Wil Thomason

CONTACT INFORMATION	Cornell University Department of Computer Science 343 Campus Road Ithaca, NY 14853 https://www.cs.cornell.edu/~wil/	804.591.7318 wbthomason@cs.cornell.edu

OBJECTIVE

I am broadly interested in algorithms for robotics, with a focus on **planning algorithms** and **integrated task and motion planning**. My work studies efficient, principled approaches to solving realistic robot problems with both logical and geometric complexity. I am also interested in fusing classical planning methods with machine learning to enable more robust, capable robots, as well as algorithms for efficient planning in constrained domains, programming languages research, and robot autonomy/decision-making. In all my work, I care about finding solutions that are both soundly based in theory and practical for real-world use.

RESEARCH INTERESTS

Robotics: integrated task and motion planning, constrained planning, multi-agent coordination
Machine Learning: learning to plan, combining ML with classical planning
Programming Languages: type theory, effect systems, compilers

EDUCATION

Cornell University, Ithaca, NY   June 2019 – Present
    Ph.D., Computer Science

Cornell University, Ithaca, NY   August 2015 – June 2019
    MS, Computer Science
    Relevant Courses: *CS 6820*: Advanced Algorithms (Fall 2015), *CS 6786*: Advanced Machine Learning (Spring 2016), *CS 6110*: Advanced Programming Languages (Spring 2016), *MAE 6790*: Intelligent Sensor Planning and Control (Fall 2016), *CS 6751*: Intro to Mobile Manipulation (Spring 2017), *MAE 6770*: Formal Methods for Robotics (Fall 2017)

University of Virginia, Charlottesville, VA   August 2012 – May 2015
    BS, Computer Science, Mathematics
    Relevant Courses: *CS 6161*: Graduate Design and Analysis of Algorithms (Fall 2014), *CS 6610*: Graduate Programming Languages (Fall 2014)

PUBLICATIONS

Automatic Distributed Multi-Agent Coordination of Single-Agent Robot Controllers. *ICRA (in submission)* (2019)
Wil Thomason, Abhishek Anand, Greg Morrisett, Ross Knepper.
We present a framework for automatically transforming single-agent robot controllers into distributed multi-agent controllers with guaranteed safety and progress under lightweight assumptions. The core of this framework is a simple protocol that maintains two invariants: (a) all executed actions are non-colliding, and (b) there is always a valid plan to reverse the system back to an earlier state.

A Unified Sampling-Based Approach to Integrated Task and Motion Planning. *ISRR* (2019)
Wil Thomason, Ross Knepper.
We contribute a novel approach to integrated task and motion planning that adapts any off-the-shelf motion planning algorithm to automatically solve *task and motion planning problems.* We construct a state space embedding the full symbolic

and continuous state of a planning problem into a single highly factorable space. Combined with a continuous semantics for Boolean predicates, which we use to derive navigation functions to task-level salient regions of the continuous space, we can efficiently solve complex manipulation problems with few domain-specific assumptions.

Social Momentum: A Framework for Legible Navigation in Dynamic Multi-Agent Environments. *HRI* (2018)
Christoforos Mavrogiannis, Wil Thomason, Ross Knepper.
We design a planning framework that aims at generating motion that clearly communicates an agent's intended collision avoidance strategy rather than its destination. Our framework estimates the most likely intended avoidance protocols of others based on their past behaviors, superimposes them, and generates an expressive and socially compliant robot action that reinforces the expectations of others regarding these avoidance protocols.

Zero-Shot Learning for Unfamiliar Gesture Recognition. *ISER* (2016)
Wil Thomason, Ross Knepper.
We explore a method for achieving increased understanding of complex, situated communications by leveraging coordinated natural language, gesture, and context. These three problems have largely been treated separately, but unified consideration of them can yield gains in comprehension.

An Accurate Real-Time RFID-Based Location System. *IJRFITA* (2016)
Kirti Chawla, Christopher McFarland, Gabriel Robins, Wil Thomason.
We outline an RFID-based object localization framework addressing challenges of performance and applicability and propose the use of Received Signal Strength (RSS) to model the behavior of radio signals decaying over distance in an orientation-agnostic manner to simultaneously locate a number of stationary and mobile objects.

