Mission

We are a group of Brown University faculty, students, and affiliates dedicated to robotics as a means to tackle the problems the world faces today. Beyond pursuing the goal of technological advancement, we want to ensure that these advancements are applicable and beneficial economically and socially. We are working across many disciplines to document the societal needs and applications of human-robot interaction research, as well as the ethical, legal, and economic questions that will arise with its development. Our research ultimately aims to help create and understand robots that coexist harmoniously with humans.
Robots are increasingly playing a role in daily life, from vacuum cleaners to self-driving cars, from surgery to social and eldercare. At Brown University’s Humanity Centered Robotics Initiative (HCRI), we believe there is a place for Brown to lead in defining and solving the next generation of problems in robotics. As robots engage more and more with the general public, facing questions of appropriate human robot interaction, ethics in robot decision making, and human centered design will become paramount.

In less than a year since its inception, HCRI has made tremendous strides in promoting an environment where cross disciplinary robotics research can thrive at Brown. We are initiating support services, from equipment to technical assistance, for faculty interested in exploring new robotics research.

In the educational domain, we have inspired students from outside of STEM disciplines to engage in robot design classes and presented cutting-edge robotics research to K-12 students and the general public. Our Speaker series continues to bring top minds in robotics and artificial intelligence to campus, offering ideas to inspire Brown’s research community.

As the university expands for the 21st century, following the path laid out in the Building on Distinction plan, the Humanity Centered Robotics Initiative lies at the nexus of a number of departments and will reach into unexpected areas of study. The HCRI is at the heart of technology education, and at the heart of the diverse and integrative scholarship that defines Brown.

Michael Littman

Bertram Malle
HCRI Administration

Michael Littman, Co-Director
Michael is the Co-Director of the Humanity Centered Robotics Initiative. He works in reinforcement learning, but has done work in machine learning, game theory, computer networking, partially observable Markov decision process solving, computer solving of analogy problems and other areas.

Littman received his Ph.D. in computer science from Brown University in 1996. From 1996-1999, he was a professor at Duke University. From 2000-2002, he worked at AT&T. From 2002-2012, he was a professor at Rutgers University; he chaired the department from 2009-12. In Summer 2012, he returned to Brown University as a full professor.

Bertram Malle, Co-Director
Bertram is the Co-Director of the Humanity Centered Robotics Initiative. In his research, Dr. Malle focuses on social and moral cognition, examining such issues as intentionality judgments, mental state inferences, behavior explanations, and blame and guilt. He uses a wide variety of methodologies, including text content analysis, observations of social interaction, eye tracking, and reaction times. Recently he has begun to examine how social and moral cognition can be realized in a robotic system, and how humans interact with such robots.

Bertram studied psychology, philosophy, and linguistics at the University of Graz. After receiving his Master’s degrees in psychology and philosophy, Malle received his Ph.D. at Stanford University in 1995, and joined the faculty of the University of Oregon the same year. During his tenure at the University of Oregon, Dr. Malle also served as the Director of the Institute of Cognitive and Decision Sciences (2001-2007). He became Professor of Psychology in 2007, and in 2008 he joined Brown University.
Peter Haas, Associate Director

Peter is the Associate Director of the Humanity Centered Robotics Initiative. He was the Co-Founder and COO of XactSense, a UAV manufacturer working on LIDAR mapping and autonomous navigation. Prior to XactSense, Peter founded AIDG – a small hardware enterprise accelerator in emerging markets. Peter received both TED and Echoing Green fellowships. He has been a speaker at TED Global, The World Bank, Harvard University and other venues. He holds a Philosophy B.A. from Yale.

Ian Gonsher, Design Instructor

Ian Gonsher is an artist, designer, and educator. He is on the faculty in the School of Engineering at Brown University, where his teaching and research focus on design process and creative practice. He is also the co-founder of the Brown Design Workshop, Brown STEAM, the Creative Scholars Project, the Brown Creative Mind Initiative, and Critical Design/Critical Futures. He holds a BFA in Industrial Design and Art History from the University of Kansas, as well as a MFA in Furniture Design from

Suzanne Alden, Grants Manager

Suzanne has been with Brown University since 2010, initially coordinating grants for the Department of Pathology and Laboratory Medicine, then transitioning in 2013 to the Department of Computer Science, where she serves a dual role as Finance and Grants Manager, and administrative coordinator of the Humanity Centered Robotics Initiative (HCRI). Prior to her work at Brown, Suzanne spent ten years as a development officer and grant writer for Rhode Island-based nonprofit organizations, raising millions of dollars for a wide range of causes, including health, housing, education, and the environment. She has a master’s degree in accounting and earned the CFRE fundraising credential in 2010.
Elizabeth Phillips

Elizabeth “Beth” Phillips earned her Ph.D. in 2016 in Applied Experimental and Human Factors Psychology at the University of Central Florida. Prior to joining the HCRI, she worked with the Robotics Collaborative Technology Alliance, a multidisciplinary research consortium working towards the development of future human-robot teams. Beth has an interest in how robots and other technologies are changing the way we interact with the world and one another, including the role that robots will play in providing companionship for humans in the near future. Her research focuses on the application of psychological principles to support the development of robotic systems that can work as partners, assistants, and companions for people.

