

Khoi Ly

Robotic Materials, Embedded Sensing, Dynamic Modeling & Control Theory

khoy.ly@colorado.edu

(+1) 214-718-01612

EDUCATION

- **University of Colorado Boulder** Boulder, USA
Paul M. Rady Mechanical Engineering - Ph.D. Candidate *August 2017 – Present*
- **Texas Tech University** Texas, USA
Magna Cum Laude with Highest Honor, Mechanical Engineering - Undergraduate *August 2014 – May 2017*

RESEARCH EXPERIENCE

- **Untethered Self-Propelled Soft-Robotic Wheel, Project Lead** **On-going**
 - Designing and characterizing a soft robotic wheel propelled by embedded HASEL electrostatic actuators.
 - Modeling and simulating the robotic wheel as a hybrid dynamic state space model with states and input jumps.
 - Developing a model predictive controller using particle swarm optimization algorithm for real-time speed regulation.
 - Incorporating wireless control on the robotic wheel with terrain classification using convolutional neural network on a compliant Ecoflex tire.
- **Soft-Robotic 2.5D Dynamic Shape-Changing Surface, Project Member** **On-going**
 - Designing and fabricating the layout for an array of 10x10 grid of HASEL actuators.
 - Developing a large scale soft, stretchable, magnetic Ecoflex skin with high speed, high resolution sensing for the shape-changing surface.
- **Magnetic Skin for Haptics, Surgical, and Robotics Applications, Project Co-Lead** **On-going**
 - Designing and fabricating a joint-angle sensor for a soft robotic tentacle
 - Designing and fabricating a surgical balloon that can sense its stretch and volume using a magnetic elastomeric skin.
 - Developing a high-speed, high resolution magnetic tactile display for a robotic manipulator
 - Training and implementing a convolutional neural network for real-time deformation-to-magnetic-field regression.
- **Self-Sensing for Electrostatic Transducers, Project Lead** **Published in Soft Robotics, 2020**
 - Inventing a low voltage coupling self-sensing method for high voltage capacitive electrostatic transducers.
 - Validating the self-sensing capability of the embedded circuit with an application of a closed loop PID control for a soft robotic arm driven by high voltage Peano HASEL actuators.
- **Dual-Mode PID Controller for a HASEL Actuator, Project Member** **Published in IEEE RA-L, 2020**
 - Implementing the dual-mode PID controller on a microcontroller for real-time, high-speed displacement regulation.
- **Joystick Controller for a Soft-Robotic Tentacle, Project Member** **Published in Advanced Science, 2019**
 - Developing a high voltage polarity reversing technique for a miniature driver circuit of a HASEL-actuator driven soft robotic tentacle.
 - Designing and testing the human-in-the-loop controller with a joystick interface for the tentacle's heading angle.

PATENTS: PROVISIONAL APPLICATIONS

- “Capacitive Self-sensing for Electrostatic Transducers with High Voltage Isolation,” **Application No 63/032,209.**
*Nikolaus Correll, **Khoi Ly**, Nicholas Kellaris, Christoph Keplinger*
- “Embedded Magnetic Sensing Method for Soft Actuators,” **Application No 63/189,571.**
*Nikolaus Correll, **Khoi Ly**, Vani Sundaram, Jatin Mayekar, Mark Rentschler*

HONORS AND AWARDS

- Texas Tech Ph.D Presidential Fellowship Award Offered, 2017.
- Undergraduate Research Scholar Award 2017.
- Texas Tech President Honor Roll 2015, 2016, 2017.
- Texas Tech Honors College Scholarship Award 2015.

PEER-REVIEWED PUBLICATIONS

1. “Miniaturized Circuitry for Capacitive Self-sensing and Closed-Loop Control of Soft Electrostatic Transducers”
K. Ly, N. Kellaris, D. McMorris, B. Johnson, E. Acome, V. Sundaram, M. Naris, S. Humbert, M. Rentschler, C. Keplinger, N. Correll
Soft Robotics 2020, Accepted
2. “Identification and Control of a Nonlinear Soft Actuator and Sensor System”
B. Johnson, V. Sundaram, M. Naris, E. Acome, K. Ly, N. Correll, C. Keplinger, J. Humbert and M. Rentschler
IEEE Robotics and Automation Letters 2020, Accepted
3. “An Easy-to-Implement Toolkit to Create Versatile and High-Performance HASEL Actuators for Untethered Soft Robots”
S. Mitchell, X. Wang, E. Acome, T. Martin, K. Ly, N. Kellaris, VG. Venkata, and C. Keplinger
Advanced Science 2020, Accepted

PEER REVIEWER

- **Journals:** Science, Science Robotics, Soft Robotics, International Journal of Robotics Research, Transaction on Robotics
- **Conferences:** Robotics Science and Systems, IEEE RA-L, IEEE Robosoft, IEEE ICRA, IEEE IROS, ISER

TEACHING & MENTORING

- **Department of Mechanical Engineering, CU Boulder, Teaching Assistant** **Fall 2019**
 - **System Dynamics (4043):** Teaching and delivering hand-on workshops on Control Implementation Labs
- **Department of Computer Science, CU Boulder, Mentor** **Spring 2018 - Present**
 - **Jatin Mayerkar, Master Thesis:** Self-Propelled Soft Robotic Wheel Project.
 - **Dade McMorris, Undergraduate Research:** Self-sensing of High Voltage Electrostatic Project.

TECHNICAL SKILLS

- **Theoretical Knowledge:** Classical and State Space Modeling, Statistical Estimation, System Identification, Controller Design and Implementation, Solid Mechanics, Power Electronics, Signal Processing, Neural Network.
- **Programming Languages:** C, C++, RTOS, Python, LATEX.
- **Software Proficiency:** SolidWork, Altium Designer, MATLAB, LabView, Adobe Premiere Pro, Adobe Illustrator, Inkscape.
- **Hardware Proficiency:** PCB Design, 3D Modeling and Printing, Laser Cutting, Machining, Wet Lab Skills.

REFERENCES

- **Dr. Nikolaus Correll**, Ph.D Advisor
University of Colorado Boulder, Department of Computer Science
1111 Engineering Drive, Boulder, Colorado 80305, USA
+1-303-492-2233, nikolaus.correll@colorado.edu
<http://correll.cs.colorado.edu/>
- **Dr. Mark E. Rentschler**, Ph.D Co-Advisor
University of Colorado Boulder, Department of Mechanical Engineering
1111 Engineering Drive, Boulder, Colorado 80305, USA
+1-303-735-6149, Mark.Rentschler@colorado.edu
<https://www.colorado.edu/lab/amtl/>
- **Dr. Christoph M. Keplinger**, Principle Collaborator
University of Colorado Boulder, Department of Mechanical Engineering
1111 Engineering Drive, Boulder, Colorado 80305, USA
+1-303-735-8064, christoph.keplinger@colorado.edu
<http://www.keplingerresearchgroup.com/>