

# Yi Yang

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## RESEARCH INTERESTS

Multiphysics modeling, Flexible electronics, neuromorphic computing, spiking neural networks (SNNs), physics-informed neural networks (PINNs), applied machine learning and deep learning

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## EDUCATION

**Purdue University**, West Lafayette, IN

**Ph.D.** in Technology | School of Engineering Technology 2017 - 2021

- *Dissertation title*: Electromechanical Characterization of Organic Field-Effect Transistors with Generalized Solid-State and Fractional Drift-Diffusion Models
  - *Co-Advisors*: Dr. Haiyan (Henry) Zhang, Dr. Richard Voyles
  - *Dissertation committee*: Drs. Robert Nawrocki, Xiumin Diao, and Lizhe Tan

**University of Michigan**, Ann Arbor, MI

**M.Sc.** in Engineering | Department of Mechanical Engineering 2015 - 2017

- *Concentration*: Control theory and mechatronics

**Huazhong University of Science and Technology**, Wuhan, China

**B.Sc.** in Engineering | School of Energy and Power Engineering 2011 - 2015

- *Concentration*: Computational fluid dynamics

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## PUBLICATIONS

### Book

1. **Yang, Yi**, & Zhang, H. H. (2019). Fractional Calculus with its Applications in Engineering and Technology. In *Synthesis Lectures on Mechanical Engineering* (Vol. 3, Issue 1). Morgan & Claypool Publishers LLC

### Book Chapter

1. **Yang, Yi**, Zhang, H. H., & Voyles, R. M. (2019). Rotary inverted pendulum system tracking and stability control based on input-output feedback linearization and PSO-optimized fractional order PID controller. In *Automatic Control, Mechatronics and Industrial Engineering* (pp. 79–84). CRC Press.

### Journal Articles

1. **Yang, Yi**, Nawrocki, R., Voyles, R., & Zhang, H. H. (2021). A Fractional Drift Diffusion Model for Organic Semiconductor Devices. *Computers, Materials & Continua*, 69(1), 237–266.
2. **Yang, Yi**, Nawrocki, R. A., Voyles, R. M., & Zhang, H. H. (2021). Modeling of the electrical characteristics of an organic field effect transistor in presence of the bending effects. *Organic Electronics*, 88, 106000.
3. **Yang, Yi**, Nawrocki, R., Voyles, R., & H. Zhang, H. (2020). Modeling of an Internal Stress and Strain Distribution of an Inverted Staggered Thin-Film Transistor Based on Two-Dimensional Mass-Spring-Damper Structure. *Computer Modeling in Engineering & Sciences*, 125(2), 515–539.

4. **Yang, Yi**, Zhang, H. H., Yu, W., & Tan, L. (2020). Optimal design of discrete-time fractional-order PID controller for idle speed control of an IC engine. *International Journal of Powertrains*, 9(1–2), 79–97.
5. **Yang, Yi**, & Zhang, H. H. (2018). Stability Study of LQR and Pole-Placement Genetic Algorithm Synthesized Input-Output Feedback Linearization Controllers for a Rotary Inverted Pendulum System. *International Journal of Engineering Innovation & Research*, 7(1), 2277–5668.

#### Conference Papers

1. **Yang, Yi**, Bai, H., Nawrocki, R., Voyles, R., & Zhang, H. (2021). Fractional Drift-Diffusion Model of Organic Field Effect Transistors Including Effects of Bending Stress for Smart Materials. *Proceedings of the ASME 2021 Conference on Smart Materials, Adaptive Structures and Intelligent Systems*.
2. **Yang, Yi**, Zhang, H. H., & Voyles, R. M. (2018). Rotary inverted pendulum system tracking and stability control based on input-output feedback linearization and PSO-optimized fractional order PID controller. In *2018 International Conference on Automatic Control, Mechatronics and Industrial Engineering*, 79–84.
3. Treadway, E., **Yang, Y.**, & Gillespie, R. B. (2017). Decomposing the performance of admittance and series elastic haptic rendering architectures. *2017 IEEE World Haptics Conference, WHC 2017*, 346–351.

#### Patent

1. **Yang, Yi** (2013). Water bottle capable of cooling. (Patent #: CN202941829U)

#### RESEARCH & WORK EXPERIENCE

##### Laboratory of Organic Bio-Electronics

**West Lafayette, IN**

*Post-doctoral Researcher*

July 2021 – Present

- Project: Fabrication and simulation of neuromorphic computing circuit systems and spiking neural networks (Sponsored by Office of Naval Research)
  - Simulated log-domain integrator (LDI), differential pair integrator (DPI) synaptic circuit and Axon-Hillock somatic circuit
  - Conduct theoretical analysis of spiking neural networks and large-scale neuromorphic circuits simulation
  - Design and fabrication of a network of organic spiking neurons
  - Integration of a network of organic spiking neurons with sensor and actuators onto a mobile soft robot

