Chen-Lung 'Eric' Lu

Email : eric565648@gmail.com
Email (2) : luc5@rpi.edu
Phone: +1-5189770826
Website: https://eric565648.github.io/
Lab: John Wen Research Group @ RPI
Address: Rensselaer Polytechnic Institute
via CII 8129, 110 8th St., Troy, NY. 12180

Education and Professional Experiences:

Ph.D. in Department of Electrical, Computer and Systems Engineering (ECSE),
Rensselaer Polytechnic Institute (RPI), Troy, NY.   Sep. 2021 ~ Present

M.S. in Institute of Electrical and Control Engineering (ECE),
National Chiao Tung University (NCTU), Taiwan.   Sep. 2018 ~ Apr. 2021
* Team Lead of Team NCTU to the DARPA Subterranean Challenge, Tunnel Circuit and Urban
Circuit in Pittsburgh PA in 2019 and Elma, WA in 2020.

Visiting Student in Dept. of Information Technology and Electrical Engineering,
Eidgenössische Technische Hochschule (ETH) Zürich   Feb. ~ Aug. 2018
* I joined the "Autolab" in IDSC under Prof. Frazolli and was supervised by Dr. Andrea Censi and
Dr. Jacopo Tani to contribute to Duckietown in the Zürich.

B.S. in Electrical and Computer Engineering (ECE),
National Chiao Tung University (NCTU), Taiwan.   Sep. 2014 ~ Sep. 2018
* Coordinator for the Duckietown @ NCTU

Research Interests

My research interests encompass motion optimization and kinematic calibration for robot arms
within manufacturing contexts. My research incorporates concepts from robotics, optimization, and
control. Additionally, I have experience in semi-autonomous vehicles for search and exploration,
utilizing SLAM, deep learning, and reinforcement learning methodologies.

Publications:

- H. He, C.-L. Lu, Y. Wen, G. Saunders, P. Yang, J. Schoonover, J. Wason, A. Julius, J. Wen. "High-Speed High-Accuracy Spatial Curve Tracking Using Motion Primitives in Industrial Robots," 2023 IEEE International Conference on Robotics and Automation (ICRA), London, United Kingdom, 2023, pp. 12289-12295, doi: 10.1109/ICRA48891.2023.10161022.

- **C.-L. Lu**, et al., "A Heterogeneous Unmanned Ground Vehicle and Blimp Robot Team for Search and Rescue using Data-driven Autonomy and Communication-aware Navigation." Field Robotics 2 (2022): 557-594.

- J.-T. Huang, **C.-L. Lu**, P.-K. Chang, C.-I. Huang, C.-C. Hsu, Z. L. Ewe, P.-J. Huang, and H.-C. Wang, "Cross-Modal Contrastive Learning of Representations for Navigation Using Lightweight, Low-Cost Millimeter Wave Radar for Adverse Environmental Conditions," in IEEE Robotics and Automation Letters, vol. 6, no. 2, pp. 3333-3340, April 2021, doi: 10.1109/LRA.2021.3062011

- Y.-W. Huang, **C.-L. Lu**, K.-L. Chen, P.-S. Ser, J.-T. Huang, Y.-C. Shen, P.-W. Chen, P.-K. Chang, S.-C. Lee, H.-C. Wang, "Duckiefloat: a Collision-Tolerant Resource-Constrained Blimp for

Long-Term Autonomy in Subterranean Environments" (arxiv: 1910.14275)

- **C.-L. Lu,** et al.. "Assistive Navigation using Deep Reinforcement Learning Guiding Robot with UWB/Voice Beacons and Semantic Feedbacks for Blind and Visually Impaired People" (Submitted to Frontier of Robotics and AI, Special Issue: Assistive Technologies for Sensory-Disabled People)

- N.-C. Lin, S.-H. Liu, Y.-W. Huang, Y.-S. Su, **C.-L. Lu**, W.-T. Hsu, L.-W. Chiu, S. Teng, L. Giarré, H.-C. Wang. "Toward an Open Platform of Blind Navigation via Interactions with Autonomous Robots," In ACM Conference on Human Factors in Computing Systems (CHI 2019) - Blind Navigation Workshop, Glasgow.

