

Henry M. Clever

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RESEARCH INTERESTS

I am interested in modeling and perceiving humans in complex environments, and improving the ability of robots to interact with them and provide meaningful assistance. My research has explored how computationally efficient physics simulators can be used to model sensors and humans in the presence of occlusion and physical contact. With such models, it is possible to generate synthetic data at scale for training deep networks that transfer to real world data. My work explores unconventional sensing modalities including pressure imagery, depth imagery, capacitive sensing, thermal sensing, and force sensing to perceive the world and humans in challenging settings. I have used these perception models to control robots to physically interact with people, and I am broadly interested in improving the safety and functionality of robot manipulation. My work spans research in the fields of haptics, machine learning, optimization, control, mechanics and multi-robot systems, to enhance machine perception and robot behavior in the real world.

EDUCATION

Georgia Institute of Technology, Atlanta, GA Ph.D. Robotics, Advisor: Charles C. Kemp	2016 - Present
New York University Tandon School of Engineering, Brooklyn, NY M.S. Mechanical Engineering, Advisor: Joo H. Kim	2014 - 2016
The University of Kansas, Lawrence, KS B.S. Mechanical Engineering, Advisor: Sarah L. Kieweg	2009 - 2014

PUBLICATIONS

Clever, H.M., P. Grady, G. Turk, and C.C. Kemp. "Inferring Body Pose and Contact Pressure from a Depth Image." *Accepted for publication at IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI)*, 2022.

C.C. Kemp, A. Edsinger, **H.M. Clever**, and B. Matulevich. "The Design of Stretch: A Compact, Lightweight Mobile Manipulator for Indoor Human Environments." *Submitted to IEEE International Conference on Robotics and Automation (ICRA)*, 2022.

Clever, H.M., A. Handa, H. Mazhar, K. Parker, O. Shapira, Q. Wan, Y. Narang, I. Akinola, M. Cakmak, and D. Fox. "Assistive Tele-op: Leveraging Transformers to Collect Robotic Task Demonstrations." *NeurIPS 2021 Workshop on Robot Learning*, 2021.

Clever, H.M.*, T. Bhattacharjee*, J. Wade, and C.C. Kemp. "Material Recognition via Heat Transfer Given Ambiguous Initial Conditions." *IEEE Transactions on Haptics (ToH)*, 2021.

Erickson, Z., **H.M. Clever**, V. Gangaram, E. Xing, G. Turk, C.K. Liu, and C.C. Kemp. "Characterizing Multidimensional Capacitive Servoing for Physical Human-Robot Interaction." *Under review at IEEE Transactions on Robotics (T-RO)*, 2021.

Clever, H.M., Z. Erickson, A. Kapusta, G. Turk, C.K. Liu, and C.C. Kemp. "Bodies at Rest: 3D Human Pose and Shape Estimation from a Pressure Image using Synthetic Data." *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, 2020. **Accepted for oral presentation (5%).**

Erickson, Z., **H.M. Clever**, V. Gangaram, G. Turk, C.K. Liu, and C.C. Kemp. "Multidimensional capacitive sensing for robot-assisted dressing and bathing." *IEEE International Conference on Rehabilitation Robotics (ICORR)*, 2019. **Best Student Paper Award.**

Kapusta, A., Z. Erickson, **H.M. Clever**, W. Yu, C.K. Liu, G. Turk, and C.C. Kemp. "Personalized collaborative plans for robot-assisted dressing via optimization and simulation." *Autonomous Robots*, 2019.

Kapusta, A., P.M. Grice, **H.M. Clever**, Y. Chitalia, D. Park, and C.C. Kemp. "A system for bedside assistance that integrates a robotic bed and a mobile manipulator." *PLOS ONE*, 2019.

Clever, H. M., A. Kapusta, D. Park, Z. Erickson, Y. Chitalia, C.C. Kemp. "Estimating 3D Human Pose on a Configurable Bed from a Single Pressure Image," *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2018.

Erickson, Z., **H. M. Clever**, G. Turk, C. K. Liu, C. C. Kemp, "Deep Haptic Model Predictive Control for Robot-Assisted Dressing," *IEEE International Conference on Robotics and Automation (ICRA)*, 2018.

Bhattacharjee, T., **H. M. Clever**, J. Wade, C. C. Kemp. "Multimodal Tactile Perception of Objects in a Real Home." *IEEE Robotics and Automation Letters (RAL)*, 2018.

Grice, P.M., Y. Chitalia, M. Rich, **H.M. Clever**, C.C. Kemp. “Autobed: Open hardware for accessible web-based control of an electric bed.” *Rehabilitation Engineering and Assistive Technology Society of North America (RESNA)*, 2016.

Clever, H.M., Brown, A., Kapila, V. “Using an AR Drone Lab in a High School Classroom to Promote Quantitative Research.” *The 123rd Annual American Society of Engineering Education Conference and Exposition (ASEE)*, 2016.

Anwar, R., **H.M. Clever**, J. Fleenor, B. Hu, V. Kheyfets, H. Sis, S.L. Kieweg. “Thin Film Coating Flows in Vaginal Drug Delivery.” *7th World Congress of Biomechanics*, 2014.

Hu, B., **H.M. Clever** and Kieweg, S.L. "Contact Line Instability of Gravity-driven Flow of Powerlaw Fluids: Comparison of Experiments and Simulations", *The 66th Annual Meeting of the American Physical Society's Division of Fluid Dynamics (APS-DFD)*, 2013.

Clever, H.M., H. Evans, S.L. Kieweg. "Ultramouse: A communicative device which allows those with disabilities to operate a computer using head movement." *ASME International Mechanical Engineering Congress and Exposition Undergraduate Poster Presentation*, 2013.

