

M.J. Mirshojaeian Hosseini

MECHATRONICS ENGINEER · PHD IN Neuromorphic Computing

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Summary

With over 5 years of experience, I specialize in designing, fabricating, and characterizing **flexible nanostructures** and organic neuromorphic circuits. My expertise extends to working **hands-on in iso 4 cleanrooms and fabrication labs**, utilizing a range of techniques such as e-beam and thermal **PVD, ALD, Sputtering, photolithography, CVD, profilometry**, and **wet chemical processing methods**.

My areas of expertise include nanofabrication, biosensors, lab-on-a-chip technologies, printing electronics, organic nanoelectronics, artificial intelligence, neuromorphic computing, 3D printers, microfluidics, control engineering, fault detection and identification, solid and fluid mechanics, and design.

Education

Purdue University

PH.D. IN NEUROMORPHIC COMPUTATION

[West Lafayette, IN, USA](#)

Aug 2018 - Aug 2023

- **Thesis:** An organic neural circuit: Towards flexible and biocompatible organic neuromorphic processing

K. N. Toosi University of Technology

M.SC. IN MECHATRONIC ENGINEERING

[Tehran, Iran](#)

Sep 2010 - Aug 2013

- **Thesis:** Design, Simulation and Control of an electro-hydrostatic actuator using an adaptive neuro-fuzzy PID controller

Ferdowsi University of Mashhad

B.SC. IN MECHANICAL ENGINEERING

[Mashhad, Iran](#)

Sep 2005 - Aug 2010

- **Thesis:** Analysis and examination of governing equations of DC and AC Motors

Work Experience

Purdue University

POSTDOCTORAL RESEARCHER

[West Lafayette, IN, USA](#)

Sep. 2023 - Present

- Develop a flexible neuromorphic processor using organic materials with four inputs and two outputs to control a four-wheel mobile robot.
- Design and implement a manual shadow mask aligner with 5um resolution for shadow masking organic thin films.
- Develop ultra-low voltage p-type OFETs resistant to ambient conditions over one year.

Purdue University

GRADUATE RESEARCH ASSISTANT

[West Lafayette, IN, USA](#)

Aug. 2018 - Aug. 2023

- Developed a 270 nm thin, lightweight, conformal, self-adhesive e-skin medical device recorder that adheres to human skin and measure biological signals such as ECG and EMG.
- Developed a modeling approach for analog organic circuits, enabling the simulation of complex behavior in circuits such as organic neuromorphic circuits.
- Introduced an organic electronics implementation of an Integrate-and-Fire spiking somatic circuit based on the Axon-Hillock CMOS circuit.
- Developing a modeling approach for analog organic circuits, enabling the simulation of complex behavior in circuits such as organic neuromorphic circuits.
- Demonstration of an organic differential-pair integrator (DPI) synaptic circuit implemented using physically flexible complementary organic electronics.
- Presenting a physically flexible organic log-domain integrator (LDI) synaptic circuit that utilizes electrically active organic-based materials with biocompatibility and biologically plausible time constants.
- Introduction of an organic electronics implementation of an Integrate-and-Fire spiking somatic circuit based on the Axon-Hillock CMOS circuit.

Laboratory of Organic Bio-Electronics (LOBE) at Purdue University

LAB MANAGER

[West Lafayette, IN, USA](#)

Aug. 2018 - Apr. 2024

- Responsible for maintaining the lab facilities, including sophisticated nanofabrication equipment involving PVD, CVD, RIE, sputtering systems, and characterization equipment such as semiconductor parameter analyzers and DAQs.
- Led comprehensive training programs for research scientists, students, and faculty members, ensuring their proficient use of laboratory facilities and equipment.
- Actively engaged with lab members and trainees, fostering a collaborative and inclusive atmosphere to encourage teamwork and knowledge sharing for innovative research projects.

- Led a cross-disciplinary project to implement an additive manufacturing technology for cell 3D printing.
- Played a key role in developing whole-thermoplastic microfluidic microvalves and micropumps for lab-on-chip applications.
- Conducted research on prosthetic robotic hands and fingers.

Ferdowsi University of Mashhad

- Developed a 3D-printed autonomous underwater vehicle featuring dual tilt-rotors, involving concept design, detailed design, prototype fabrication, fluid and solid finite element analysis, SolidWorks-based solid machine design, power and control electronics integration, and Python coding.
- Applied model predictive control (MPC) algorithm to control the 3D-printed autonomous underwater vehicle.
- Implemented an 80 cm × 100 cm × 50 cm FDM 3d printer to print the AUV body.

Skills

Engineering (Software)	Labview, Matlab, Simulink, Solidworks, Comsol, Simplify, S7 Lite (PLC programming), JMP
Discipline	Process engineering, Real-time data acquisition, Material science
Hands-on skills	Electronics, Solid and fluid mechanics design, 3D printing, Control engineering, Mechatronics
Physics	Manual and automated assembly systems, Testing and troubleshooting, Mechanical aptitude, Automation
Programming	Nanofabrication, Cleanroom, photolithography, Wet chemical processing, Thin-film devices
Software	Python, FORTRAN, C, LaTeX
	Adobe Illustrator, Microsoft Access, Microsoft Office.

