NATHAN P. PETERSEN

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SUMMARY

Nathan is a 4th year PhD student in Electrical Engineering. His research area is electric drives and control algorithms for bearingless motors. He has a technically diverse skillset developed via experiences in industry, academia, and personal projects. Nathan is personable, a natural leader, and a team player who helps projects succeed.

EDUCATION

UNIVERSITY OF WISCONSIN – MADISON

B.S. – Computer Science with Distinction, GPA: 3.720 / 4.0   May 2019

M.S. – Electrical and Computer Engineering, GPA: 3.900 / 4.0   December 2021
    Project: Open-Source Hardware and Software for Advanced Motor Drives

Ph.D. – Electrical and Computer Engineering   expected May 2024
    Topic: Sensorless Bearingless Motors: Modeling and Control Methods
    Advisor: Prof. Eric Severson

RESEARCH EXPERIENCE

Research Assistant: Department of Electrical and Computer Engineering, UW–Madison   Jan. 2020 – Present
- Member of WEMPEC: Wisconsin Electric Machines and Power Electronics Consortium
- Embedded system design (PCB, FPGA, DSP) of platform for controlling advanced electric motors
  - Lead developer of open-source hardware and firmware platform: docs.amdc.dev
  - Used by over ten other graduate students in the lab for hardware research experiments
- Control methods for bearingless motors: both continuous and discrete-time control theory, field-oriented current regulation, motion control for rotation and levitation, observer-based estimation of system state, self-sensing of position and speed for both rotor angle and radial displacement
- Control simulation and verification via MATLAB/Simulink: model-in-loop (MIL), custom C code software-in-loop (SIL), auto-generate embedded C code and integration into custom control board
- Collaboration with other grad students to develop common lab infrastructure and experiment procedures
- Mentor to numerous younger students (both MS and undergraduate) on independent study projects
  - Developed project goals and timeline, regular meetings, hands-on help

JOBS & INTERNSHIPS

Motor Control Intern: TESLA INC, Palo Alto, CA   May 2022 – Oct. 2022
- Optimized sensorless field-oriented control (FOC) algorithms for small permanent magnet motors
- Advanced motor control algorithms implemented with fixed-point math; software-in-loop (SIL) testing; torque ripple (NVH) reduction techniques; hardware testing and validation on dyno and in-car

Motor Control Engineer: BETA TECHNOLOGIES, Burlington, VT   June 2019 – Dec. 2019
- Ground-up design of hardware and real-time software for inverter on electric airplane propulsion unit
- Implemented sensor-based and self-sensing field-oriented current regulation on permanent magnet motor
- Direct hands-on development from initial concept to full 100+ kW dyno testing

Firmware Engineer Intern: SILICON LABS, Austin, TX   Summer 2017, Summer 2018
- Optimized memory usage of embedded digital radio product with pool-based block allocation
- Design of circuit board for customer to interface host system with embedded devices over SPI
- Created system tracing framework for monitoring real-time task scheduling and system utilization

Web Developer: UW-MADISON COMPUTER SYS. LAB (CSL), Madison, WI   March 2016 – Sept. 2018

- Worked with other students and full-time staff to create modern web apps for internal and external use

Software Development Intern: INTEL CORPORATION, Champaign, IL   Summer 2013, Summer 2014
- Testing of mobile performance tool, developed Android app to visualize metrics & Qt GUI for Pintool

TECHNICAL SKILLS & ABILITES

Programming Languages: C, C++, Verilog / SystemVerilog, MATLAB/Simulink, Python, Tcl, Julia, R, Java, HTML, CSS, JavaScript, PHP, SQL, LaTeX

Operating Systems / RTOS: Windows, Linux, ThreadX, FreeRTOS, bare-metal

CAD / EDA / FEA: Altium Designer, Autodesk Eagle, ModelSim, Xilinx Vivado, Solidworks, FEMM, LTspice

Lab Equipment: oscilloscope, logic analyzer, multimeter, power analyzer, function generator, soldering

Embedded Communication Protocols: UART, SPI, I2C, CAN, USB, Ethernet

Embedded Hardware Platforms: Xilinx Zynq-7000 (FPGA + DSP), STM32, EFM32, Arduino

SELECTED PUBLICATIONS

1. **N. Petersen**, A. Khamitov, T. Slininger and E. L. Severson, "Machine Design and Precision Current Regulation for the Parallel DPNV Bearingless Motor Winding," *IEEE Transactions on Industry Applications*, 2021.
2. **N. Petersen**, T. Slininger, and E. L. Severson, "State Observers and Run-Out Reduction for Magnetically Levitated Motor Systems," *IEEE Transactions on Industry Applications*, 2022.
3. **N. Petersen** and E. L. Severson, "Suitability of Bearingless Motor Windings for Non-Salient Rotor Displacement Self-Sensing," *2022 IEEE Energy Conversion Congress and Exposition (ECCE)*, 2022.

AWARDS

Grainger Power Engineering Graduate Award   April 2023
- Recognition of scholarly achievements in the field of power engineering
- 1 of 3 graduate awardees at UW-Madison

Wisconsin Distinguished Graduate Fellowship   January 2020
- Direct support of graduate studies provided by the UW-Madison Graduate School
- Awarded to about 10% of graduate students at UW-Madison each year

Grainger Power Engineering Undergraduate Award   April 2019
- Recognition of scholarly achievements in the field of power engineering
- 1 of 5 undergraduate awardees at UW-Madison

Big Ten Conference Distinguished Scholar Award   2017-18 Season, 2018-19 Season
- Recognition of student-athletes who have a GPA of 3.7 or higher for the previous academic year
- 1 of 5 awardees from Wisconsin Men's Rowing

Intercollegiate Rowing Association (IRA) All-Academic Team   2017-18 Season, 2018-19 Season
- Recognition of student-athletes with top academic standing as well as high athletic performance
- 1 of 3 awardees from Wisconsin

SOCIETIES, ACTIVITIES & SERVICE

- Student member of IEEE Industry Applications Society (IAS) and Power Electronics Society (PELS)
- Technical peer reviewer of publications in IEEE IAS
- STEM outreach to middle school youth across Wisconsin
    - Developed electromagnetic science experiment kits: severson.wempec.wisc.edu/outreach
    - Kit contains hardware components and custom lab manual describing three experiments
    - Multiple outreach events during COVID-19 pandemic using online Zoom meeting format