PATENTS

H.M. Clever, C.C. Kemp. “System and Method to Monitor and Localize High Pressure Density Area on a Person in Contact with a Surface Using Depth Sensor”, U.S. Patent Application No. 63/187,917. Provisional Filing Date: May 12, 2021.

Kemp, C.C., **H.M. Clever**. “A Low-Cost General-Purpose Mobile Manipulator for Indoor Use”, U.S. Patent Application No. 15/924,052. Provisional Filing Date: March 20, 2017. Patent application submitted to USPTO March 2018.

- Technology licensed by Hello Robot, Inc. Company link: www.hello-robot.com
- Stretch RE-1 commercial robot unveiled in 2020, currently available for \$17,950
- Many top research labs in industry and academic have purchased a Stretch RE-1
- Called a “Beautifully simple, clever robot design” by IEEE Spectrum

Kemp, C.C., **H.M. Clever**. “Additional Hardware and Software for a Low-Cost General-Purpose Mobile Manipulator for Indoor Use”, U.S. Patent Application No. 15/924,088. Provisional Filing Date: February 5, 2018. Patent application submitted to USPTO March 2018.

AWARDS AND HONORS

NSF Graduate Research Fellowship (GRF)	2015 – 2020
President’s Fellowship – Georgia Tech	2016 – 2020
NRT – NSF Research Traineeship – Georgia Tech	2016 – 2018
Selected speaker – New York University President’s Global Council	2015
NSF G-K12 Fellowship: Applying Mechatronics to Promote Science – NYU	2014 – 2015
3rd place, University of Kansas Innovation and Collaboration Fair	2014
Wesley G. Kramer Scholar Award – University of Kansas	2014
2nd place, ASME IMECE Undergraduate Poster Competition	2013
3rd place, Sigma Xi Undergraduate Research Symposium – University of Kansas	2013
Undergraduate Research Award – University of Kansas	2013
Eagle Scout – Scouts of America	2006

WORK EXPERIENCE

NVIDIA Seattle Robotics Lab: Intern, Seattle, WA Robot manipulation, shared autonomy, and physics simulation	Summer 2021
Robots for Humanity: Design Engineer, Menlo Park, CA Collaboration between Willow Garage, Inc., Healthcare Robotics Lab, and Henry and Jane Evans	2012 – 2017
Project #1: The WOUSE: PR2 robot safety stop device Set of customized safety goggles to detect a wince on the user See www.ros.org/wiki/wouse for videos and further documentation	
Project #2: The Ultramouse: A device to control a computer cursor with head movement Watch the Ultramouse in action: www.youtube.com/watch?v=2kRi1g88mWI Featured on the evening news in Kansas City (KCTV5), Topeka–Capital Journal and used by a person with quadriplegia on TED Mid-Atlantic	
Project #3: The AutoBed: A device enabling control of a hospital bed via computer interface Watch the QuadRock, where the AutoBed enables a person with quadriplegia to dance: www.youtube.com/watch?v=-t5U4LzEz0Y	
Project #4: The Whiskey-bot: Assistive EEG-based drinking system Whiskey-bot in action: www.youtube.com/watch?v=D9E8Q1PQ9Mw Featured and described in TEDx Sonoma: www.youtube.com/watch?v=Tg7EHj74AKk	

- Briem Engineering: Intern, St. Louis, MO** 2011 – 2012
 Materials science, metallurgy, failure analysis
 Develop testing methods, operate precision testing equipment
- Frontenac Bank: Teller, St. Louis, MO** 2009 – 2010
 Customer service, account management, telephone reception, executive assistance

OUTREACH

- Undergraduate Research Mentor – Healthcare Robotics Lab, Georgia Tech** 2021 –
 Mentor highly motivated 2nd year biomedical engineering student
 Research project: modeling statically stable human pose at rest
- Vice President of Outreach – Robograds, Georgia Tech** 2019 – 2020
 Organize tours at Georgia Tech robotics labs for K-12 students
 Give robotics demonstrations at local libraries, schools, and community centers
- Teaching Assistant – Introduction to Biomechanics, Georgia Tech** 2017, 2020
 Sophomore level course in the Biomedical Engineering Department
 Lesson plan preparation, test preparation, recitation instructor
- NSF Summer Undergraduate Research in Engineering Robotics Program mentor** 2019
 Summer research immersion program for undergraduate students
 Mentored one student for a summer of research
 Taught programming in ROS and Unity for the Microsoft Hololens
- Applied Research Innovations in Science and Engineering program mentor, NYU** 2014 – 2016
 Research immersion program for 10th and 11th grade high school students
 Mentored five students throughout two summers of research
 Taught computer programming, circuits, basic control systems
- FIRST Robotics Club Leader – Millennium Brooklyn High School, Brooklyn, NY** 2014 – 2015
 Started robotics club and led weekly meetings, recruiting twenty students
 Taught students programming and hardware development
 Led students to build working robot and compete in First Tech Challenge (FTC) of NYC
- Teaching Assistant – Millennium Brooklyn High School, Brooklyn, NY** 2014 – 2015
 Ninth grade quantitative research class, co-instructor
 Mentor students with special needs, particularly Autism Spectrum Disorders (ASD)

SKILLS

Programming Languages – Python, C++, HTML, Javascript, CSS, MATLAB, Simulink, LabVIEW, PBASIC, Unity, C-Sharp

Software –NVIDIA FleX, NVIDIA PhysX, Dynamic Animation and Robotics Toolkit (DART) simulator, ROS, Gazebo, Patran/Nastran Finite Element Analysis, Solidworks, Autodesk, Visual 3D

Deep Learning – Pytorch, Pytorch Lightning, wandb.ai, differentiable geometry, Keras

Hardware – Robot building, soldering, electronic troubleshooting, machining, wood working, automotive repair