

# Charles C. Kemp

Health Systems Institute  
*The Wallace H. Coulter Department of Biomedical  
Engineering at the Georgia Institute of Technology  
and Emory University*  
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(publications available on website)

## EDUCATION

- Ph.D.**, Massachusetts Institute of Technology  
2005, Electrical Engineering and Computer Science  
Thesis: A Wearable System that Learns a Kinematic Model and Finds Structure in Everyday Manipulation by using Absolute Orientation Sensors and a Camera  
Adviser: Prof. Rodney Brooks
- M.Eng.**, Massachusetts Institute of Technology  
1998, Electrical Engineering and Computer Science
- B.S.**, Massachusetts Institute of Technology  
1997, Computer Science and Engineering

## RESEARCH EXPERIENCE

- Assistant Professor** Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University, August 2007 – present
- Director** Center for Healthcare Robotics in the Health Systems Institute, November 2006 – present
- Senior Research Scientist** Health Systems Institute and Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University, September 2006 – August 2007  
Started an interdisciplinary research program in healthcare robotics. Developed proposals to fund research into core technologies for human-robot interaction and autonomous robot manipulation for telemedicine, medical automation, and assistive mobile manipulation. Designed and led the development of an innovative robot for assistive mobile manipulation in home environments. The resulting robotic platform supports several active research projects.
- Postdoctoral Research** M.I.T., CSAIL, September 2005 – July 2006  
Research Adviser: Rodney Brooks  
Created new methods for manipulation in human environments for the humanoid robot Domo, including novel approaches to tool use, visual-motor learning, human-robot interaction, and assistive applications. Developed applications in collaboration with Aaron Edsinger that enabled Domo to help a seated person place everyday objects on a shelf, or perform everyday bimanual tasks such as pouring and stirring. Adapted a wearable vision system to humanoid robots (Obrero, Mertz, and Domo). Worked with Bryan Adams to develop a system that autonomously monitors a Roomba and assesses its performance.
- Doctoral Research** M.I.T., AI Lab and CSAIL, December 1998 – May 2005  
Research Adviser: Rodney Brooks  
Created the first wearable system to autonomously infer a kinematic model of the wearer via body-mounted orientation sensors and a head-mounted camera. Demonstrated applications for this fully untethered system, such as browsing the wearer's activities, acquiring image segments of the wearer's hand and manipulated objects, and discovering significant arm postures. Worked on the mobile manipulation platform Cardea, which used a single compliant robot arm on a Segway RMP mobile platform to navigate down a hall and find, open, and pass through a door. Created the first system to use a shoe-mounted camera to perform gait analysis, obstacle detection, and context recognition (joint work with Paul Fitzpatrick). Designed real-time machine vision systems to enable robotic platforms to better interact with humans including Yuppy, a wheeled mobile robot, and Coco, a quadrupedal

robot. Created the distributed software infrastructure for Coco, and collaborated on the overall design of Yuppy and Coco, including motor control, vestibular sensing, auditory processing, and high-level behavior control.

**Doctoral Area Exam** M.I.T., AI Lab, Fall 2001

Committee: Professors Hal Abelson, Leslie Kaelbling, and Marvin Minsky

“Think Like a Rat”: Evaluated computational models of the rat hippocampus based on in-vivo multi-electrode array recordings, provided extensions, and proposed future research.

**Master’s Research** M.I.T., AI Lab, Winter 1996 - December 1998

Research Adviser: Rodney Brooks

Wrote software for tracking and simple segmentation on robotic stereo vision platforms, including the humanoid robot Cog.

**Summer Intern** Texas Instruments, Dallas, TX, Summer 1993

Analyzed software engineering practices of a large software product division.

**Summer Intern** Texas Instruments, Dallas, TX, Summer 1992

Supervisor: Dr. Bruce Flinchbaugh

Developed innovative user interface designs for a vision database for intelligent surveillance at TI research.

**Research Specialist** Forward Concepts, Dallas, TX, Summer 1991

Supervisor: Will Strauss

Researched and assessed the future market for multimedia technology through a literature review and conference participation.

