Sven Lilge

Curriculum Vitae

University of Toronto Robotics Institute
Toronto, Ontario, Canada

sven.lilge@utoronto.ca
svenlilge.github.io

Professional Experience

from 09/23 **Postdoctoral Fellow**, *Autonomous Space Robotics Laboratory*, University of Toronto, Canada

05/19 – 08/23 **Research Assistant**, *Continuum Robotics Laboratory*, University of Toronto Mississauga, Canada

08/18 **Visiting Graduate Student**, *REACH Laboratory*, University of Tennessee Knoxville, United States

02/17 – 04/19 **Research Assistant**, *Laboratory for Continuum Robotics*, Leibniz University Hannover, Germany

11/15 – 02/16 **Internship**, *WABCO Vehicle Control Systems*, Hanover, Germany

01/13 – 09/16 **Student Assistant**, *Institute of Electrical Engineering and Measurement Technology*, Leibniz University Hannover, Germany

10/12 – 12/12 **Student Assistant**, *Institute of Microelectronic Systems*, Leibniz University Hannover, Germany

08/11 – 09/11 **Internship**, *J. Helmke & Co.*, Hanover, Germany

Education

05/19 – 08/23 **Doctor of Philosophy**, *University of Toronto*, Canada
Computer Science

Thesis: Tendon-Driven Parallel Continuum Robots: Modeling, Characterization and State Estimation

10/14 – 11/16 **Master of Science**, *Leibniz University Hannover*, Germany
Electrical Engineering and Information Technology, Specialization: Automation Engineering, Graduation with distinction
Thesis: Conception and Implementation of a System for Obstacle Avoidance in Pedestrian Navigation with Electrical Muscle Stimulation

10/11 – 12/14 **Bachelor of Science**, *Leibniz University Hannover*, Germany
Electrical Engineering and Information Technology, Specialization: Microelectronics

Thesis: Conception and Implementation of a Hardware-interface for Real-time Visualization of Audio-analysis Results

Publications

Journal Articles

[1] S. **Lilge**, K. Nuelle, J. A. Childs, K. Wen, D. C. Rucker, and J. Burgner-Kahrs. Parallel-continuum robots: A survey. *IEEE Transactions on Robotics*, 40:3252–3270, 2024.

[2] S. **Lilge** and J. Burgner-Kahrs. Kinetostatic modeling of tendon-driven parallel continuum robots. *IEEE Transactions on Robotics*, 39(2):1563–1579, 2023.

[3] S. **Lilge**, T. D. Barfoot, and J. Burgner-Kahrs. Continuum robot state estimation

using gaussian process regression on $SE(3)$. *The International Journal of Robotics Research*, 41(13-14):1099–1120, 2022.

[4] S. **Lilge**, K. Wen, and J. Burgner-Kahrs. Singularity analysis of 3-dof planar parallel continuum robots with constant curvature links. *Frontiers in Robotics and AI*, 9:1082185, 2023.

[5] S. **Lilge**, K. Nuelle, G. Böttcher, S. Spindeldreier, and J. Burgner-Kahrs. Tendon Actuated Continuous Structures in Planar Parallel Robots: A Kinematic Analysis. *Journal of Mechanisms and Robotics*, 13(1):011025, 2021.

[6] G. Böttcher, S. **Lilge**, and J. Burgner-Kahrs. Design of a reconfigurable parallel continuum robot with tendon-actuated kinematic chains. *IEEE Robotics and Automation Letters*, 6(2):1272–1279, 2021.

[7] K. Nuelle, T. Sterneck, S. **Lilge**, D. Xiong, J. Burgner-Kahrs, and T. Ortmaier. Modeling, calibration, and evaluation of a tendon-actuated planar parallel continuum robot. *IEEE Robotics and Automation Letters*, 5(4):5811–5818, 2020.

[8] M. T. Chikhaoui, S. **Lilge**, S. Kleinschmidt, and J. Burgner-Kahrs. Comparison of modeling approaches for a tendon actuated continuum robot with three extensible segments. *IEEE Robotics and Automation Letters*, 4(2):989–996, 2019.

[9] P. Rao, Q. Peyron, S. **Lilge**, and J. Burgner-Kahrs. How to model tendon-driven continuum robots and benchmark modelling performance. *Frontiers in Robotics and AI*, 7:223, 2021.

