Matthew B. Luebbers

PhD Student / Researcher
University of Colorado Boulder
matthew.luebbers@colorado.edu
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Research Interests

Space Robotics
Co-operative Robot Planning
Robotic Operation Interfaces
Explainable Artificial Intelligence
Verifiable Robotics
Virtual & Augmented Reality

Education

University of Colorado Boulder; Boulder, CO — Aug 2018 –
Doctor of Philosophy, Computer Science
Advisor: Prof. Bradley Hayes
Collaborative AI and Robotics Lab (CAIRO)

Cornell University; Ithaca, NY — Aug 2014 – May 2018
Bachelor of Arts, Computer Science
Internal Concentration: Artificial Intelligence & Robotics

Professional Experience

NASA Jet Propulsion Laboratory; Pasadena, CA — Jun 2019 – Aug 2019
Summer Intern, Robotics (347)
Developed prototype virtual reality application for stereo image viewing and 3D overlay for the Rover Sequencing & Visualization Program (RSVP). Intended for use in daily rover driving activities for Mars Curiosity and Mars 2020 missions. Also participated in tactical rover planning sessions for the Curiosity rover, learning to sequence and operate the vehicle.

NASA Jet Propulsion Laboratory; Pasadena, CA — Jun 2018 – Aug 2018
Summer Intern, Instrument Data Systems (398)
Continued development work on the Common Workflow Service (CWS), including the creation of a web-based BPMN process modeler to contain all functionality for CWS within a single webapp.

NASA Jet Propulsion Laboratory; Pasadena, CA Jun 2017 – Aug 2017
Summer Intern, Instrument Data Systems (398)

Continued development work on the Common Workflow Service (CWS), including adaptation work for the Instrument Data Systems pipelines of the Mars 2020 mission.

NASA Jet Propulsion Laboratory; Pasadena, CA Jun 2016 – Aug 2016
Summer Intern, Instrument Data Systems (398)

General-purpose development work on the Common Workflow Service (CWS), a highly distributable, adaptable workflow system for NASA's Advanced Multi-Mission Operations System (AMMOS) using industry standard BPMN modeling semantics.

Publications

Workshops, Symposia, & Posters

1. Matthew B. Luebbers, Connor Brooks, Minjae John Kim, Daniel Szafir, and Bradley Hayes. (2019). **Augmented Reality Interface for Constrained Learning from Demonstration.** To appear in *Proceedings of the Workshop of Virtual, Augmented and Mixed Reality for Human-Robot Interaction (VAM-HRI 2019*). Daegu, South Korea.

2. Matthew B. Luebbers, Ramchandran Muthukumar, Madeleine Udell, and Ross A. Knepper. (2017). **Planning Aerial Survey Missions using Low Rank Approximation.** Presented at *Northeast Robotics Colloquium (NERC 2017).* Boston, Massachusetts, USA.

Teaching Experience

CSCI 1300 (Introduction to Computer Science) Aug 2019 –
Teaching Assistant, Prof. Ioana Fleming

University of Colorado Boulder: First class in introductory Computer Science sequence, with roughly 900 students. Teach 50 student recitation section, generate problems for homework, grade homework and exams, hold office hours, and proctor exams.

CS 4700 (Foundations of Artificial Intelligence) Aug 2017 – Dec 2017
Teaching Assistant, Prof. Bart Selman

Cornell University: Elective class typically taken by juniors and seniors majoring in Computer Science, with roughly 200 students. Held

office hours, assisted in grading of problem sets and exams, and assisted in proctoring of exams.

CS 3410 (Computer System Org. & Programming) Aug 2016 – May 2017
Teaching Assistant, Prof. Anne Bracy

Cornell University: Core class typically taken by sophomores and juniors majoring in Computer Science, with roughly 200 students. Taught two 20 student lab sections, held office hours, assisted in grading of problem sets and exams, and assisted in proctoring of exams.

CS 2110 (OO Programming & Data Structures) Aug 2015 – May 2016
Course Consultant, Profs. David Gries, Nate Foster, & Ross Tate

Cornell University: Second course in introductory Computer Science sequence, with roughly 500-600 students. Held office hours, assisted in grading of problem sets and exams, and assisted in proctoring of exams.