##### Collaborative Robotics Lab

**West Lafayette, IN**

*Graduate Student Research Assistant*

Jan. 2018 – May 2021

- Project: MRI: Development of a Next-Generation 3-D Printer for Smart Product Design-Purdue PolymerMakers (Sponsored by the National Science Foundation, Award #: 1726865)
  - Implemented the pick-n-place module to automate the mounting of non-polymer electronic components on additive-manufactured polymer surfaces
  - Designed and programmed the graphical user interface for the pick-n-place module, achieved the coordinated motion control of printer heads with mounting offsets
  - Selected appropriate anisotropic adhesives and encapsulating glue for the printed void
  - Tested the conductivity of the anisotropic glue under different curing temperature/pressures

- Project: Modeling the electrical characteristics of organic field effect transistors under mechanical deformation (Partially sponsored by the National Science Foundation, Award #: 1726865 and United States Department of Agriculture, Grant #: 2019-67021-28990)
  - Proposed the mass-spring-damper (MSD) model for stress/strain simulation in the thin-film structures
  - Developed generalized solid-state model to quantify the effects of trap states in the band structure of organic semiconductors
  - Created fractional drift-diffusion (Fr-DD) model and develop a model solver to simulate carrier transport in irregular crystalline semiconductors
  - Established the electromechanical coupling relationships for the generalized solid-state model and the Fr-DD model to characterized deformable transistors

### **Multidisciplinary Design Lab**

**West Lafayette, IN**

*Graduate Student Research Assistant*

Aug. 2017 – May 2021

- Project: Application of Fractional Calculus to Mechatronics Problems
  - Optimized the discrete-time fractional-order PID controller to achieve the idle speed control of an internal combustion engine
  - Designed the optimal fractional-order PID controller and feedback linearized nonlinear controller to achieve the stabilization and trajectory tracking of a rotary inverted pendulum
  - Compared the stability of least square regulator (LQR) controller and the input-output feedback linearization controller on a rotary inverted pendulum
- Project: Advanced Mechatronics for monitoring and control of Distributed Parameter Systems
  - Discussed the design and realization of biomechatronic robots to provide therapy for tumor ablation
  - Conducted literature reviews and mathematical preparation on the distributed parameter system theory

### **HaptiX Lab**

**Ann Arbor, MI**

*Graduate Student Researcher*

May 2016 - Apr. 2017

- Project: Haptic Rendering and Human Perception
  - Conducted the hands-on experiments on the admittance and series elastic actuator (SEA) architectures
  - Collected experimental data and analyzed the device performance by decomposing the driving point impedance frequency response into effective stiffness, inertia, and damping
  - Simulated the theoretical models to obtain results that are comparable to the experimental measurements

### **The State Key Lab of Coal Combustion**

**Wuhan, China**

*Undergraduate Student Researcher*

Mar. 2014 – Jun. 2015

- Project: Design of a Multi-Split Air Conditioning System for a Passenger Station in Wuhan (Undergraduate thesis)
  - Calculated the cool and heat load of air conditioners in winter and summer, selected the air conditioning system based on the architecture characteristics and load type of the air conditioning system
  - Selected the indoor engines and used CFD to analyze the indoor air distributions
  - Optimized the configurations of refrigerant pipes, divergent pipes, condensate water pipeline and refrigerant charge amount

- Project: Reducing Titanium Dioxide Doped Titanium<sub>3</sub> for Photocatalytic Reduction of Carbon Dioxide
  - Prepared the doped titanium dioxide catalysts and analyzed the spectroscopy of the pre-doped and doped catalysts
  - Designed and conducted the photocatalytic CO<sub>2</sub> reduction experiment, measured the reduction rate and analyzed the reduction efficiency

**Sichuan Air Separation Plant (Group) Co., Ltd.**

**Jiayang, China**

*Internship Engineer*

Jun. 2014 – Sep. 2014

- Assisted senior engineers to evaluate the operational stability of the boilers and deliver air separation products
- Recorded the conditions of air separation units and operated workplace safety regulations
- Helped document the safety regulations, laws and policies from different workshops and departments

**TECHING EXPERIENCE**

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**Substitute Lecturer**, Purdue University, IN

Mar. 2019

- Course: MET 382 – Controls and Instrumentation for Automation
  - Lectured three lab sessions to 27 undergraduate students
  - Supervised the students in the experimental procedures and graded their lab reports

**Grader**, Purdue University, IN

Aug. 2017 – Dec. 2017

- Course: MET 214 – Machine Elements
  - Graded the homework assignments, midterm and final exams for 62 undergraduate students

**AWARDS AND HONORS**

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- Purdue University Library Open Access Publishing Fund. Amount: \$2000 2021
- Dean’s Graduate Student Travel Grant. Amount: \$600 (Awarded by Purdue University) 2018
- Outstanding Undergraduate Thesis Award 2015
- National Encouragement Scholarship. Amount: \$800 2013

**PROFESSIONAL SERVICE**

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- Journal reviewer
  - *Organic Electronics*
  - *Engineering Optimization*
  - *Journal of Electrical and Electronic Engineering*
- Conference proceedings reviewer
  - *IEEE International Conference on Robotics and Automation (ICRA)*

**PROFESSIONAL AFFILIATIONS**

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- Institute of Electrical and Electronics Engineers (IEEE) 2020 – Present
- The American Society of Mechanical Engineers (ASME) 2020 – Present

(Updated August 2021 by Yi Yang)