**RESEARCH INTERESTS**

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**Autonomous robot manipulation**

**Healthcare robotics** (e.g., assistive robots, telemedicine, medical automation, and rehabilitation)

**Human-robot interaction**

**Perception and learning for intelligent systems**

**PUBLICATIONS**

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Hai Nguyen, Advait Jain, Cressel Anderson, and Charles C. Kemp. “A Clickable World: Behavior Selection Through Pointing and Context for Mobile Manipulation.” *In IEEE/RJS International Conference on Intelligent Robots and Systems (IROS)* (To be published in September, 2008).

Travis Deyle, Charles C. Kemp, and Matt Reynolds. “Probabilistic UHF RFID tag pose estimation with multiple antennas and a multipath RF propagation model.” *In IEEE/RJS International Conference on Intelligent Robots and Systems (IROS)* (To be published in September, 2008).

Travis Deyle, Cressel Anderson, Charles C. Kemp, and Matt Reynolds. “A foveated passive UHF RFID system for mobile manipulation.” *In IEEE/RJS International Conference on Intelligent Robots and Systems (IROS)* (To be published in September, 2008).

Advait Jain and Charles C. Kemp. “Behaviors for Robust Door Opening and Doorway Traversal with a Force-Sensing Mobile Manipulator.” *RSS Manipulation Workshop: Intelligence in Human Environments* (2008).

Charles C. Kemp, Paul Fitzpatrick, Hirohisa Hirukawa, Kazuhito Yokoi, Kensuke Harada, and Yoshio Matsumoto. *Springer Handbook of Robotics*, chapter 56: Humanoids (Springer, 2008).

Hai Nguyen, Cressel Anderson, Alexander J. Trevor, Advait Jain, Zhe Xu, and Charles C. Kemp. “El-E: An Assistive Robot that Fetches objects from Flat Surfaces.” *HRI Workshop on Robotic Helpers: User Interaction, Interfaces and Companions in Assistive and Therapy Robots* (2008).

- Charles C. Kemp, Cressel Anderson, Hai Nguyen, Alexander J. Trevor, and Zhe Xu. “A Point-and-Click Interface for the Real World: Laser Designation of Objects for Mobile Manipulation.” *In 3rd ACM/IEEE International Conference on Human-Robot Interaction (HRI)* (2008).
- Aaron Edsinger and Charles C. Kemp. *Recent Progress in Robotics: Viable Robotic Service to Human*, volume 370 of *Lecture Notes in Control and Information Sciences*, chapter : Two Arms Are Better Than One: A Behavior Based Control System for Assistive Bimanual Manipulation, pp. 345–355 (Springer, Berlin / Heidelberg, 2008).
- Cressel Anderson, Ben Axelrod, J. Philip Case, Jaeil Choi, Martin Engel, Gaurav Gupta, Florian Hecht, John Hutchinson, Niyant Krishnamurthi, Jinhan Lee, Hai Dai Nguyen, Richard Roberts, John G. Rogers, Alexander J. B. Trevor, Henrik I. Christensen, and Charles Kemp. “Mobile manipulation: a challenge in integration.” *Unmanned Systems Technology X* (2008).
- Aaron Edsinger and Charles C. Kemp. “Human-Robot Interaction for Cooperative Manipulation: Handing Objects to One Another.” *In Proceedings of the 16th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)* (2007).
- Aaron Edsinger and Charles C. Kemp. “Two Arms are Better than One: A Behavior-Based Control System for Assistive Bimanual Manipulation.” *In Proceedings of the 13th International Conference on Advanced Robotics (ICAR)* (2007). **best paper finalist (top 4)**.
- Charlie Kemp. “Three Broad Themes for Testing Machines.” *IEEE CIS AMD Newsletter* **4**, 6–7 (2007).
- Charles C. Kemp, Aaron Edsinger, and Eduardo Torres-Jara. “Challenges for Robot Manipulation in Human Environments.” *IEEE Robotics & Automation Magazine* <sup>1</sup> **14**, 20–29 (2007).
- Charles C. Kemp. “Wearables and Robots: A Shared View.” *IEEE Pervasive Computing* **5**, 16–20 (2006).
- Aaron Edsinger and Charles C. Kemp. “Manipulation in Human Environments.” *In Proceedings of the IEEE-RAS International Conference on Humanoid Robotics (Humanoids06)* (2006). **best paper award**.
- Aaron Edsinger and Charles C. Kemp. “What Can I Control? A Framework for Robot Self-Discovery.” *In Proceedings of the Sixth International Conference on Epigenetic Robotics (EpiRob 2006)* (2006).
- Charles C. Kemp and Aaron Edsinger. “What Can I Control?: The Development of Visual Categories for a Robot’s Body and the World that it Influences.” *In 5th IEEE International Conference on Development and Learning (ICDL5): Special Session on Perceptual Systems and their Development* (2006).
- Charles C. Kemp and Aaron Edsinger. “Robot Manipulation of Human Tools: Autonomous Detection and Control of Task Relevant Features.” *In 5th IEEE International Conference on Development and Learning (ICDL5): Special Session on Classifying Activities in Manual Tasks* (2006).
- Charles C. Kemp and Aaron Edsinger. “Visual Tool Tip Detection and Position Estimation for Robotic Manipulation of Unknown Human Tools.” Technical Report AIM-2005-037 (2005).
- Charles C. Kemp. *A Wearable System that Learns a Kinematic Model and Finds Structure in Everyday Manipulation by using Absolute Orientation Sensors and a Camera*. Ph.D. thesis, Massachusetts Institute of Technology (2005).
- Rodney Brooks, Lijin Aryananda, Aaron Edsinger, Paul Fitzpatrick, Charles Kemp, Una-May O’Reilly, Eduardo Torres-Jara, Paulina Varshavskaya, and Jeff Weber. “Sensing and manipulating built-for-human environments.” *International Journal of Humanoid Robotics* (2004).
- Paul Fitzpatrick and Charles C. Kemp. “Shoes as a Platform for Vision.” *In Seventh IEEE International Symposium on Wearable Computers (ISWC)*, pp. 231–234 (2003).