[10] H. Donat, S. **Lilge**, J. Burgner-Kahrs, and J. J. Steil. Estimating tip contact forces for concentric tube continuum robots based on backbone deflection. *IEEE Transactions on Medical Robotics and Bionics*, 2(4):619–630, 2020.

[11] D. Black, S. **Lilge**, C. Fellmann, A. V. Reinschluessel, L. Kreuer, A. Nabavi, H. K. Hahn, R. Kikinis, and J. Burgner-Kahrs. Auditory display for telerobotic transnasal surgery using a continuum robot. *Journal of Medical Robotics Research*, 4(02):1950004, 2019.

Peer-Reviewed Conference Publications

[12] S. Teetaert, S. **Lilge**, J. Burgner-Kahrs, and T. D. Barfoot. Space-Time Continuum: Continuous Shape and Time State Estimation for Flexible Robots. *40th Anniversary of the IEEE International Conference on Robotics and Automation*, 2024.

[13] S. **Lilge**, D. Black, A. Nabavi, and J. Burgner-Kahrs. Comparison of Haptic and Auditory Feedback Methods for the Teleoperation of Concentric Tube Continuum Robots. *Proceedings of the 17th Annual Meeting of the German Society for Computer- and Robot-Assisted Surgery e.V.*, 2018.

[14] L. Kreuer, S. **Lilge**, and J. Burgner-Kahrs. Entwicklung von Kontrollalgorithmen für die Teleoperation von tubulären Kontinuumsrobotern. *Proceedings of the 16th Annual Meeting of the German Society for Computer- and Robot-Assisted Surgery e.V.*, 2017.

[15] N. Liang, R. M. Grassmann, S. **Lilge**, and J. Burgner-Kahrs. Learning-Based Inverse Kinematics from Shape as Input for Concentric Tube Continuum Robots. *IEEE International Conference on Robotics and Automation*, 2021.

[16] H. J. Zhang, S. **Lilge**, M. T. Chikhaoui, and J. Burgner-Kahrs. Cooperative Control of Dual-Arm Concentric Tube Continuum Robots. *International Conference on Manipulation, Automation and Robotics at Small Scales*, 2022.

[17] A. Krawciw, S. **Lilge**, and T. D. Barfoot. LaserSAM: Zero-Shot Change Detection Using Visual Segmentation of Spinning LiDAR. *21st Conference on Robots and Vision*.

Workshop Publications

[18] M. Boxan, A. Krawciw, E. Daum, X. Qiao, S. **Lilge**, T. D. Barfoot, F. Pomerleau. FoMo: A Proposal for a Multi-Season Dataset for Robot Navigation in Forêt Montmorency. *Field Robotics Workshop at IEEE International Conference on Robotics and Automation*, 2024.

[19] S. **Lilge**, and J. Burgner-Kahrs. Derivation and Evaluation of a Kinetostatic Modeling Approach for Spatial Tendon Driven Parallel Continuum Robots. *Parallel Robots or not Parallel Robots? New Frontiers of Parallel Robotics Workshop at IEEE International Conference on Robotics and Automation*, 2022.

[20] S. **Lilge**, and J. Burgner-Kahrs. Design, Modeling and Evaluation of Tendon Driven Parallel Continuum Robots. *Parallel Robots or not Parallel Robots? New Frontiers of Parallel Robotics Workshop at IEEE International Conference on Robotics and Automation*, 2021.

[21] R. M. Grassmann, S. **Lilge**, P. Le, and J. Burgner-Kahrs. CTCR Prototype Development: An Obstacle in the Research Community? *Robotics Retrospective Workshop at Robotics: Science and Systems Conference*, 2020.

[22] S. **Lilge**, and J. Burgner-Kahrs. Enforcing Shape Constraints during Motion of Concentric Tube Continuum Robots. *Open Challenges and State-of-the-Art in Control System Design and Technology Development for Surgical Robotic Systems Workshop at IEEE International Conference on Robotics and Automation*, 2019.

[23] H. Donat, S. **Lilge**, J. Burgner-Kahrs, and J. J. Steil. Towards Learning Force Sensing for a Concentric Tube Continuum Robot. *Open Challenges and State-of-the-Art in Control System Design and Technology Development for Surgical Robotic Systems Workshop at IEEE International Conference on Robotics and Automation*, 2019.

Manuscripts In Review

[24] S. **Lilge**, T. D. Barfoot, and J. Burgner-Kahrs. State Estimation for Continuum Multi-Robot Systems on SE(3). *IEEE Transactions on Robotics*, In Review.

