

Nicholas (Nick) Rotella, Ph.D.

CONTACT INFORMATION

Nicholas Rotella
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BACKGROUND

I am a robotics software engineer and researcher specializing in sensor fusion, motion planning, and model-based control for autonomous systems. My expertise spans development and integration work on manipulator, legged, mobile, aerial, and marine robots. I have experience with sensing modalities including vision, LIDAR, radar, GPS, and IMU, as well as with controlling hydraulic, electric, and pneumatic robots. My academic background in mechanical engineering, neuroscience, and computer science allows me to approach robotics problems from a multidisciplinary perspective. I remain engaged with the academic community as a regular invited reviewer for conferences and journals across the field of robotics.

EDUCATION

Doctor of Philosophy (Computer Science)

June 2014 - May 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

Seegrid (Pittsburgh, PA)

January 2021 - Present

Research Software Engineer

- Founding team member of **Blue Labs** research and development group
- Exploration of aspirational technologies for autonomous mobile robotics, including research, design, and software prototyping

Ainstein (Greater Kansas City, MO)

January 2021 - Present

Contractor/Consultant

- ROS package development for radar-based perception
- Analysis of drive data for algorithm improvements
- Support definition of long-term strategic objectives in robotics space

Ainstein (Greater Kansas City, MO)

September 2018 - January 2021

Sr. Robotics Software Engineer

- Sensor fusion and sensor-based controls for autonomous systems including self-driving vehicles, mobile robots, and drones (PX4) using LIDAR, radar, vision, GPS, and IMU
- Development and support of **ROS packages** for sensor integration and 3d perception (PCL)
- Implementation (C/C++, Python) of SLAM, sensor fusion, and object tracking in simulation (Gazebo) and on real systems
- Development of realtime object tracking algorithms in FreeRTOS on Xilinx Zynq SoCs, core technology for the **Doosan Bobcat partnership**
- Utilization of high-performance computing platforms (NVIDIA) for deep learning applications (TensorFlow) and GPU programming
- **NSF IUCRC** representative, experience with SBIR grant proposals
- Industry mentor for the **Harvey Mudd Clinic Program**

Garmin International (Greater Kansas City, MO)

January 2018 - September 2018

Software Engineer, Controls

- Designed and implemented (C/C++, Python) optimal controllers (LQR), estimators (EKF/UKF, MMAE), and navigation algorithms based on simplified models for underactuated marine systems using GPS and IMU
- Developed a physics simulator (Qt, OpenGL) for prototyping control algorithms
- Performed controller testing and verification on electromechanical systems
- Utilized code reviews (Git/Gerrit), software quality testing, and documentation tools (Jira, Confluence)

RESEARCH EXPERIENCE

Research Assistant, **Computational Learning and Motor Control (CLMC) Lab**

University of Southern California, Los Angeles, CA

August 2012 - January 2018

- Formulated, prototyped (MATLAB, Python), implemented (C/C++), and published novel estimation and control algorithms for humanoid robot manipulation and locomotion
- Applied model-based optimizations (QPs, LQR, DDP) for trajectory planning and whole-body control of high-dimensional systems
- Used optimal filtering (EKF/UKF) and statistical learning for model-based sensor fusion
- Developed realtime-safe software (Xenomai) and embedded motor control algorithms for a hydraulic humanoid robot
- Wrote, peer reviewed, and presented conference and journal papers at major conferences

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 center-out reaching task
- Implemented a simulated brain-machine interface (BMI) using artificial neural networks trained by reinforcement learning, analyzed performance in the context of the simulated task, and published results