Maartje de Graaf

Dr. Maartje de Graaf is currently a postdoctoral researcher at the Department of Communication Science, University of Twente, The Netherlands. Before starting her career in academia, she worked in industry for six years. Maartje has a Bachelor in Communication Management (BBA) from Amsterdam University of Applied Sciences (2005), a Master of Communication Science (MSc) from the University of Twente (2011), and obtained her PhD in Human-Robot Interaction from the University of Twente in 2015. Maartje’s Ph.D. research on long-term user acceptance of social robots in domestic environments, indicated a strong role of people’s anthropomorphic responses to robots in the process of long-term acceptance. Envisioning a future in which the social abilities of robots can only increase, her current research interests focuses on people’s social, emotional, and cognitive responses to robots, and the societal and ethical consequences of those responses.
Malle suspects that we might actually want our robots to make different decisions than the ones we’d want other humans to make . . . [in a life or death scenario] . . . we might actually expect a robot to flip the switch. The participants in Malle’s experiment blamed the robot more if it didn’t step in and intervene. And the more machine-looking the robot was, the more they blamed it . . .

-- Kristen Clark at IEEE Spectrum
New Research Spaces: HRI Lab and Robotics/IOT Lab

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<td>The Human-Robot Interaction (HRI) Lab is another new addition to the HCRI. The HRI lab is a simulated smart living room environment, that will be equipped with Kinect motion sensors, camera equipment, and humanoid robots, among others. This room will be used for testing everything from toy robots for the elderly to developing next generation ethical frameworks for robots.</td>
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<td>The new HCRI space also features the Robotics/Internet of Things (IOT) lab. Here students can take advantage of a sandbox style makerspace that gives the campus community a place to learn by creating. The lab features a variety of equipment that can be used to prototype robots and IOT devices. It joins the Brown Design Workshop and the Cogut Physical Media Lab as a campus robot building space.</td>
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### IOT meets Robots
The build space in the IOT/Robotics lab includes soldering stations, a 3D printer, a PCB CNC, embedded computers, basic electronics supplies and everything needed to get a project from ideation to prototype. HCRI has sponsored the supplies in the lab giving students an area where they can easily build a low cost prototype and not have to worry about where to find the parts online.

### Robots in Homes
The HCRI envisions a future in which robots in the home are a ubiquitous part of everyday life. As such, the HRI lab serves as a space to study near future human-robot interaction in household environments. We hope to use this space to better understand the types of interactions people would prefer with robots and improve the utility of robots in these types of environments.

“The spaces will help Brown students and faculty push forward inquiry around Human Robot Interaction and engage in the application of Human Centered Design to Robotics.”

-- Peter Haas
Associate Director HCRI
At the core of the Humanity Centered Robotics Initiative are the researchers undertaking robotics research at Brown. Researchers who opt to be part of the HCRI get support in undertaking their research, including administrative support in writing major grants, support in building corporate partnerships, connections with other researchers for collaborations, access to robots, support with PR, access to robotics research spaces, and seed exploration grants.

Keeping with the HCRI goal of promoting cross disciplinary research, HCRI members come from various departments, from Ecology and Evolutionary Biology to Economics. Our goal is that Brown becomes known as an institution where robotics research is not limited to Computer Science and Engineering.

What is the aim of your research?

"[My aim is] to construct robots that seamlessly use natural language to communicate with humans... In twenty years, every home will have a personal robot which can perform tasks like clearing the dinner table, doing laundry and preparing dinner... But to achieve this aim, it is essential for robots to move beyond merely interacting with people and toward collaboration."

--Stefanie Tellex
CS Assistant Professor in Wired Magazine
What are you working on?

“Social robotics: robotics learning from humans, interacting with humans, and making ethical decisions.”

-- James MacGlashan, Adjunct Assistant Professor CS

“I published research on people’s perception of robots’ perceptual ability and mental agency at HRI 2016. Also I conducted research on the ethical issues of self-driving cars.”

