J. Zack Woodruff

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EDUCATION

Ph.D. in Mechanical Engineering (Robotics), *Northwestern University* — Dec 2020
Advisor: Kevin M. Lynch — GPA: 3.96/4.0
Thesis: Modeling, Motion Planning, and Feedback Control for Dynamic, Graspless, and Hybrid Robotic Manipulation Tasks

Kellogg Management for Scientists and Engineers Certificate, *Northwestern University* — Aug 2017

B.S. in Mechanical Engineering, *University of Notre Dame* — May 2013
Concentration: Design and Manufacturing — GPA: 3.88/4.0

PROFESSIONAL EXPERIENCE

Intuitive Surgical Inc. — Sunnyvale, CA
Robotics Controls Engineering Intern — Summer 2018

- Researched and developed prototypes for control of next-gen surgical robots
- Identified how new and existing technologies within the company could be leveraged to improve performance, and designed, integrated, and presented working demos
- Co-inventor on a pending patent based on this research

Electroimpact Inc. — Mukilteo, WA
Mechanical Engineering Intern — Summer 2011

- Assembled and installed components on an automated Boeing 787 fuselage riveting machine
- Manufactured parts and incorporated design changes into existing machine elements
- Prepared a proposal for an industrial client detailing the redesign of a machine component

RESEARCH EXPERIENCE

Robotic Manipulation — Evanston, IL
Graduate Researcher — 2013-2020

- Focused on modeling, motion planning, feedback control, and optimization for robotic manipulation of objects while accounting for dynamics
- Specialized in hybrid systems and manipulation without grasping such pushing, rolling, and sliding
- Graduate coursework in biomedical robotics, optimal control, dynamic systems, programming embedded systems in robotics using ROS (Robot Operating System), artificial intelligence and machine learning, and mechatronics

Green Cloud Clean Energy — Notre Dame, IN
Undergraduate Researcher — 2012-2013

- Generated a computer model to perform cost-benefit analyses of Green Cloud technology that harnesses waste heat from data centers for use in buildings
- The model calculates and highlights the most effective ways to restructure an organization to maximize energy savings [Woodruff et al. 2014]

TECHNICAL SKILLS

Programming: C (embedded systems, QNX RTOS), C++, MATLAB, Python, Mathematica, Linux, ROS
Electronics: Microcontroller programming (PIC32, Arduino), Raspberry Pi, computer vision (RGBD, IR, stereo), sensor integration, motor characterization and control
Manufacturing: SolidWorks, Creo, 3D printing, laser cutting, CNC milling, lathe
Design/Publishing: Illustrator, Photoshop, Office, LaTeX

AWARDS

Northwestern McCormick Terminal Year Fellowship	2019-2020
ME Graduate Leadership & Service Award	2016
National Science Foundation Graduate Research Fellowship	2015

MENTORSHIP & SERVICE

Member of US 2020 Robotics Roadmap Committee	2019-2020
Northwestern Science Policy Outreach Taskforce (SPOT)	2017-2020
Mentor for multiple high school robotics/engineering teams	2013-2020
Northwestern ME graduate student mentor	2013-2020
Instructor at Northwestern youth teaching program (SPLASH)	2014, 2017
President/officer of the Mechanical Engineering Graduate Student Society	2014-2016

PROFESSIONAL MEMBERSHIP & SERVICE

Member, IEEE Society	2015-present
Member, IEEE Robotics and Automation Society	2017-present
Member, Tau Beta Pi Engineering Honors Society	2013-present
Reviewer, Journal of Mechanisms and Robotics	2020
Reviewer, IEEE Transactions on Automation Science and Engineering	2018/2019
Reviewer, Int. Conference on Intelligent Robots and Systems (IROS)	2017/2018/2019

TEACHING EXPERIENCE

Teaching assistant for *Robotic Manipulation*	Fall 2018
Co-teacher for *Designing Product Interactions*	Fall 2017
Teaching assistant for *Introduction to Mechatronics*	Winter 2014
Grader for *Robotic Manipulation*	Fall 2014
Teacher at Northwestern youth teaching program (SPLASH)	2014, 2017

PUBLICATIONS

Woodruff, J. Zachary, Shufeng Ren, and Kevin M. Lynch. "Motion planning and feedback control of rolling bodies." *IEEE Access*, vol. 8, pp. 31780-31791, 2020.

Woodruff, J. Zachary, and Kevin M. Lynch. "Second-order contact kinematics between three-dimensional rigid bodies." *Journal of Applied Mechanics* vol. 86 issue 8, 2019.

Shi, Jian, **J. Zachary Woodruff**, Paul Umbanhowar, and Kevin M. Lynch. "Dynamic in-hand sliding manipulation." *IEEE Transactions on Robotics*, vol. 33, issue 4, pp. 778-795, 2017.

Woodruff, J. Zachary, and Kevin M. Lynch. "Planning and control for dynamic, nonprehensile, and hybrid manipulation tasks." *Robotics and Automation (ICRA), 2017 IEEE International Conference on*. IEEE, 2017.

Shi, Jian, **J. Zachary Woodruff**, and Kevin M. Lynch. "Dynamic in-hand sliding manipulation." *Intelligent Robots and Systems (IROS), 2015 IEEE/RSJ International Conference on.* IEEE, 2015.

Woodruff, J. Zachary, Aimee P. C. Buccellato, Paul Brenner, David B. Go, "Environmentally Opportunistic Computing: A distributed waste heat reutilization approach to energy-efficient buildings and data centers." *Energy and Buildings*, vol. 69, pp. 41-50, 2014.

PRESENTATIONS

J. Zachary Woodruff, and Kevin M. Lynch. "Planning and Control for Dynamic, Nonprehensile, and Hybrid Manipulation Tasks." *Robotics and Automation (ICRA), 2017 IEEE International Conference on*. IEEE, June 2017. Oral and Poster.

J. Zachary Woodruff, and Kevin M. Lynch. "Planning and Control for Dynamic, Nonprehensile, and Hybrid Manipulation Tasks." *Midwest Robotics Workshop,* May 2017. Poster.

Shi, Jian, **J. Zachary Woodruff**, and Kevin M. Lynch. "Dynamic In-Hand Sliding manipulation." *Intelligent Robots and Systems (IROS), IEEE/RSJ International Conference on*. September 2015. Oral.