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<sup>1</sup>RAM has consistently been ranked among the top four robotics publications world wide. It is anonymously peer reviewed.

Charles C. Kemp. "Duo: A Human/Wearable Hybrid for Learning About Common Manipulable Objects." *In Proceedings of the Third IEEE International Conference on Humanoid Robots (Humanoids 2003)* (2003).

Artur Arsenio, Paul Fitzpatrick, Charles C. Kemp, and Giorgio Metta. "The Whole World in Your Hand: Active and Interactive Segmentation." *In Proceedings of the Third International Workshop on Epigenetic Robotics* (2003).

Rodney A. Brooks, Cynthia Breazeal (Ferrell), Robert Irie, Charles C. Kemp, Matthew Marjanovic, Brian Scassellati, and Matthew M. Williamson. "Alternative Essences of Intelligence." *In AAAI '98*, pp. 961–968 (1998).

Cynthia B. Ferrell and Charles C. Kemp. "An Ontogenetic Perspective to Scaling Sensorimotor Intelligence." *In Embodied Cognition and Action: Papers from the 1996 AAAI Fall Symposium* (1996).

## TEACHING

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**Instructor** Georgia Tech, Spring 2008

"BMED 3400 Introduction to Biomechanics"

Instructor for this required upper-level undergraduate biomedical engineering course that is typically taken by juniors and seniors. The class intensively covers statics, mechanics of materials, kinematics, and dynamics as applied to biomechanical systems. My responsibilities include developing the schedule and syllabus, managing the course, preparing and giving lectures, and writing exams.

**Co-instructor** Georgia Tech, Fall 2007, Spring 2008

"CS/AE/ECE/ME/BME 8750, Multidisciplinary Robotics Research I"

Course requires a semester-long research project under the guidance of at least two faculty members from distinct participating schools (AE, BME, CoC, ECE, or ME). Students must write a proposal, perform and write up a literature survey, perform research and write and present a conference-style paper.