--Xuan Zhao, Graduate Student CLPS
Tellex thinks the way robots will get faster and smoother at picking up unfamiliar objects is to give them programs that let them learn from experience.

—Joe Palca, NPR

Featured Research: Million Object Challenge

Helping Robots Pick Things Up

Most robots can’t pick up most objects most of the time. Tellex aim to change that by using a fleet of Baxter robots to construct a corpus of manipulation experiences for one million real-world objects. Existing collections consist of photos taken by a human photographer and may contain many examples of objects, but typically only a single view of each individual object. To bridge this gap, Tellex is building software for an industrial robot, the Baxter, to automatically collect a database of object models.

Highlights of results:

Largest deployment of Baxter robots on a single research challenge, with up to 300 participants. Featured on NPR.

Future plans:

Release of data and new software to the participant cohort. Patent and Licensing Exploration
Featured Research: Full Scale Telepresence

Making Telepresence More Human

Telepresence robots have a reputation for being impersonal. Most have a small screen that embodies the presenter as a “talking head” incapable of full human gesture and interaction. Some people go so far as to dress Telepresence robots to hide their frames. This prototype explores what happens if you extend the robot’s screen size to almost the size of a full human. How does the interaction with the robot change?

“We further developed our designs for telepresence robots by integrating smart phones and servo motors to help us imagine how the robot might interact with its environment.”

--Ian Gonsher in Make Magazine

Highlights of results:
- Full Mobile Prototype, Projection Version Prototype

Future plans:
Classes: Designing Humanity Centered Robots

HCRI sponsors the Designing Humanity Centered Robots course in the Brown Design Workshop, where students build robots for real world challenges.

Enabling Mobility

Students spent the semester applying human centered research methods to the design of robots for elderly populations. “Walkerbot” emerged from user feedback that identified two modes for use: First as an aid for mobility, and second as an autonomous telepresence robot.

Telepresence

In addition to the “Walkerbot” students built their own telepresence bot as an alternative to the Beam robots. They started with the electronic guts of a Roomba, the vacuum-cleaner robot, and equipped the machine with a robotic arm that can be raised to push elevator buttons. The design also includes a head-tracking device that transmits signals to allow for head movement on the robot.
“What we’ve discovered is that people who write a lot of code tend not to make things with their hands. People who make things with their hands don’t always know how to do code... [this class is] a nice mix of different peoples’ skills.”

-- Ian Gonsher

Hands On Skills

Designing Humanity Centered Robots gives students the opportunity to develop a technical foundation for designing and building robots. They also critically engage how technology might change human behavior and society in speculative near future scenarios.

Varied Background

The class can most easily be described as one half science fiction, one half science fact. Students iteratively design, build, and critique projects, drawing on the diversity of the teams from across campus, including engineers, designers, computer scientists, as well as designers and social scientists.

Rapid prototyping UI/UX considerations

Varied Background
Events: Robot Block Party

Location: Pizzitola Sports Center April 9, 2016

Summary: Rhode Island Robot Block Party, an expo founded by the Rhode Island Students of the Future in partnership with the Humanity Centered Robotics Initiative and the Department of Computer Science, highlights the innovation of Rhode Island’s robotic community. Bringing together industry, universities, community organizations, and K-12 schools, it’s open to the public and includes numerous pieces of robotic equipment that range from ocean exploration devices to animatronic toys. The event was a Rhode Island Monthly Editor’s Choice “Best of” Award winner in 2015.

Impact:


Groups attended from Brown, Harvard, Johns Hopkins, Johnson and Wales, Roger Williams, Rutgers, Temple, Union College, University of Delaware, University of Massachusetts, Amherst, University of Rhode Island, Worcester Polytechnic Institute, Yale.
“Robotics technology will fuel a broad array of products and solutions in manufacturing, health care, agriculture, national defense, and transportation. Robots are also an engaging way for young students to learn about science, technology, engineering, and math . . . Robot Block Party is a fun way to build the skills that prepare our students for a 21st century workforce.”

-- Rhode Island Governor Gina Raimondo
Bringing new ideas to Brown:

Rapid advances in robotic technologies in the military, medicine, education, and other areas demand a careful examination of the potentially transformative impact of robotics on society. The transformation could be positive: providing access to services previously unattainable, raising productivity; and enhancing safety and quality of life. But the transformation could also be negative: restricting access to services to only those who can afford new technology; replacing whole segments of the human workforce; and endangering people’s psychological safety.

Our speaker series and conferences explore these ideas in a public forum.