AWARDS **Outstanding Teaching Assistant Award**
Cornell University Department of Computer Science, May of 2017
Awarded for my work as a TA for the new Foundations of Robotics course in Fall 2016, taught by Ross Knepper.

NDSEG Fellow   *American Society for Engineering Education*, April of 2017
The National Defense Science and Engineering Graduate (NDSEG) Fellowship is a highly competitive, portable fellowship that is awarded to U.S. citizens and nationals who intend to pursue a doctoral degree in one of fifteen supported disciplines. NDSEG confers high honors upon its recipients, and allows them to attend whichever U.S. institution they choose. (https://ndseg.asee.org/)

NSF GRFP Fellow   *The National Science Foundation*, March of 2017
The NSF Graduate Research Fellowship Program recognizes and supports outstanding graduate students in NSF-supported science, technology, engineering, and mathematics disciplines who are pursuing research-based Master's and doctoral degrees at accredited United States institutions. (https://www.nsfgrfp.org/)

Outstanding Teaching Assistant Award
Cornell University Department of Computer Science, May of 2016
Awarded for my work as a TA for the Intro to Python course (CS 1110) in Fall 2015, taught by Walker White.

NSF GRFP Honorable Mention *The National Science Foundation*, March of 2016

The NSF Graduate Research Fellowship Program recognizes and supports outstanding graduate students in NSF-supported science, technology, engineering, and mathematics disciplines who are pursuing research-based Master's and doctoral degrees at accredited United States institutions.(https://www.nsfgrfp.org/)

Louis T. Rader Outstanding Education Undergraduate Student Award
University of Virginia Department of Computer Science, May of 2015
> Awarded for my work for several years as a TA for multiple courses in the computer science department at UVA.

PRESENTATIONS   "A Flexible Sampling-Based Approach to Task and Motion Planning."
RSS 2019 Workshop on Robust Task and Motion Planning   June 23, 2019
> http://dyalab.mines.edu/2019/rss-workshop/thomason.pdf

"Which comes first, the task plan or the motion plan?." (joint with Ross Knepper)
RSS 2018 Workshop on Exhibition and Benchmarking of Task and Motion Planners
June 30, 2018
> http://www.neil.dantam.name/2018/rss-tmp-workshop/

"Exploiting Heterogeneity in Robot Teams Through a Formalism of Capabilities."
RSS 2018 Workshop on Heterogeneity and Diversity for Resilience in Multi-Robot Systems   July 15, 2017
> https://www.cs.cornell.edu/~wil/papers/
> rss2017_workshop_heterogeneous_coordination.pdf

"Toward Contextual Grounding of Unfamiliar Gestures for Human-Robot Interaction."
FG 2017: First International Workshop on Adaptive Shot Learning for Gesture Understanding and Production   May 30, 2017
> https://www.cs.cornell.edu/~wil/papers/asl4gup2017_unfamiliargestures.pdf

"Recognizing Unfamiliar Gestures for Human-Robot Interaction through Zero Shot Learning."
ISER 2016   October 6th, 2016
> http://www.iser2016.org/program/

"Recognizing Unfamiliar Gestures for Human-Robot Interaction through Zero-Shot Learning."
2nd Workshop on Model Learning for Human-Robot Communication, RSS 2016   June 19th, 2016
> http://www.ece.rochester.edu/projects/rail/mlhrc2016/

RESEARCH   **Graduate Research Assistant**   August 2015 – Present
EXPERIENCE   *Cornell University, Department of Computer Science*
> Advised by Professor Ross Knepper, I have studied problems in the domains of integrated task and motion planning, human-robot interaction and multi-agent planning. Specifically, I have made advances in efficient task and motion planning, gesture recognition, and coordination for ad hoc teams of heterogeneous robots. This work has resulted in several publications and presentations, and is ongoing.

Undergraduate Research Assistant   August 2014 – July 2015
The University of Virginia, Department of Computer Science

I worked with Professor Westley Weimer on automatic software functionality transplantation. We developed an algorithm based on analyzing differences in test suite performance to identify software modules responsible for specific functionality and a combination of function dependency tracing and extraction with the GenProg program repair tool to perform transplants.