**Advait Jain** spring 2008, instructed with Prof. Henrik Christensen (CoC), Topic: force/torque sensing and control for opening doors and drawers

**Maya Cakmak** fall 2007, instructed with Prof. Henrik Christensen (CoC), Topic: Object Manipulation and Developmental Robotics

**Hai Nguyen** fall 2007, instructed with Prof. Tucker Balch (CoC), Topic: Information Networks in the Ant *Aphaenogaster cockerelli*

**Alex Trevor** fall 2007, instructed with Prof. Ayanna Howard (ECE), Topic: Autonomous Toy Manipulation for Therapeutic Play

**Co-instructor** Georgia Tech, Spring 2007

"4632B/8803 Advanced Intelligent Robotics - Mobile Manipulation"

Co-instructor with Henrik Christensen on new graduate level course. Developed and presented lectures, and advised students on projects. Students used a mobile manipulator (Segway RMP 200 base, KUKA KR5 Sixx arm, Schunk PG 70 2-finger parallel gripper, SICK LMS291 laser range finder, and a Unibrain Fire-i camera) to prepare and serve coffee.

**Guest Lecture** February 9, 2007

"Health Systems Information Technology, HS 6300"

Lecture title: "Healthcare Robotics"

**Teaching Assistant** M.I.T., Spring 2000

"Embodied Intelligence"

Helped with homework assignment design, graded homework assignments, advised students on projects, evaluated projects, and held office hours for students.

**Guest Lecturer** MIT Summer Professional Institute, Summer of 1998 and Summer of 1999

"Embodied Intelligence"

## PRESENTATIONS, POSTERS AND DEMONSTRATIONS

- HRI2008: Workshop on Helper Robots** Amsterdam, NL, March 12, 2008.  
presentation, “EI-E: An assistive robot that fetches objects from flat surfaces”
- Daniel Wolpert’s Lab** University of Cambridge, Cambridge, UK, July 2007.  
invited presentation to lab group, “Autonomous Robot Manipulation for Healthcare”
- International Conference on Development and Learning (ICDL)** London, UK, July 2007.  
invited talk, “How much can robots do for us without learning and developing?”
- Health Systems Student Symposium** Atlanta, Georgia, April 27, 2007.  
keynote presentation, “Healthcare Robotics”
- Sixth International Conference on Epigenetic Robotics** Paris, France, September 2006.  
presentation, “What Can I Control? A Framework for Robot Self-Discovery”
- International Conference on Development and Learning (ICDL)** Bloomington, IN, June 2006.  
presentation, “Robot Manipulation of Human Tools: Autonomous Detection and Control of Task Relevant Features”
- NASA** Kennedy Space Center, Florida, May 2006.  
presentation, “Tooltip Detection for Robot Manipulation”
- PyCon2006** Dallas, TX, February 2006.  
presentation, “pysense: Humanoid Robots, a Wearable System, and Python”
- Workshop on Humanoid Manipulation at Robotics: Science & Systems** Cambridge, MA, June 2005.  
poster, abstract and demo, “Capturing Everyday Human Manipulation”
- International Symposium on Wearable Computers** Arlington, VA, 2004.  
poster and demo, “Duo: A Wearable System for Learning about Everyday Objects and Actions”  
abstract in *The Eighth International Symposium on Wearable Computers (ISWC)*, pp. 182-183.
- International Symposium on Wearable Computers** White Plains, NY, 2003.  
presentation, “Shoes as a Platform for Vision”
- IEEE International Conference on Humanoid Robots** Munich, Germany, 2003.  
presentation, “Duo: A Human/Wearable Hybrid for Learning About Common Manipulable Objects”
- DARPA Omni LifeLog Workshop** Washington D.C., 2002.  
presentation, “Humans as Robots”
- AAAI Fall Symposium: Embodied Cognition and Action** Cambridge, MA, 1996.  
presentation, “An Ontogenetic Perspective to Scaling Sensorimotor Intelligence”

## HONORS AND AWARDS

- Best paper finalist (top 4)** International Conference on Advanced Robotics 2007
- Best paper award** IEEE-RAS International Conference on Humanoid Robotics 2006 (Humanoids06)
- Tau Beta Pi** member, national engineering honor society
- Sigma Xi** member, scientific research society
- Eta Kappa Nu** member, EE/CS national honor society