	<p>Research Assistant, Laboratory for Energy Reclamation and Innovation The Cooper Union, Hveragerdi, Iceland June 2010 - August 2010</p> <ul style="list-style-type: none"> • Designed and constructed a geothermally-heated garden at the HNLFI health clinic • Performed data collection and analysis of plant growth and published results
TEACHING EXPERIENCE	<p>Guest Lecturer, Introduction to Robotics (CSCI545) The University of Southern California, Los Angeles, CA August 2012 - December 2017</p> <ul style="list-style-type: none"> • Prepared and delivered occasional lectures on graduate-level robotics topics including optimal estimation and control for humanoid robots <p>Teaching Assistant, Introduction to Neurophysiology (PH330) The Cooper Union, New York, NY August 2011 - December 2011</p> <ul style="list-style-type: none"> • 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 <p>Teaching Assistant, Summer Engineering Research Program The Cooper Union, New York, NY June 2011 - August 2011</p> <ul style="list-style-type: none"> • Assisted high school students with neuroscience course material and experiments • Aided students in developing, performing, and analyzing novel research projects
VOLUNTEERING	<p>Programming and Controls Mentor, FIRST robotics team 1939 Kansas City, MO 2019 - Present</p> <p>Robotics Mentor, PREP-KC Kansas City, MO 2019 - Present</p> <p>Judge, PLTW KC Engineering Design Contest Kansas City, MO 2019</p> <p>Judge, Greater KC Science and Engineering Fair Kansas City, MO 2018, 2019</p> <p>Teaching Assistant, TEALS K-12 Program Kansas City, MO 2018 - 2019</p> <p>Research Lab Tour Guide, USC Robotics Open House Los Angeles, CA 2012 - 2017</p>
HARDWARE AND SOFTWARE SKILLS	<p>Programming and Scripting Languages:</p> <ul style="list-style-type: none"> • Proficient in: C/C++, Python, MATLAB, LaTeX, Markdown • Familiar with: Java, JavaScript, HTML/CSS

Programming Libraries:

- Robotics middleware (ROS, ROS 2), simulation environments (Gazebo/Ignition, Webots, CoppeliaSim), linear algebra (Eigen), GUI development (Qt, TkInter), graphics programming (OpenGL, OGRE), GPU programming (CUDA), deep learning (TensorFlow), point cloud processing (PCL), machine vision (OpenCV), motion planning (MoveIt!)

Operating Systems and Tools:

- Proficient in: Operating systems (Linux, Windows), realtime operating systems (Xenomai, FreeRTOS), version control (Git), software IDEs (Eclipse, Visual Studio, JetBrains suite)
- Familiar with: Embedded systems (NVIDIA, ARM microprocessors, Xilinx Zynq SoCs), Atlassian tools (Confluence, JIRA)

Robotics:

- **Theoretical and applied knowledge** of model-based robot control (inverse kinematics/dynamics), optimal control (LQR and nonlinear variants), optimal estimation (Kalman Filtering and nonlinear variants), trajectory optimization, autonomous navigation, and robot learning
- Robotics software engineering using ROS and related open-source libraries for 3d perception, navigation, and sensor fusion using LIDAR, radar, vision, GPS, and IMU
- Experience architecting linux-based systems for robot control, writing realtime-safe software, interfacing with sensors, and performing experiments on a variety of platforms
- Broad experience with robotics simulation software and robotics middleware

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.

PAPER REVIEWS

NB: Although IEEE provides a compilation of reviewer activities, it is not provided on the basis of preserving confidentiality. Instead, here is a summary:

- IEEE-RAS International Conference on Humanoid Robots (Humanoids): 2013, 2014, 2016, 2017, 2018, 2019
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS): 2013, 2014, 2015, 2016, 2017, 2018, 2019
- IEEE International Conference on Robotics and Automation (ICRA): 2017, 2018, 2019, 2020
- IEEE International Conference on Multisensor Fusion and Integration for Intelligent Systems (MFI): 2016, 2017
- IEEE International Conference on Advanced Intelligent Mechatronics (AIM): 2017, 2018, 2019
- IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechanics (BioRob): 2018
- Conference on Robot Learning (CoRL): 2018

- IEEE Transactions on Robotics (TR-O): x4
- IEEE Robotics and Automation Letters (RA-L): x7
- Journal of Intelligent and Robotic Systems (JINT): x1
- Autonomous Robots (AURO): x1
- Robotics and Autonomous Systems: x1
- Sensors Journal: x2
- Electronics Journal: x2