Undergraduate Research Assistant   January 2013 – May 2014
The University of Virginia, Department of Computer Science
As a part of Professor Gabriel Robins' lab, I helped to create an efficient, scalable system for real-time localization of objects in 3D space using passive RFID tags. In addition to designing and running experiments for the system, I researched and created a novel approach to distinguishing between noisy measurements and measurements corresponding to moving objects. This approach, which was based on a sliding-window particle filter, significantly increased the accuracy of our system. This work resulted in a journal publication.

TEACHING
EXPERIENCE

Graduate Teaching Assistant: CS 4750   Fall 2016 & Fall 2017
Cornell University
TA for Foundations of Robotics: A new course designed to introduce students to the knowledge they need to conduct research in robotics. I helped to create the course syllabus, textbook, and software for course assignments, and was also responsible for giving weekly office hours, grading, and assisting with lecturing.

Graduate Teaching Assistant: CS 1110   Fall 2015
Cornell University
Head TA for Cornell's introductory computer science course. Responsible for coordinating TA staff, giving review lectures, supervising lab sessions, grading, and giving weekly office hours.

Instructor: Introduction to Robotics   Spring 2015
University of Virginia
I designed and taught a 1-credit course introducing undergraduate students to core topics in robotics. As a part of the course, students built and programmed their own quadrotor robots and learned about basic kinematics, control, perception, and learning.

Undergraduate Teaching Assistant: CS 4610   Spring 2015
University of Virginia
TA for UVA's undergraduate programming languages course.

Undergraduate Teaching Assistant: CS 4710   Spring 2015
University of Virginia
TA for UVA's undergraduate artificial intelligence course.

Undergraduate Teaching Assistant: CS 4414   Spring 2014
University of Virginia
TA for UVA's undergraduate operating systems course. Helped create course content using the Rust programming language as well as an automatic grading server for the class.

Undergraduate Teaching Assistant: CS 2150   Fall 2013 – Spring 2015
University of Virginia
TA for UVA's undergraduate data structures and C++ programming course.

INDUSTRY EXPERIENCE	**Software Engineering Intern at Fluencia**	May 2015 – August 2015

Software Engineering Intern at Fluencia　　May 2015 – August 2015
Worked on adding voice understanding for speech practice exercises

- Improved voice understanding software
- Integrated into language learning website
- Created test and development framework for voice exercises

Software Development Engineer Intern at Microsoft　May 2014 – August 2014
Microsoft Accounts Client Team

- Implemented and tested cryptographic operations and network protocol for forthcoming feature in Microsoft Accounts Android app. The implemented feature enables more convenient and more secure sign-in for Microsoft accounts via mobile devices.
- Coordinated the work of several other interns working on related components of the same project to ensure successful integration and delivery of the fully-functional feature ahead of schedule.

Software Development Engineer Intern at Microsoft　May 2013 – August 2013
Xbox LIVE Cloud Security Team

- Designed, implemented, and shipped a RESTful web service capable of logging and auditing security records in Xbox LIVE in real time. Also designed, created, and tuned associated database and procedures. Service is currently in use in the Xbox LIVE network.
- Spearheaded and completed a total rewrite of an important development library – starting with old, cobbled together library used across principal components of the Xbox LIVE network, redesigned and reimplemented the entire library to provide a faster and easier to use interface to the same core functionality.

TECHNICAL SKILLS

Programming Languages: C++, Python, Rust, C, CL, Haskell, OCaml, etc.
Technologies: Linux, ROS, OMPL, PyTorch, TensorFlow, Git, CUDA, etc.

LANGUAGES

English *(Fluency: Native speaker)*
German *(Fluency: Working)*

OUTREACH

Expanding Your Horizons　　　　　　　　　Spring 2016 – Spring 2019
Taught middle school girls from at-risk communities about programming
https://www.eyh.cornell.edu/

- Created interface for introducing the concept of programming with state machines
- Wrote ROS software to run state machine code on a Kuka youBot

UVa High School Programming Contest　　　Spring 2014 – Spring 2015
Helped plan and run the biggest programming competition for high school students in the mid-Atlantic region.
http://acm.cs.virginia.edu/hspc.php

- Created contest problems
- Planned contest logistics
- Helped run contest

UVa CS Education Week　　　　　　　　　　Winter 2014 – Winter 2015
Visited area schools to teach workshops on introductory programming with JKarel