Teresa A. Kent

TeresaAKent@gmail.com |+1 301-254-3721 | TeresaAKent.com

Education

Doctor of Philosophy: Robotics Institute, Carnegie Mellon University: *School of Computer Science* Pittsburgh, PA, USA
GPA 3.67/4.3 November 2024
Thesis: Whisker Sensors for Unstructured Environments

Master of Research Science: Mechanical Engineering, Carnegie Mellon University: *College of Engineering* Pittsburgh, PA, USA
GPA 3.83/4.0 May 2019
Thesis: *Soft actuators using liquid crystal elastomers with encapsulated liquid metal joule heaters*

Bachelor of Science: Mechanical Engineering, University of Maryland: *A. James Clark School of Engineering* College Park, MD, USA
GPA 3.17/4.0 May 2017
Minor in Sustainability, Minor in Statistics, Honors Citation in Gemstone Research
Thesis: Piezoelectric Sensing and Energy Harvesting in Touchscreens

Research Experience

Carnegie Mellon University: *Micro Robotics Lab* Pittsburgh, PA, USA
Graduate Researcher, Dr. Sarah Bergbreiter September 2019-November 2024

- **Sensor Design and Development**: Conceptualized and prototyped whisker-inspired sensors for tactile, airflow, and waterflow sensing in unstructured environments, integrating rapid prototyping, custom PCB design, and signal processing algorithms
- **Validation and Testing**: Automated test setups to quantify sensor designs and performance
- **Collaborative Tools**: Developed MATLAB-based UI applications to enable collaborators to use my analytical models of flow sensors

Selected Projects:

Hall Effect Based Airflow Whisker Sensing

- Designed and prototyped two airflow sensing arrays for a DJI Tello drone, resulting in two provisional patents
- Evaluated the benefits of different signal interpretation algorithms (neural networks with PyTorch, data-driven solvers, and analytical models) on simulated and experimental data from our sensors
- Sensor Array 1: Achieved a 35% improvement in single flow direction detection by leveraging the embodied intelligence from a pair of asymmetric cross-sections with offsets to elucidate the causal flow direction
- Sensor Array 2: Enabled simultaneously detection of airflow from drone motion (drag) and an external fan (wind) using a densely packed array of sensors

Hydrodynamic Whisker Sensing

- Mentored a Master's student who was developing aquatic whisker-inspired sensors tested on a RC boat for velocity detection
- Supervised an undergraduate student project focusing on control of a robotic fish

Vision Based Tactile Whisker Sensing

- Developed custom computer vision algorithms for whisker base segmentation and tracking during bending
- Sensor Array 1: Engineered an array and algorithm capable of accurately differentiating whisker signals caused by robot motion, airflow, and contact events (Python)
- Sensor Array 2: Improved 2D surface mapping by rejecting 94% of poor contact point estimates on compliant or slippery surfaces using a custom sensor and confidence algorithm

Carnegie Mellon University: *Soft Machines Lab* Pittsburgh, PA, USA
Graduate Researcher September 2017-May 2019

- Designed a liquid metal joule heater to transform a thermally driven soft actuator (Liquid Crystal Elastomer) into an electrically driven soft actuator capable of 50% strain
- Quantified, the increased likelihood of liquid metal circuits to fail due to electromigration, providing quantitative metrics to optimize the heater design for cyclic actuation without electrical failure
- Identified the change in resistance of the joule heater as the actuator contracted, creating a contraction aware actuator

University of Maryland: Honors Gemstone Program College Park, MD, USA
Undergraduate Researcher September 2013-May 2017
Team Liaison, Team Lead, Gemstone Researcher

- Collaborated with a team of 12 students to research applications for piezo-electric materials, developing a final piezoelectric tile with etched electrodes that functioned as a no energy touchscreen
- Won Gemstone Team of the Year (out of 12) for our research which was provisional patented

Skills

CAD: Autodesk Inventor, ANSYS, Fusion, Creo Parametric, SolidWorks, Solve Space
FEA: ANSY, SolidWorks
PCB Design: KiCAD, CircuitPro
Coding Experience: Arduino, MATLAB, Python, C++
3d Printers: Asiga, Form2, MakerBot, Raise 3d, Prusa
Machining: CNC, CO_2 Laser cutter, Photo laser, Milling Machine, Soldering Iron, Turning Machine
Software Packages: OpenCV, PyTorch, LATEX
Testing Equipment: ATI Nano Force Sensor, Instron, Oscilloscopes

Relevant Course Work

Planning and Control: Linear Control Systems (Python), Machine Learning (Python), Mechanics of Manipulation (MATLAB)
Robotic/Mechatronic Design: Assistive Robotics, Bio-Inspired Robotics (MATLAB), Fundamental of Mathematics for Robotics (MATLAB), Human Robot Interaction (VREP), Soft Robotics (ANSYS), Mechatronics
Sensing: Computational Photography (Python), Computer Vision (Python), Tactile Sensing and Haptics (Python)
Manufacturing: Additive Manufacturing, DIY Design and Fabrication, Engineering Computation (C++), Fundamentals of CNC Machining (ANSYS Workbench), Jewelry Making, Machine Shop Practice
Ethics and Leadership: Ethics in Robotics, Global Leadership in Engineering, Environmental Law

Professional Experience

Arieca Pittsburgh, PA, USA
Summer Intern May 2019-August 2019

- Manufactured and tested new formulations of their patented thermal rubber product which: 1. maintained performance while decreasing manufacturing costs by over 15% 2. increasing the thermal conductivity of the material by 100%
- Worked independently to create 8 shipments for customers: communicating with customers to understand requirements, deciding on formulations, creating the sample, validate the characteristics and packaging the product for shipment

