Lee Clement, Ph.D.

Mobile Robotics, Computer Vision, Machine Learning, State Estimation

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Experience

Software Engineer · Oxbotica
Toronto, Canada
2019 - Present

Object Tracking & Prediction Team

- Developing model- and learning-based object tracking and prediction algorithms for on-road mobile autonomy.

Graduate Researcher · University of Toronto
Toronto, Canada
2013 - 2019

Institute for Aerospace Studies · Space and Terrestrial Autonomous Robotic Systems (STARS) Lab

- Conducted independent research on improving model-based visual navigation systems using modern machine learning techniques.
- Developed and tested a neural network sun sensor to correct long-range drift errors in visual odometry.
- Developed and tested learning-based image transformations to aid long-term visual localization.

Subject Matter Expert · Coursera
Toronto, Canada
2018

Self-Driving Cars Specialization · University of Toronto

- Co-created the State Estimation and Localization course of the Coursera Self-Driving Cars Specialization.

Course Instructor · University of Toronto
Toronto, Canada
2018

Division of Engineering Science

- AER 521: Mobile Robotics and Perception
- ROB 501: Computer Vision for Robotics

Teaching Assistant · University of Toronto
Toronto, Canada
2015 - 2018

Division of Engineering Science

- ROB 301: Introduction to Robotics
- AER 521: Mobile Robotics and Perception

Research Assistant · Argonne National Laboratory
Chicago, USA
2013

Argonne National Laboratory Physics Division · University of Manitoba Department of Physics and Astronomy

- Participated in experiments with the Argonne Tandem Linac Accelerator System (ATLAS).

Research Assistant · University of Manitoba
Winnipeg, Canada
2012

Department of Physics and Astronomy

- Developed astrophysical modelling software.

Education

Doctor of Philosophy · University of Toronto
Toronto, Canada
2014 - 2019

Institute for Aerospace Studies · Space and Terrestrial Autonomous Robotic Systems (STARS) Lab

- Thesis title: "On learning models of appearance for robust long-term visual navigation." Advised by Prof. Jonathan Kelly.
- Supported by an NSERC Postgraduate Scholarship - Doctoral Program, valued at $63,000.
- Invited to participate in the first annual RSS Pioneers workshop and mentor junior students as part of Inclusion@RSS.
- Appointed as a Postgraduate Affiliate of the Vector Institute.

M.A.Sc. (Partial), Aerospace Science & Engineering · University of Toronto
Toronto, Canada
2013 - 2014

Institute for Aerospace Studies · Space and Terrestrial Autonomous Robotic Systems (STARS) Lab

- GPA: 4.0 / 4.0
- Transferred directly to the Ph.D. program without completing the M.A.Sc. thesis.
- Supported by an NSERC Canada Graduate Scholarship - Master's Program, valued at $21,000.
- Received a Kenneth Molson Fellowship, valued at $12,000.

B.Sc. (Maj.) with Distinction, Physics & Computer Science · University of Manitoba
Winnipeg, Canada
2010 - 2013

Department of Physics and Astronomy · Department of Computer Science

- GPA: 4.31 / 4.50
- Received two competitive Centennial Scholarships in Physics in 2011 and 2012.
- Received two NSERC Undergraduate Student Research Awards in 2012 and 2013.

B.Comm. (Hon.) with Distinction, Accounting & Finance · University of Manitoba
Winnipeg, Canada
2006 - 2010

I. H. Asper School of Business

- GPA: 4.13 / 4.50
- Inducted into Beta Gamma Sigma Honors Society.

Professional Activities & Community Service

Organizer · Debates on the Future of Robotics Research Workshop
Various Locations

IEEE International Conference on Robotics and Automation
2019-2020

- The Debates on the Future of Robotics Research Workshop brings together prominent researchers and industry leaders to formally debate key issues affecting robotics as an academic discipline and its broader social and economic contexts.

Postgraduate Affiliate · Vector Institute
Toronto, Canada

Vector Institute Postgraduate Affiliate Program
2019-2020

- The Vector Institute drives excellence and leadership in Canada's knowledge, creation, and use of artificial intelligence (AI) to foster economic growth and improve the lives of Canadians.
- Member of the Vector Institute Social Committee.

Invited Participant · RSS Pioneers Workshop
Pittsburgh, USA

Robotics: Science and Systems
2018

- RSS Pioneers is a day-long invitation-only workshop for senior graduate students and postdocs, held in conjunction with Robotics: Science and Systems, that seeks to bring together a cohort of the world's top early career researchers in all areas of robotics.

Student Mentor · Inclusion@RSS
Pittsburgh, USA

Robotics: Science and Systems
2018

- Inclusion@RSS focuses on programs that increase and sustain a broader participation in the robotics research community of groups traditionally underrepresented in robotics (including but not limited to: women, LGBTQ+, underrepresented minorities, and people with disabilities), especially people early in their studies and career.

Graduate Student Representative · Faculty Council
Toronto, Canada

University of Toronto Faculty of Applied Science and Engineering
2017-2018

- Faculty Council sets and approves academic policy, principles, priorities, and the general direction for the teaching and research activities of the Faculty of Applied Science and Engineering.

Graduate Student Representative · Community Affairs & Gender Issues Committee
Toronto, Canada

University of Toronto Faculty of Applied Science and Engineering
2017-2018

- The CA&GI Committee seeks to improve and to recommend on strategies related to student recruitment and outreach and quality of life within the Faculty community, including the student experience, gender issues, diversity, safety and security, and personal conduct.