Speaker Series

David McAllester - Strong AI: Prospects and Control
There continues to be public concern over the near-term possibility of strong AI - human level intelligence in machines. This talk presented the case that near-term strong AI is plausible and when it does arrive it will have a profound impact on society that requires explicitly programmed controls.

Satinder Singh - RL: From Vision to Action and Back
Building on the great successes of Supervised Machine Learning the field of Reinforcement Learning (RL) has achieved new milestones. Satinder described some results on a simple new connection between planning horizon and overfitting in RL, and combining RL with Deep Learning in Atari games and Minecraft.

Cynthia Matuszek - Robotic Acquisition of Grounded Semantic Concepts
This talk described robots that can learn to follow instructions, understand descriptions of objects, and build models of language and the physical world, all from interactions with users. It discussed work on allowing robots to learn from untrained end-users in an intuitive way.

Bilge Mutlu: Human-Centered Principles and Methods for Designing Robotic Technologies
To achieve complex but intuitive robot-human interactions, developers must simultaneously address human and computational challenges. This talk presented work on building human-centered guidelines, to address these challenges to facilitate the design of robotic technologies that are more effective, intuitive, and even enjoyable.

Jean Francois Bonnefon: Experimental Ethics for Driverless Cars
The wide adoption of self-driving Autonomous Vehicles (AVs) promises to dramatically reduce the number of traffic accidents. In the accidents that do happen, this talk asserted people want their cars to protect them and other cars to simply minimize death toll.
Jeffrey Siskind: Decoding the Brain to Help Build Machines
Humans can describe observations and act upon requests, requiring that language be grounded in perception and motor control. This talk presented a system that learns the meanings of nouns and prepositions from video, paired with sentential descriptions of such activity.

Noah Goodman: PPLs: Principles, Implementations, and Applications
Probabilistic Programing Languages (PPLs) are formal languages for probabilistic modeling, in which distributions are described via programs with random choices. This talk discussed a number of techniques for fast and efficient inference in arbitrary probabilistic programs, including Metropolis-Hastings, Hamiltonian Monte Carlo, and Sequential Monte Carlo.

Jeffrey Bigham: Transitioning Crowd-Powered Systems to Computation
This talk addressed using crowd-powered systems that solved characteristic “hard” problems to help people get things done in their everyday lives. Recently, this crowd approach is shifting to computation in domains such as (i) ubiquitous sensing, (ii) speech recognition, (iii) conversational assistance, and (iv) vision.

Matt Klingensmith: Articulated SLAM
This talk addressed using visual Simultaneuos Localization and Mapping (SLAM) techniques for robot manipulation. It mapped one kind of visual SLAM technique, Kinect Fusion, to the robot’s configuration space, and showed how the robot’s joint encoders can be used appropriately to inform the pose of the camera.

Lawson Wong: Object-based World Modeling and State Estimation for Mobile-Manipulation Robots
Mobile-manipulation service robots rarely know the exact state of the world, unlike industrial robots in structured environments. Mobile-manipulation robots therefore need to continuously perform state estimation. This talk proposed a world model based on objects, their ‘semantic’ attributes (such as type and pose), and their geometric realizations in the physical world.

SIROs Symposium:
This symposium brings together scholars and practitioners from multiple disciplines to examine the difficult questions: What are our obligations to shape this transformation to be positive? How can we contribute to such a positive shaping? And what legal and ethical norms may have to be established to foster a harmonious growth toward a future society with robots?

The next SIROs symposium will take place March 31st 2017, and will be co-hosted by HCRI and the WeRobot robotic policy conference. HCRI is co-organizing WeRobot 2017.
Malle points out that autonomous vehicles are just the tip of the robot-human interaction iceberg. While the international community has extensively discussed the ethics of autonomous weapons, artificial intelligence in health care and robots that care for the sick and elderly are proliferating — yet there has been little discussion about the moral decision-making of robots in homes and hospitals.

-- Kate Allen, The Toronto Star

Malle and Littman participated in the Hasbro, Brown Medical/Lifespan, Optum - Health Summit & Brainstorm Meeting at Hasbro, Pawtucket. The goal was to explore possible research collaborations that integrate basic science and the technology of robotic animals to make a difference in health prevention and monitoring, elderly care, social companionship, and the like. As a result of this and follow-up meetings, Malle, Littman, Epstein-Lubow and Armey (Alpert Medical School and Butler Hospital) submitted a proposal with Hasbro to NSF’s Partnership for Innovation (PFI) competition, entitled “Affordable Robotic Intelligence for Psychosocial Support in Elderly Populations.” This proposal focuses on designing and validating improvements to Hasbro’s robotic cat for the elderly. The project is especially concerned with patients suffering from dementia. The proposal was invited for resubmission in 2016.
Featured Grant Awards