[25] M. Hachen, C. Shentu, S. **Lilge**, and J. Burgner-Kahrs. A Non-Linear Model Predictive Task-Space Controller Satisfying Shape Constraints for Tendon-Driven Continuum Robots. *IEEE Robotics Automation Letters*, In Review.

[26] X. Qiao, A. Krawciw, S. **Lilge**, and T. D. Barfoot. Radar Teach and Repeat: Architecture and Initial Field Testing. *IEEE International Conference on Robotics and Automation*, In Review.

[27] S. **Lilge**, and T. D. Barfoot. Incorporating Control Inputs in Continuous-Time Gaussian Process State Estimation for Robotics. *Robotica*, In Review

Talks and Presentations

Invited Talks

05/24 *Continuum Robot State Estimation Using Gaussian Process Regression*, Workshop "Continuum and Soft Robotics for Medical Applications with Rising Stars on the Stage" at IEEE International Conference of Robotics and Automation, Yokohama, Japan

04/24 *Modeling, State Estimation, and Control for Continuum Robotic Manipulation*, Department of Electrical and Computer Engineering, Toronto Metropolitan University, Canada

11/23 *Modeling, State Estimation, and Control for Continuum Robotic Manipulation*, Department of Mechanical and Mechatronics Engineering, University of Waterloo, Canada

08/23 *Continuum Robot State Estimation Using Gaussian Process Regression on SE(3)*, Department of Mechanical Engineering, McGill University, Canada

11/20, 03/22 & 04/23 *Lie Theory in Robotics*, Invited Guest Lecturer, Computer Science Course MAT305H5S: Elementary Lie Theory, University of Toronto Mississauga, Canada

03/23 *Continuum Robot State Estimation Using Gaussian Process Regression on SE(3)*, Toronto AI Robotics Seminar, University of Toronto, Canada

05/22 *Tendon-Driven Parallel Continuum Robots*, Toronto AI Robotics Seminar, University of Toronto, Canada

03/22 *Mathematical and Computational Modeling of Continuum Robots*, Invited Guest Lecturer, Student Robotics Club, University of Toronto Mississauga, Canada

09/18 *Human Computer Interaction in Continuum Robotics*, Human Computer Interaction Workshop at 17th Annual Meeting of the German Society for Computer- and Robot-Assisted Surgery e.V., Leipzig, Germany

Other Presentations

05/22 *Tendon-Driven Parallel Continuum Robots*, Graduate Research Colloquium, University of Toronto Mississauga

Awards and Recognitions

07/23 **Robotics: Science and Systems Pioneer 2023**, *Robotics: Science and Systems Conference, Daegu, South Korea*
Recognizing the world's top early-career robotics researchers, 22% acceptance rate (30/135)

05/22 **Graduate Student Conference Grant**, *School of Graduate Studies, University of Toronto*

11/22 **3 Minute Thesis Competition Winner**, *Robotics Institute University of Toronto*, Parallel Continuum Robots: Collaboration in Confined Spaces

07/22 **Best Robotics Paper Award Finalist**, *International Conference on Manipulation, Automation and Robotics at Small Scales*, Cooperative Control of Dual-Arm Concentric Tube Continuum Robots

05/22 **Graduate Student Travel Grant**, *Department of Mathematical and Computational Sciences, University of Toronto Mississauga*

09/18 **Best Paper Award, 2nd Place**, *17th Annual Meeting of the German Society for Computer- and Robot-Assisted Surgery e.V.*, Comparison of Haptic and Auditory Feedback Methods for the Teleoperation of Concentric Tube Continuum Robots

09/18 **Travel Scholarship**, *17th Annual Meeting of the German Society for Computer- and Robot-Assisted Surgery e.V.*, Top 30% of the paper rankings

12/17 **Third best graduate M. Sc. Electrical Engineering**, *Leibniz University Hannover*

10/15 – 09/16 **Deutschlandstipendium**, *Leibniz University Hannover*
The Deutschlandstipendium supports highly talented students at universities in Germany. Selection criteria include academic achievement, social commitment and personal achievements. Across Germany, 24,276 students received this scholarship in 2015.

12/15 **Third best graduate B. Sc. Electrical Engineering**, *Leibniz University Hannover*

10/14 – 03/15 **Lower Saxony Scholarship**, *Leibniz University Hannover*
The Lower Saxony Scholarship is awarded to students with outstanding academic achievements at universities in Lower Saxony, Germany.

