

Nicholas (Nick) P. Rotella

CONTACT INFORMATION

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RESEARCH INTERESTS

My work deals with state **estimation**, model-based **planning** and **control** for complex robotic systems. I am interested in developing robust and efficient methods for controlling electromechanical systems using a combination of physical models and sensor data. My background in mechanical engineering, neuroscience and computer science allows me to approach robotics problems from an interdisciplinary perspective, and my expertise spans both software implementation and testing on physical systems.

EDUCATION

Doctor of Philosophy (Computer Science)

June 2014 - January 2018

The University of Southern California, Los Angeles, CA

- Thesis: “Estimation-Based Control for Humanoid Robots”
- Advisor: Dr. Stefan Schaal (**Computational Learning and Motor Control Lab**)
- Co-Advisor: Dr. Ludovic Righetti (in collaboration with the **Max-Planck Institute for Intelligent Systems**, Tuebingen, Germany)
- Viterbi Dean’s Fellowship, 2012 - 2016

Master of Science (Computer Science)

August 2012 - June 2014

The University of Southern California, Los Angeles, CA

- Specialization: **Intelligent Robotics**
- GPA: 3.82

Bachelor of Engineering (Mechanical Engineering)

August 2008 - June 2012

The Cooper Union for the Advancement of Science and Art, New York, NY

- Academic Societies: American Society of Mechanical Engineers, Tau Beta Pi Engineering Honors Society, Pi Tau Sigma Mechanical Engineering Honors Society
- Senior Project: “Gestural Language for Operations in Virtual Environments” (G.L.O.V.E.), an Arduino-based wearable device equipped with finger flex sensors and IMUs for gesture recognition and sign language translation (advised by Dr. Stan Wei)
- GPA: 3.71

INDUSTRY EXPERIENCE

Garmin International, Olathe, KS
January 2018 - Present

Software Engineer, Autopilot Algorithms (Marine)

- Responsible for development, implementation, testing and documentation of new autopilot controllers, vessel parameter identification/estimation methods and dynamics simulations (C/C++, Python)

RESEARCH
EXPERIENCE

Research Assistant, [Computational Learning and Motor Control \(CLMC\) Lab](#)
University of Southern California, Los Angeles, CA
August 2012 - January 2018

- Develop estimation and control algorithms for humanoid robots
- Use model-based optimization for trajectory planning and whole-body control
- Apply optimal filtering and statistical learning to fuse models with sensor data
- Develop realtime-safe software for the operation of a hydraulic humanoid robot
- Peer review conference and journal paper submissions for major robotics conferences (IROS, ICRA, Humanoids, MFI, AIM, T-RO, RA-L)

Research Assistant, [The Joe Francis Lab](#)
SUNY Downstate Medical School, Brooklyn, NY
June 2011 - December 2011

- Simulated a population of motor cortex neurons for a target-based reaching task
- Implemented a simulated brain-machine interface (BMI) using an artificial neural network trained by reinforcement learning
- Studied the effect of hyperparameter tuning, simulated electrode noise and loss of neurons on BMI performance to improve *in vitro* results

Research Assistant, Laboratory for Energy Reclamation and Innovation
The Cooper Union, Hveragerdi, Iceland
June 2010 - August 2010

- Designed and constructed a geothermally-heated garden at the HNLFI health clinic
- Performed data collection and analysis for ongoing plant growth comparison experiments

TEACHING
EXPERIENCE

Teaching Assistant, Introduction to neurophysiology and the biophysics of computation (PH330)
The Cooper Union, New York, NY
August 2011 - December 2011

- Facilitated experiments involving invertebrate dissection, neural recording and data processing throughout the semester-long course
- Maintained the lab space and constructed tools for electrophysiological experiments

Teaching Assistant, Summer Engineering Research Program
The Cooper Union, New York, NY
June 2011 - August 2011

- Assisted high school students with basic neuroscience course material and experiments
- Aided students in developing, performing and analyzing novel research projects

HARDWARE AND
SOFTWARE SKILLS

Programming Languages:

- Proficient in: C/C++, Python, Matlab, LaTeX
- Familiar with: ROS, Java, JavaScript, PHP, HTML/CSS

Operating Systems and Tools:

- Proficient in: Linux and realtime Xenomai patch, Windows, C/C++ IDEs, Git
- Familiar with: Atlassian tools, programming embedded systems (ARM microprocessors)

Robotics:

- Extensive [theoretical and practical knowledge](#) of model-based robot control (inverse kinematics/dynamics), optimal control (LQR and nonlinear variants, e.g. iLQR, DDP), optimal estimation (Kalman Filtering and nonlinear variants, e.g. EKF, UKF), trajectory optimization, data analysis and machine learning techniques (supervised, unsupervised and reinforcement learning)