- Malle, Littman, Austerweil (Brown), and Scheutz (Tufts) received a grant from DARPA on Foundations of Human–Machine Collaboration: Networks of Social and Moral Norms in Human and Artificial Agents, in November 2015
- Tellex received a grant for Reducing Errors in Human-Robot Communication With Real-Time Feedback from DARPA in September 2015
- Tellex, Littman received a grant for Large: Collaborative Research: A Framework for Hierarchical, Probabilistic Planning and Learning from NSF in July 2015
- Tellex, Littman received a grant for Autonomously Acquiring Models for Verbs in the Field from General Dynamics, in May 2016

Featured Pending Grants

- Littman, Malle are awaiting notice from the NSF on a grant entitled Creating Competent Robots Via Cumulative Learning from Human Teachers
- Tellex is awaiting notice from the NSF on a grant entitled CAREER: Robots that Help People
- Tellex is awaiting notice from Intel on a grant entitled Timelapse Light Field Photography with a Seven-Degree of Freedom Arm
- Tellex is awaiting notice from NASA on a grant entitled Human-Robot Collaboration on Complex Tasks
- Tellex is awaiting notice from NSF on a grant entitled NRI: Collaborative Research: A Framework for Hierarchical, Probabilistic Planning and Learning

Hardware Spotlight:

Bahar, Reda, Kellner and Jenkins received a Brown Seed Grant in 2014 for “Enabling Autonomous Flight of Drones in complex, unpredictable environments.” and as a result of this submitted a grant to the NSF for “Enabling Characterization of Tropical Rainforest Environments via Autonomous Flight Planning and Navigation of Drones”

This research project spawned a number of other grants in the area of hardware design for energy efficient vision processing and autonomous navigation in drones. It resulted in a Draper Fellowship for Christopher Picardo providing a model for other Draper Fellows at Brown.
CESSR Proposal

In 2017 HCRI will begin the process of developing a proposal for the establishment of a NSF Science and Technology Center at Brown.

The Center for Ethical and Safe Social Robots (CESSR) will conduct research on robotic systems that interact with people for the benefit of people.

As the research community makes steady progress on the basic problems of robot perception, decision making, and motion, we expect increasing numbers of robots engaged in productive interactions with the general public.

CESSR will address this coming Human Robot Interaction problem.

HCRI Goals 2016-17

Research

In 2016-2017, HCRI aims to leverage the increase in space and staff resources put in place at the end of the prior fiscal year to significantly increase robotic research opportunities.

HCRI aims to facilitate collaboration among Brown researchers by providing access to robots, robotic research and building spaces and specialized network access. Using seed grants, awards and hackathons, it hopes to inspire new research which can be leveraged for the development of proposals and corporate partnerships. Longer term, HCRI looks to develop opportunities for corporate partnerships and the commercialization and licensing of robotic research performed at Brown.

Research Space and Robots

HCRI aims to facilitate members, Faculty, and Students doing research in three spaces on campus.

The first space is the newly opened 8th floor of the Sciences Library, which houses the Human Robot Interaction testing area with a motion capture and camera tracking system, a robot build area in the Internet Of Things Lab, and numerous breakout tables to be used for student classes and hackathons.

The Robotics Lab in CIT 115 and 121 will continue as traditional robotics testing areas with a focus on software development.

The Brown Design Workshop (BDW) will be used for building robots.

HCRI is also investigating an appropriate location for UAV research on Brown’s campus.

HCRI is ensuring all these spaces are part of the Brown RLAB wireless network, supporting special access for headless computers and robots. This will allow researchers and students to easily move robots between the areas without network connectivity issues.
**Events**

HCRI will continue the Robot Block Party in 2017, with an eye towards expanding the exhibition space. In late 2016 or early 2017 HCRI, will sponsor its first faculty/student hackathon in robotics.

**Symposium and Speakers**

The regular speaker series will continue and the SIRoS symposium will be launched again in conjunction with WeRobot 2017.

**Seed Grants and Awards**

HCRI plans to start providing seed grants to faculty in late 2016. In addition it will be working with OVPR to develop an annual robotics prize for faculty and students.

**Curriculum Leadership**

HCRI will work with faculty to set a new direction for robotics curriculum at Brown making a cohesive approachable path for students.

“[People are] blurring the line between AI technology of the kind that we’re familiar with, and a kind of super-intelligent, willful entity ... The latter is pure fantasy and a significant distraction from attempts to develop technology to help”

-- Michael Littman in TechRadar
Designing Better Robots for Humanity