United States Consumer Product Safety Commission Rockville, MD
Summer Intern June 2016- August 2016

- Designed, manufactured, and preformed tests to measure product dangers to the users
- Developed two prototypes to contain window blind cords, reducing risks to infants

Project Experience/Highlights

Mechatronics Project: *Window Washer Bot* Pittsburgh, PA, USA
Carnegie Mellon University January 2018-May 2018

- Developed a robot capable of autonomously cleaning windows, crossing window barriers, and leaving the window dry and streak-free within two minutes of cleaning it to placed 1st out of 3 teams of five in a semester design challenge
- Led the development of the adhesion sub system: utilized MATLAB, FEA, and rapid prototyping to optimize the tilt angle of the fan adhesion system to maximize the sum of the lift and frictional force

Leadership

Vice President and Co-Founder of the Carnegie Mellon Club Swim Team *September 2017-December 2018*
Team Liaison and Team Lead for Team Piezo in the University of Maryland Gemstone Program *September 2013-May 2017*
Grant Author and Implementer for Project Sustainable Tailgating at the University of Maryland October 2014-December 2016

Mentoring

Adriana Holtzman: Undergraduate summer student	Summer 2024
Tuo Wang: Masters	Fall 2021-Spring 2023
Jose Garcia: Undergraduate	Fall 2022-Spring 2022
Courage Lahban: RISS Summer Scholar c	Summer 2022

Teaching

Curriculum Development *Ethics Module for Insects and Robotics*	*Spring 2021*
Teaching Assistant *for Computer Vision at Carnegie Mellon University*	Fall 2021
Teaching Assistant for Mechatronics at Carnegie Mellon University	Spring 2020

Outreach and Service

Mentor for the Road 2 Research outreach program at Carnegie Mellon University	November 2020-March 2021
RoboOrg: *Robo Lounge Manager*	October 2021-May 2023
PhD Admissions Committee: *Member*	December 2021-Feburary 2022, December 2022- February 2023
RISS, GASP: *Application Advisor*	November 2020, 2022

Peer Reviewed Journal Articles

1. **Kent, T. A.,** Thomas, L., & Bergbreiter, S. Asymmetric Whisker Cross Sections: A Method to Enhance Wind Sensing on Drones (In preparation for Advanced Intelligent Systems)
2. Wang, T*., **Kent, T. A.*,** & Bergbreiter, S. (2023). Design of whisker-inspired sensors for multi-directional hydrodynamic sensing. arXiv preprint arXiv:2307.09569 (In preparation for Frontiers in Robotics)
3. **Kent, T.A**., Kim, S., Kornilowicz, G., Yuan, W., Hartmann, M., Bergbreiter, S. (2021). WhiskSight: A Reconfigurable, Vision Based, Optical Whisker Sensing Array for Simultaneous Contact, Airflow, and Inertia Stimulus Detection. IEEE Robotics and Automation Letters, vol. 6, no. 2, pp. 3357-3364
4. **Kent, T. A.**, Ford, M. J., Markvicka, E. J., & Majidi, C. (2020). Soft actuators using liquid crystal elastomers with encapsulated liquid metal Joule heaters. Multifunctional Materials, 3(2), 025003.
5. Ford, M. J., Ambulo, C. P., **Kent, T. A.,** Markvicka, E. J., Pan, C., … & Majidi, C. (2019). A multifunctional shape-morphing elastomer with liquid metal inclusions. Proceedings of the National Academy of Sciences, 116(43), 21438-21444.

Peer Reviewed Conference Publications

1. **Kent, T. A.,** Thomas, L., & Bergbreiter, S. Flow Shadowing: Detecting Wind on a Moving Drone using a densely packed array of Whisker-Sensors (In preparation for the Robotics Systems and Sciences Conference)
2. Imamura, T.*, **Kent, T. A**.*, Taylor B., Bergbreiter, S. (2025) Measuring DNA Microswimmer Locomotion in Complex Flow Environments. IEEE International Conference on Robotics and Automation (ICRA) (Under Review)
3. **Kent, T. A.,** & Bergbreiter, S. (2024, May). Flow Shadowing: A Method to Detect Multiple Flown Headings Using an Array of Densely Packed Whisker-Inspired Sensors. In 2024 IEEE International Conference on Robotics and Automation (ICRA)
4. **Kent, T. A.,** Emnett, H., Babaei, M., Hartmann, M. J., & Bergbreiter, S. (2023, May). Identifying Contact Distance Uncertainty in Whisker Sensing with Tapered, Flexible Whiskers. In 2023 IEEE International Conference on Robotics and Automation (ICRA) (pp. 607-613). IEEE

Workshop Presentations

1. **Kent, T.A.** "Asymmetric Mechano-sensing for Uncertainty Reduction in Bio-Inspired Flight" International Conference on Robotics and Automation, Yokohama, Japan, 13 May 2024
2. **Kent, T.A.** "Designing Whisker Sensors for Noisy Environment" Robotics Systems and Sciences Conference, Workshop, New York, USA, 2 July 2022

Theses

1. **Kent, T.** (2024). *Whisker-Inspired Sensors for Unstructured Environments* (Doctoral dissertation).
2. **Kent, T.** (2019). *Soft actuators using liquid crystal elastomers with encapsulated liquid metal joule heaters* (Masters dissertation).
3. Bremerman, J.*, Bronocco, S.*, Caffey, B.*, **Kent, T.*,** Reed, E.*, Lee, E., * ... & Wang, T.* (2017). Piezoelectric Sensing and Energy Harvesting in Touchscreens (Undergraduate dissertation).