President · Aerospace Students' Association
Toronto, Canada

University of Toronto Institute for Aerospace Studies
2016-2017

- The ASA represents graduate students at UTIAS and organizes athletic, social, academic and professional events.
- Previously: Social Coordinator (2015-2016).

Co-founder / Aerospace Representative · Graduate Engineering Council of Students
Toronto, Canada

University of Toronto Faculty of Applied Science and Engineering
2016-2017

- The Graduate Engineering Council of Students (GECoS) acts as a forum for all Engineering Graduate Student Associations at UofT to collaborate and represent Engineering graduate students.

Student Member · UTIAS Student Experience Committee
Toronto, Canada

University of Toronto Institute for Aerospace Studies
2015-2017

- The SEC gathers data about the UTIAS student body's experiences at the Institute and makes a report to the Director summarizing the data and suggesting improvements.

Re-founder / Director · SEDS-Canada
Toronto, Canada

Students for the Exploration and Development of Space
2014-2017

- Students for the Exploration and Development of Space (SEDS) is an international group of student-run organizations dedicated to promoting public interest in space.

Publications

[1] L. Clement, "On learning models of appearance for robust long-term visual navigation," Ph.D. dissertation, University of Toronto, 2020.

[2] L. Clement, M. Gridseth, J. Tomasi, and J. Kelly, "Learning matchable image transformations for long-term metric visual localization," *IEEE Robotics and Automation Letters (RA-L)*, 2020.

[3] L. Clement, V. Peretroukhin, M. Giamou, J. Leonard, H. Kress-Gazit, J. How, M. Milford, O. Brock, R. Gariepy, A. P. Schoellig, N. Roy, H. Siegel, L. Righetti, A. Billard, and J. Kelly, "Where do we go from here? Debates on the future of robotics research at ICRA 2019," *IEEE Robotics and Automation Magazine (RA-M)*, Sep. 2019.

[4] L. Clement, M. Gridseth, J. Tomasi, and J. Kelly, "Matchable colorspace transformations for long-term metric visual localization," in *CVPR Workshop on Image Matching*, Long Beach, USA, Jun. 2019.

[5] L. Clement and J. Kelly, "How to train a CAT: Learning canonical appearance transformations for robust direct localization under illumination change," *IEEE Robotics and Automation Letters (RA-L)*, 2018.

[6] V. Peretroukhin[†], L. Clement[†], and J. Kelly, "Inferring sun direction to improve visual odometry: A deep learning approach," *International Journal of Robotics Research (IJRR) Special Issue on Experimental Robotics*, 2018, [†]Equal contribution.

[7] ——, "Reducing drift in visual odometry by inferring sun direction using a bayesian convolutional neural network," in *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, Singapore, May 2017, [†]Equal contribution.

[8] J. Lambert, L. Clement, M. Giamou, and J. Kelly, "Entropy-based Sim(3) calibration of 2D lidars to egomotion sensors," in *Proceedings of the IEEE International Conference on Multisensor Fusion and Integration for Intelligent Systems (MFI)*, Baden-Baden, Germany, Sep. 2016, Best Student Paper Award.

[9] L. Clement, J. Kelly, and T. D. Barfoot, "Robust monocular visual teach and repeat aided by local ground planarity and colour-constant imagery," *Journal of Field Robotics*, 2016.

[10] L. Clement, V. Peretroukhin, and J. Kelly, "Improving the accuracy of stereo visual odometry using visual illumination estimation," in *Proceedings of the IFRR International Symposium on Experimental Robotics (ISER)*, Tokyo, Japan, Oct. 2016, Toyota Student Participation Award, invited to IJRR special issue.

[11] V. Peretroukhin, L. Clement, M. Giamou, and J. Kelly, "PROBE: Predictive robust estimation for visual-inertial navigation," in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Hamburg, Germany, Sep. 2015, pp. 3668–3675.

[12] L. Clement, J. Kelly, and T. D. Barfoot, "Monocular visual teach and repeat aided by local ground planarity," in *Proceedings of the 10th Conference on Field and Service Robotics (FSR)*, Toronto, Canada, Jun. 2015, pp. 547–561.

[13] L. Clement[†], V. Peretroukhin[†], J. Lambert, and J. Kelly, "The battle for filter supremacy: A comparative study of the multi-state constraint kalman filter and the sliding window filter," in *Proceedings of the 12th Conference on Computer and Robot Vision (CRV)*, Halifax, Canada, Jun. 2015, pp. 23–30, [†]Equal contribution.

[14] V. Peretroukhin, L. Clement, and J. Kelly, "Get to the point: Active covariance scaling for feature tracking through motion blur," in *ICRA Workshop on Scaling Up Active Vision*, Seattle, USA, May 2015.

[15] L. Clement, J. Kelly, and T. D. Barfoot, "Monocular vision for long-range visual teach and repeat in unstructured environments," *NSERC Canadian Field Robotics Network (NCFRN) and Conference on Computer and Robot Vision (CRV) Joint Poster Session*, May 2014.

[16] B. Russell, L. Clement, J. Hernandez, A. Byagowi, D. Schor, and W. Kinsner, "Implementation of a nanosatellite attitude determination and control system for the T-Sat1 mission," in *Proceedings of the Canadian Conference on Electrical and Computer Engineering (CCECE)*, Regina, Canada, May 2013.