Certifications

Siemens PLC programming using S7 lite , Airtech	Iran
Microsoft Certified Systems Administrator (MCSA) , Microsoft	USA
Microsoft Certified Systems Engineer (MCSE) , Microsoft	USA

Selected Publications

- **Mirshojaein Hosseini, M. J.**, Yang, Y., Kruger, W., Yokota, T., Lee, S., Someya, T., and Nawrocki, R. A. 270 nm, ultra-thin, self-adhesive, conformable, and long-term air-stable organic electronics biosignal amplifying circuits. *NPJ Flexible Electronics*, vol. 7, no. 1, pp. 1–12, Aug. 2023, doi: <https://doi.org/10.1038/s41528-023-00267-y>
- Yang, Y., **Mirshojaein Hosseini, M. J.**, Kruger, W., and Nawrocki, R. A. Modular modeling of analog organic neuromorphic circuits: Toward prototyping of hardware-level spiking neural networks. *IEEE Transactions on Circuits and Systems I: Regular Papers* 70, 3 (2023), 1161–1174 <https://ieeexplore.ieee.org/abstract/document/9976306>
- **Mirshojaein Hosseini, M. J.**, Yang, Y., Prendergast, A. J., Donati, E., Faezipour, M., Indiveri, G., and Nawrocki, R. A. An organic synaptic circuit: towards flexible and biocompatible organic neuromorphic processing. *Neuromorphic Computing and Engineering* 2, (2022) 034009 <https://iopscience.iop.org/article/10.1088/2634-4386/ac830c>
- **Mirshojaein Hosseini, M. J.**, Donati, E., Indiveri, G., and Nawrocki, R. A. Organic log-domain integrator synapse. *Advanced Electronic Materials* 8, 2 (2021), 2100724 <https://onlinelibrary.wiley.com/doi/abs/10.1002/aem.202100724>
- **Mirshojaein Hosseini, M. J.**, and Nawrocki, R. A. A review of the progress of thin-film transistors and their technologies for flexible electronics. *Micromachines* 12, 6 (2021), 655 <https://www.mdpi.com/2072-666X/12/6/655>
- **Mirshojaein Hosseini, M. J.**, Donati, E., Yokota, T., Lee, S., Indiveri, G., Someya, T., and Nawrocki, R. A. Organic electronics axon-hillock neuromorphic circuit: towards biologically compatible, and physically flexible, integrate-and-fire spiking neural networks. *Journal of Physics D: Applied Physics* 54, 10 (2020), 104004 <https://iopscience.iop.org/article/10.1088/1361-6463/abc585/meta>
- Banejad, A., Passandideh-Fard, M., Niknam, H., **Mirshojaein Hosseini, M. J.**, and Mousavi Shaegh, S. A. Design, fabrication and experimental characterization of whole-thermoplastic microvalves and micropumps having micromilled liquid channels of rectangular and half-elliptical cross-sections. *Sensors and Actuators A: Physical* 301 (2020), 111713 <https://www.sciencedirect.com/science/article/abs/pii/S0924424719316589>

Selected Presentation

- **Mirshojaein Hosseini, M. J.**; Yang, Y.; Prendergast, A. J.; Donati, E.; Faezipour, M.; Indiveri, G.; Nawrocki, R. A., Soft Spiking synaptic Circuits for Neural Interfaces, *MRS Spring 2022 Meeting*
- **Mirshojaein Hosseini, M. J.**; Yang, Y.; Donati, E.; Indiveri, G.; Nawrocki, R. A., Spiking Organic Electronics Synaptic Circuits, *MRS Fall 2021 Meeting*
- **Mirshojaein Hosseini, M. J.**; Donati, E.; Indiveri, G.; Nawrocki, R. A., Organic Electronics Axon-Hillock Neuromorphic Circuit: Towards Biologically Compatible, And Physically Flexible, Integrate-And-Fire Spiking Neural Networks, *MRS Fall 2020 Meeting*

Research Grant

2019-2021 **Purdue Research Foundation**, \$29,976.00

USA

Patents

2024 **Ultra-low voltage p and n-type OFETs**, USPTO

USA

2024 **Solid-state organic, flexible neuron**, USPTO

USA

2011 **DC motor parameter analyzer**, Organization for the Registration of Deeds and Property

Iran

Supervised Students

Purdue University

West Lafayette, IN, USA

SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP (SURF) PROGRAM

- **2021 - 2022** Walter Kruger; BS in EET from SoET, Purdue University.
- **Summer of 2019** Dakota Jake Warren; BS in AET from SoET, Purdue University.
- **2018-2019** Shih Hsuan (Vick) Hung; BS in EET from SoET, Purdue University.

Teaching Experience

Ferdowsi University of Mashhad

Mashhad, Iran

TEACHER ASSISTANT

2017

- Model Predictive Control

Ferdowsi University of Mashhad

Mashhad, Iran

TEACHER ASSISTANT

2015

- Adaptive Control

Khorasan Institute of Higher Education

Mashhad, Iran

INSTRUCTOR

2014

- Actuation Systems

K. N. Toosi University of Technology

Tehran, Iran

TEACHER ASSISTANT

2011

- Industrial Control

Honors & Awards

2024 **Employee Recognition Award**, for the efficiency improvement.

West Lafayette, USA

2017 **3rd Place**, for the novel design of a tilt-rotor AUV at "Iran Darya" The 3rd Maritime National Festival.

Tehran, Iran

2013 **Ranked 1st**, based on GPA among 21 M.Sc. mechatronic students of K.N. Toosi University of Technology.

Tehran, Iran