## ACADEMIC SERVICE

### *Committees*

- BME Admissions Committee** fall 2007, spring 2008
- Robotics PhD Program Committee** fall 2007, spring 2008

*Dissertations and Proposals*

**Dissertation Committee** Shane Migliore (ECE - BIOE), December 2007, The Role of Passive Joint Stiffness and Active Knee Control in Robotic Leg Swinging: Applications to Dynamic Walking

**Proposal Committee** Young Sang Choi (ISyE), February 2008, A Study of Human Robot Interaction with an Assistive Robot for People with Severe Motor Impairments - User Needs Assessment and Human Evaluation

**Proposal Committee** Sekou L. Remy (ECE), December 2007, How to Teach a New Robot New Tricks - An Interactive Learning Framework Applied to Service Robotics

*Conferences, Workshops, and Journals*

**RSS 2008** Workshop Chair

**RSS 2008 Manipulation Workshop: Intelligence in Human Environments** co-organizer

**RSS 2007 Manipulation Workshop: Sensing and Adapting to the Real World** lead organizer

**RSS 2006 Workshop: Manipulation for Human Environments** lead organizer

**Robotics: Science and Systems (RSS)** reviewer 2008

**AAAI-07** program committee member

**International Conference on Development and Learning (ICDL)** reviewer 2007, Publicity Chair and Program Committee member 2008

**The International Journal of Robotics Research (IJRR)** reviewer 2007

**International Journal of Humanoid Robotics (IJHR)** reviewer 2006, reviewer 2007

**International Journal of Human-Computer Interaction (IJHC)** reviewer 2006, reviewer 2007, editorial board 2008

**Robotics & Automation Magazine** reviewer 2006, reviewer 2007

**International Conference on Intelligent Robots and Systems (IROS)** reviewer 2007, reviewer 2008

**International Conference on Robotics and Automation (ICRA)** reviewer 2008

**International Symposium on Robot and Human Interactive Communication (RO-MAN)** reviewer 2008

**The Robot Manipulation Reading Group at MIT CSAIL** founder and leader in 2006

MEDIA COVERAGE

**Various Online Publications**

Google News indicates that over 100 web-based publications carried a story on El-E in March 2008. Presumably, some percentage of these publications included it in print as well. Web publications included: Forbes, USA Today, Newsweek, ABC News, MSNBC, FOXNews, Boston Globe, Atlanta Journal Constitution, Seattle Times, Houston Chronicle, San Francisco Chronicle, Mercury News, Toronto Star, Times of India, Mumbai Mirror Online, News Post India, Thaindian News (Thailand), Sydney Morning Herald, The Register, Personal Computer World (UK), United Press International, Dallas Morning News Technology Blog, PhysOrg.com, Wired blog, engadget, eurekaalert, hardware.slashdot.org, Medical News Today, MedGadget

**Technology Review Online**

“A Robotic Helping Hand: Georgia Tech’s prototype robot responds to instructions given with an ordinary laser pointer” by Kristina Grifantini  
Monday, March 24, 2008

**New York Times**

"An Assistant Who May Need the Occasional Battery" by Anne Eisenberg  
Sunday, March 16th, 2008

**Associated Press**

"Researchers Show Off Laser-Guided Robot" by Greg Bluestein  
March 12, 2008

**Nursing Spectrum Magazine**

"Robots Become Nurses' Valuable Assistants" by Janet Boivin, RN, and Scott Williams  
I am quoted for the opening and closing of the article and a description of El-E is included.  
Monday March 10th, 2008

**Taiwan's Business Weekly**

Full page image on pg. 75 of issue #925 as part of an article on CSAIL  
August 15, 2005 publication date

**CNN "Mystery of Memory"**

Interview and demonstration for this Dr. Sanjay Gupta special  
First aired nationwide on March 27th, 2005 and has been rerun several times

**Ivanhoe Productions "Man or Machine? Part 1: Human or Robot?"**

Interview and demonstration  
Aired nationwide on many local news programs in mid-2003

**CITIZENSHIP**

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U.S. Citizen