Neural network based 3D tracking with a graphene transparent focal stack imaging system," Nature Communications, 12/1/2021, https://doi.org/10.1038/s41467-021-22696-x
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Recent U.S. Patents

- Two-dimensional material based ion exchange membrane sensors, #10845324, 2020
- Uniform multilayer graphene by chemical vapor deposition, #10886126, 2020

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