- A. Censi, L. Paull*, J. Tani, T. Ackermann, O. Beijbom, B. Berkai, G. Bernasconi, A. K. Bowser, S. Bing, P.-W. Chen, Y.-C. Chen, M. Chevalier-Boisvert, B. Considine, J. D. Castri, M. D. Cicco, M. Diaz, P. A. Diederichs, F. Golemo, R. Hristov, L. Hsu, Y.-W. Huang, C.-H. Hung, Q.-S. Jia, J. Kindle, D. Lapandic, **C.-L. Lu**, S. Mallya, B. Mehta, A. Neff, E. Nice, Y.-H. Ou, A. Qbaich, J. Quack, C. Ruch, A. Sigal, N. Stolz, A. Unghia, B. Weber, S. Wilson, Z.-X. Xia, T. V. Yasin, Nivethan, Yogarajah, J. Zilly, Y. Bengio, T. Zhang, H.-C. Wang, S. Soatto, M. Egerstedt, and E. Frazzoli. "The AI Driving Olympics at NIPS 2018," RSS Workshop on New Benchmarks, Metrics, and Competitions for Robotic Learning, Pittsburgh.

Projects:

Convergent Manufacturing (ARM 22-01-F-07)

- Developed a **kinematic calibration framework** for robot arms, leveraging motion capture systems to achieve **sub-millimeter** accuracy in TCP position estimation, significantly surpassing baseline performance by **sixfold**.
- Developed a scan-n-print framework for wire arc additive manufacturing, resulting in a **66% smoother** deposition than the baseline, while integrating **multiple sensor interfaces** to enhance manufacturing cell capabilities.

Robot Motion Optimization (ARM 21-02-F-19)

- Developed a **full stack robot arm motion optimization framework** achieving **sub-millimeter** accuracy in tracking desired curves in space with the robot arm, surpassing baseline speeds by up to **7.8 times**. Created a user-friendly Python interface for FANUC robots, facilitating seamless programming. Successfully implemented and showcased the developed system on GE's dual arm testbed, highlighting practical applications and versatility.

Robot Arm Motion and Force Control for Drawing (On-going)

- Developed a robot drawing and writing platform, implementing **force control** techniques along the optimized trajectory.

DARPA Subterranean Challenge

- **Team Lead of Team NCTU**: Directed efforts in creating an **autonomous system** for DARPA's Subterranean Challenge, addressing diverse underground environments. Integrated SLAM, deep learning artifact classification, and reinforcement learning for effective robot control in challenging subterranean conditions.

Emotional Expressive Robot

- Designed a control strategy for a **10-degree-of-freedom mobile manipulator** to express internal information, focusing on emotions, through motion behaviors. Utilized **crowdsourcing to learn the best parameter** combinations for expressing different emotions.

Blind Navigation with a Guiding Robot and UWB Beacons

- Developed assistive guiding robot to aid individuals with visual impairments in navigating virtual trails using UWB technology. Incorporated semantic sound feedback to intuitively inform users about points-of-interest, improving overall navigation experience for the visually impaired.

Duckietown: A Platform for Autonomy Research and Education

- Localizing Duckiebots in Duckietown with a decentralized localization and tracking network with **over fifty image sensors**. Built a **self-driving vehicle** for the AI Driving Olympics (AIDO) using deep learning approaches in "gym-Duckietown."
- Outreach:
    - Duckietown workshop at RoboCup 2019 in Sydney, Australia.
    - AI Driving Olympics at ICRA 2019 in Montreal,Canada.
    - Duckietown at 2018 Zurich E-Prix (Formula E)
    - Coordinator for 4 outreach activities for high-school students in Taiwan.

Technical Skills:

Programming: Python (7 years exp.), C/C++ (3 years exp.), Matlab (3+ years exp),
Middleware and Libraries: Robot Operating System (ROS) (7 years exp.), Tensorflow, Pytorch, PCL, Apriltags, OpenCV
Knowledge: Robotics, Control, SLAM, Deep supervised learning, Deep reinforcement learning, Discrete/Digital Signal Processing, Basic computer vision, Basic control theory.
Robots: ABB, FANUC, Yaskawa, UR

Leaderships:

Director of Student Association of Department of Electrical and Computer Engineering (2016~2017)
Event General Coordinator of Night of ECE 2017 (2017)
Head of Activity of Taiwan Model United Nation 2016 (2016)