Research Experience

Conversational Planner Generation for Teleop. Robots Jan 2019 –
Prof. Bradley Hayes

Combining techniques from human-in-the-loop planner generation and explainable AI to allow for robot planners to be learned and converged upon in 'conversation space', where acceptable and verifiable planners for teleoperated robots are iterated towards by human operators and robot agents each possessing partial information.

AR Interface for Constrained Learning from Demonstration Oct 2018 –
Prof. Bradley Hayes & Prof. Daniel Szafir

Using the Microsoft HoloLens to provide augmented reality visualization and control to create better performing, more usable systems for robot Learning from Demonstration (LfD), where a human teacher provides a robot with demonstrations of a task rather than needing to program them explicitly.

Presented at **VAM-HRI 2019**
Daegu, South Korea Mar 2019

Miniature Self-Driving Car Jan 2018 – May 2018
Prof. Ross Knepper, Robotic Personal Assistants Lab

Group project to apply various learning models to a self-driving car made from RC car parts to uncover more accurate dynamics models for wheel-terrain interactions that can be utilized to successfully perform high-speed maneuvers like drifting.

Aerial Survey Mission Planning w/ Low Rank Approx. Aug 2017 – Dec 2017
Prof. Ross Knepper & Prof. Madeleine Udell

Characterized efficient aerial path-planning for maximum information gain using methods from numerical linear algebra and machine learning. Low rank approximation is used to estimate hidden data on a large map after observing a small portion of it, and machine learning is used to pick Hamiltonian flight paths that travel through nodes minimizing error between prediction and observation. An example application for this method is drought prediction through localized observation of normalized difference vegetation index (NDVI) from an aerial platform.

Presented at **NERC 2017**
Boston, MA Oct 2017
Presented at **NSF Computational Sustainability Consortium**
Ithaca, NY Oct 2017

Autonomous Solar-Powered Airship Sep 2016 – May 2018
Prof. Ross Knepper, Robotic Personal Assistants Lab

Group project to build an airship (blimp) capable of flying autonomously for extended periods of time for use in monitoring ecological conditions. In the future, we aim to extend the range and flight time further by including a lightweight solar power system. My work has been varied on this project, but the bulk of it has been focused on physical simulation, control, and high-level mission and path planning.

Development Technologies

OS:	Linux (Ubuntu, RHEL), MacOS, Windows
Tools:	ROS, BPMN, Gazebo, Unity, Git, JIRA, AWS, Bamboo, Eclipse, Gym, MuJoCo, Maya, Verilog, Camunda, OpenGL
Languages:	Python, Java, shell scripting, Julia, OCaml, C++, C, C#, assembly languages
Web Stack:	HTML, CSS, Javascript, Node, PHP, MariaDB, MySQL
Hardware:	Rethink Sawyer, Microsoft HoloLens, Meta2, Oculus Quest

Honors & Awards

Dean's Graduate Award
University of Colorado Boulder College of Engineering & Applied Science

National Merit Scholar
National Merit Scholarship Program

Dean's List
Cornell University College of Arts & Sciences
Fall 2014, Spring 2015, Spring 2016

Top 10 in Competition
Big Red Hacks 2015 – "Flushr"

Additional Projects

Multiple Asteroid Flyby Mission Concept Jan 2019 – May 2019

Semester-long project to design a mission concept and deliver a mock-PDR (Preliminary Design Review) and formal proposal for a NASA Discovery-class mission call. Designed cost-constrained spacecraft to perform remote sensing of three selected main-belt asteroids. Created in a team of ten as a semester-long project for ASEN 5148 – Spacecraft Design. I was responsible for CDH (Command & Data Handling), and FSW (Flight Software) subsystems.

Grasp Selection through Evaluative RL Oct 2018 – Dec 2018

Experiment to learn optimal robotic arm grasp positions for novel objects in simulation through the use of reinforcement learning with human-agent transfer (HAT) and human-provided demonstrations. Utilizes the MuJoCo physics simulator and the OpenAI Gym toolkit. Created in a team of three as a final project for CS 5622 – Machine Learning.

Multi-Purpose Neural Net Mar 2018 – May 2018

Experiment to design singular neural nets with multiple, unrelated capabilities – in this case, bitwise logic operations, handwritten digit classification, and novel music composition. Created in a team of three as a final project for CS 6700 – Advanced Artificial Intelligence.