

**ALEXANDER BROAD**  
alex.broad@u.northwestern.edu  
www.alexanderbroad.com  
Northwestern University, Chicago, IL

---

## EDUCATION

**Northwestern University** School of Engineering and Applied Science, Evanston, IL  
*Doctoral Candidate* in Computer Science, 2014 - Present  
*Research Area:* Machine Learning, Robotics, Control, Rehabilitation  
*Advisor:* Brenna Argall

**Washington University in St. Louis** School of Engineering and Applied Science, St. Louis, MO  
*Master of Science* in Computer Science, May 2011  
*Masters Thesis:* Generating Muscle Driven Arm Movements Using Reinforcement Learning

**Washington University in St. Louis** College of Arts and Sciences, St. Louis, MO  
*Bachelor of Arts* in Applied Mathematics and Philosophy-Neuroscience-Psychology (PNP), May 2009

## HONORS AND AWARDS

**Todd M. and Ruth Warren Fellowship (2014-2019)** Highly selective 5-year fellowship for top computer science students

**Walter P. Murphy Fellowship (2014)** Fellowship for first year computer science students

**IES Brain Research Foundation Grant (2008)** Competitive grant for future brain research scientists (1 of 6 people awarded)

## RESEARCH AND WORK EXPERIENCE

**Northwestern University** September 2014 - Present  
Assistive and Rehabilitation Robotics Laboratory *PhD Research Assistant*

**MIT Lincoln Laboratory** August 2011 - August 2014  
Intelligence and Decision Technologies, Lexington, MA *Associate Technical Staff*

- *Information Provenance and Plagiarism Detection:* Developed and implemented a novel algorithm for plagiarism detection and document similarity. Adapted a Hidden Markov Support Vector Machine to learn a sequence tagger that can distinguish between instances of plagiarism and original content. Produced better than state-of-the-art results on established community dataset. Wrote tech report.
- *Automatic Path Planning for Flight Simulation:* Designed an open-loop controller for optimal path planning of a simulated aerial platform. Implemented efficient algorithm, capable of real-time updates to desired waypoints. Utilized various coordinate frames, including geocentric, geodetic and local, to accurately calculate updates for the platform's location in 4-dimensional space (latitude, longitude, elevation, heading). Developed simple interface allowing algorithm to be used on numerous subsequent projects.
- *Mission Planning System:* Developed graphical user interface for a mission planning and data exploitation tool for U.S. military intelligence. Integrated advanced image processing algorithms with real time situational awareness to improve image analyst accuracy and efficiency. Worked closely with operational military intelligence to improve workflow and automate routine procedures. Designed the tool to integrate with pre-existing processing chain including complimentary tactile intelligence applications. Tested software with trained mission planners and image analysts and reported 2x increase in efficiency.

**Washington University in St. Louis** January 2010 - May 2011  
Media and Machines Lab, St. Louis, MO *Advisor : Professor Bill Smart*

- *MS Thesis - Optimization of Complex Biomechanical Systems:* Researched motor control and optimization techniques to generate novel motion from first principles using reinforcement learning. Created biologically realistic model of hominoid arm using Stanfords open-source simulation software. Constructed evolutionarily motivated value function for reinforcement learning algorithm explicitly defined to optimize accuracy

**ALEXANDER BROAD**  
alex.broad@u.northwestern.edu  
www.alexanderbroad.com  
Northwestern University, Chicago, IL

---

and minimize energy expenditure. Worked with Dr. Tom Erez to apply his receding-horizon optimization algorithm to simulated arm resulting in energy-efficient motor control system.

**Washington University in St. Louis**  
Media and Machines Lab, St. Louis, MO

September 2008 - January 2009  
*Advisor : Professor Bill Smart*

- *Human-Machine Interaction*: Researched methods for supervisory control of large mobile robot groups. Designed user interface models for use in directing robots.