- Experience writing realtime-safe software, interfacing with sensors and performing experiments on a torque-controlled hydraulic humanoid robot

PROFESSIONAL MEMBERSHIPS

- Institute of Electrical and Electronics Engineers (2012–present)
- Tau Beta Pi Engineering Honors Society (2011–present)
- Pi Tau Sigma Mechanical Engineering Honors Society (2011–present)

PUBLICATIONS

- [1] N. Rotella, , S. Schaal, and L. Righetti, “Unsupervised contact learning for humanoid estimation and control,” in *2018 IEEE International Conference on Robotics and Automation (ICRA)*, 2018. [Online]. Available: <https://arxiv.org/abs/1709.07472>
- [2] S. Mason, N. Rotella, , S. Schaal, and L. Righetti, “Mpc walking framework with external contact forces,” in *2018 IEEE International Conference on Robotics and Automation (ICRA)*, 2018.
- [3] S. Mason, N. Rotella, S. Schaal, and L. Righetti, “Balancing and walking using full dynamics lqr control with contact constraints,” in *2016 IEEE-RAS 16th International Conference on Humanoid Robots (Humanoids)*, Nov 2016, pp. 63–68.
- [4] N. Rotella, S. Mason, S. Schaal, and L. Righetti, “Inertial sensor-based humanoid joint state estimation,” in *2016 IEEE International Conference on Robotics and Automation (ICRA)*, May 2016, pp. 1825–1831.
- [5] N. Rotella, A. Herzog, S. Schaal, and L. Righetti, “Humanoid momentum estimation using sensed contact wrenches,” in *Humanoid Robots (Humanoids), 2015 IEEE-RAS 15th International Conference on*, Nov 2015, pp. 556–563.
- [6] A. Herzog, N. Rotella, S. Schaal, and L. Righetti, “Trajectory generation for multi-contact momentum control,” in *Humanoid Robots (Humanoids), 2015 IEEE-RAS 15th International Conference on*, Nov 2015, pp. 874–880.
- [7] A. Herzog, N. Rotella, S. Mason, F. Grimmering, S. Schaal, and L. Righetti, “Momentum control with hierarchical inverse dynamics on a torque-controlled humanoid,” *Autonomous Robots*, vol. 40, no. 3, pp. 473–491, 2015. [Online]. Available: <http://dx.doi.org/10.1007/s10514-015-9476-6>
- [8] N. Rotella, M. Bloesch, L. Righetti, and S. Schaal, “State estimation for a humanoid robot,” in *2014 IEEE/RSJ International Conference on Intelligent Robots and Systems*, Sept 2014, pp. 952–958.
- [9] A. Tarigoppula, N. Rotella, and J. T. Francis, “Properties of a temporal difference reinforcement learning brain machine interface driven by a simulated motor cortex,” in *2012 Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, Aug 2012, pp. 3284–3287.

CONFERENCE TALKS

- [1] N. Rotella, “Humanoid Momentum Estimation Using Sensed Contact Wrenches,” in the *IEEE-RAS Conference on Humanoid Robots (Humanoids)*, Seoul, Korea, November 3–5, 2015.
- [2] N. Rotella, “Estimation, Planning and Control for Force-Centric Bipedal Locomotion,” in the *Conference on Dynamic Walking*, Columbus, OH, 2015.

CONFERENCE
POSTERS

- [3] N. Rotella, “Unsupervised contact learning for humanoid estimation and control,” in IEEE International Conference on Robotics and Automation (ICRA), Brisbane, Australia, May 21–25, 2018
- [4] N. Rotella, “IMU-based joint state estimation for humanoid control,” in the Conference on Dynamic Walking, Ann Arbor, MI, June 4–7, 2016.
- [5] N. Rotella, “Inertial Sensor-Based Humanoid Joint State Estimation,” in IEEE International Conference on Robotics and Automation (ICRA), Stockholm, Sweden, May 16–21, 2016.
- [6] N. Rotella, “Momentum Estimation, Planning and Control for Force-Centric Bipedal Locomotion,” in the Conference on Dynamic Walking, Columbus, OH, July 21–24, 2015.
- [7] N. Rotella, “State estimation for a humanoid robot,” in the IEEE/RSJ International Conference on Intelligent Robots and Systems, Chicago, IL, September 14–18, 2014.
- [8] N. Rotella, “State Estimation for Walking Humanoids on Unknown Terrain,” in the Conference on Dynamic Walking, Zurich, Switzerland, June 10–13, 2014.