#### CONFERENCE, WORKSHOP AND JOURNAL PUBLICATIONS

- Broad, A., Argall, B. “Geometry-Based Region Proposals for Real-Time Robot Detection of Tabletop Objects”. Submitted to Autonomous Robots (AURO). 2017.
- Broad, A., Murphey, T., Argall, B. “Learning Models for Shared Control of Human-Machine Systems with Unknown Dynamics”. Robotics: Science and Systems (RSS). 2017.
- Broad, A., Arkin, J., Ratliff, N., Howard, T., Argall, B. “Real-Time Natural Language Corrections for Assistive Robotic Manipulators”. International Journal of Robotics Research (IJRR). 2017.
- Broad, A., Gopinath, D., Murphey, T., Argall, B. “An Empirical Analysis of Methods for Learning Robot Kinematics from Demonstration”. Midwest Robotics Workshop (MWRW). 2017.
- Broad, A., Schultz, J., Derry, M., Murphey, T., Argall, B. “Trust Adaptation Leads to Lower Control Effort in Shared Control of Crane Automation”. IEEE Robotics and Automation Letters (RA-L). 2016. Also presented at the 12th IEEE Conference on Automation Science and Engineering (CASE).
- Broad, A., Arkin, J., Ratliff, N., Howard, T., Argall, B. “Towards Real-Time Natural Language Corrections for Assistive Robots”. Robotics: Science and Systems (RSS) Workshop on Model Learning for Human-Robot Communication. 2016.
- Broad, A., Argall, B. “Geometry-Based Region Proposals for Accelerated Image-Based Detection of 3D Objects”. Robotics: Science and Systems (RSS) Workshop on Deep Learning. 2016.
- Broad, A., Derry, M., Schutlz, J., Murphey, T., Argall, B. “Inverted Trust Improves Shared Control of Complex Dynamic Systems”. Robotics: Science and Systems (RSS) Workshop on Social Trust in Autonomous Robots. 2016.
- Broad, A., Argall, B. “Path Planning under Kinematic Constraints for Assistive Robotics”. International Conference on Planning and Scheduling (ICAPS). 2016.
- Arkin, J., Broad, A., Ratliff, N., Howard, T., Argall, B. “Probabilistic Models for Real-Time Natural Language Corrections to Assistive Robotic Manipulators”. Midwest Robotics Workshop (MWRW). 2016.
- Jain, S., Farshchiansadegh, A., Broad, A., Abdollahi, F., Mussa-Ivaldi, F., Argall, B. “Assistive Robotic Manipulation through Shared Autonomy and a Body-Machine Interface.” IEEE International Conference on Rehabilitation Robotics (ICORR). 2015.
- Broad, A., King, D. “Feature-Rich Plagiarism Detection Using Structured Prediction.” MIT Lincoln Laboratory Tech Report.
- Broad, A. “Generating Muscle Driven Arm Movements Using Reinforcement Learning.” Washington University in St. Louis Masters Thesis. 2011.
- Lorence, E., Truong, J., Broad, A., Sideris, A., Ali, S., Franke, T. “Molecular Implication for Impaired Akt Signal Transduction in Depression.” NYU Psychiatry Annual Research Day. 2008.

**ALEXANDER BROAD**  
alex.broad@u.northwestern.edu  
www.alexanderbroad.com  
Northwestern University, Chicago, IL

---

### **TEACHING EXPERIENCE**

- T.A. for Introduction to Robotics Laboratory (EECS 301) at Northwestern University. 2015, 2016.
- T.A. for Programming Systems and Languages (CSE 425S) at Washington University in St. Louis. 2010.
- T.A. for Logic and Discrete Mathematics (CSE 240) at Washington University in St. Louis. 2010.

### **PROFESSIONAL SERVICE**

- Reviewer for Robotics and Automation Letters (RA-L) - 2017
- Reviewer for the International Conference on Robotics Automation (ICRA) - 2017
- Reviewer for Transactions on Robotics (T-RO) - 2016
- Reviewer for the International Conference on Robotics Automation (ICRA) - 2016
- Reviewer for the International Conference on Intelligent Robots and Systems (I-ROS) - 2016
- Reviewer for the International Conference on Intelligent Robots and Systems (I-ROS) - 2015

### **TECHNICAL SKILLS**

- Languages: Python, Java, Matlab, C++, Scheme, Mathematica
- Packages: ROS, Theano, Keras, NumPy, SciPy, Dlib
- Productivity: Git,  $\LaTeX$