10/11 – 09/12 **Faculty internal scholarship**, *Leibniz University Hannover*
This scholarship was awarded by the Faculty of Electrical Engineering and Computer Science to the most competitive first-year students in terms of personal and academic achievements.

Teaching

Courses

Fall 2022 **Fundamentals of Robotics**, *University of Toronto Mississauga*
Head TA, designing course material and assignments, tutoring and supervising students in a practical exercise, grading, design and delivery of selected lectures

Fall 2021 **Fundamentals of Robotics**, *University of Toronto Mississauga*
Head TA, designing course material and assignments, tutoring and supervising students in a practical exercise, grading, design and delivery of selected lectures

Winter 2021 **Introduction to Continuum Robotics**, *University of Toronto Mississauga*
Head TA, designing course material and assignments, tutoring and supervising students in a practical exercise, grading, design and delivery of selected lectures

Fall 2020 **Fundamentals of Robotics**, *University of Toronto Mississauga*
Head TA, designing course material and assignments, tutoring and supervising students in a practical exercise, grading, design and delivery of selected lectures

Fall 2019 **Fundamentals of Robotics**, *University of Toronto Mississauga*
Head TA, designing course material and assignments, tutoring and supervising students in a practical exercise, grading, design and delivery of selected lectures

Fall 2017/ Winter 2018 **Continuum Robotics**, *Leibniz University Hannover*
Tutoring and supervising students in a practical exercise

Fall 2017/ Winter 2018 **Journalclub Continuum Robotics**, *Leibniz University Hannover*
Tutoring and supervising students

2013 – 2016 **Electrical Engineering Laboratory**, *Leibniz University Hannover*
Tutoring, supervising and examining students in the conduction of electrical engineering laboratory experiments

Fall 2012 **First Semester Project: Circuit Engineering**, *Leibniz University Hannover*
Tutoring and supervising students during a circuit engineering project

Student Mentoring

Mentoring students in their individual research projects and theses: Conceptualizating research projects, holding weekly meetings, supervising and advising in research and writing.

Leibniz University Hannover, Germany
Simon Kleinschmidt (M.Sc. Mechanical Engineering), Xueyang Zhang (M.Sc. Electrical Engineering), Anton Sauer (M.Sc. Mechanical Engineering), Georg Böttcher (M.Sc. Mechatronics), Wenkang Yang (B.Sc. Mechatronics)

University of Toronto, Canada
Hanna Zhang (B.Sc. Engineering Science), Michael Shanks-Marshall (B.Sc. Engineering Science), Jiajie Xu (B.Sc. Electrical Engineering), Syeda Sani-e Zehra (B.Sc. Computer Science), Kyrel Jerome (B.Sc. Computer Science), Paul Zhang (B.Sc. Computer Science), Travis Shao (B.Sc. Computer Science), Spencer Teetaert (B.Sc. Engineering Science)

Grant Writing Experiences

2022 **CFI (Canada Foundation for Innovation) John R. Evans Leaders Fund**
PI: Jessica Burgner-Kahrs
Project #42138
Collaborating Continuum Robots
2022-2025
400,000 CAD
Assisted in grant writing by helping with the conceptualization of the research questions and project, writing the state-of-the-art section and drafting the methodology section.

2019 **CNRS - UofT Joint Research Programme**
PI: Jessica Burgner-Kahrs (UofT), M. Taha Chikahoui (CNRS)
Dual-arm Continuum Robots for Single-port Interventions
2019 (12 months)
7,000 CAD (Uoft) plus 4,800 Euro (CNRS)
Assisted in grant writing by helping with the conceptualization of the research questions and project, writing the state-of-the-art section and drafting the methodology section.

Professional Development

05/22 - 07/23 **Robotics Leadership Program**, *Graduate Training Program*, University of Toronto, Canada
Participated in a series of workshops focusing on professional communication and team building, leading to various outreach initiatives. Efforts included interacting with grade-school teachers to promote robotics-centered education and hosting events for student groups and classes at the University of Toronto Robotics Institute.

07/18 **Control of Surgical Robots (COSUR)**, *Summer School*, University of Verona, Italy

07/18 **Basics of Rhetoric for Research Assistants**, *Seminar*, Leibniz University Hannover, Germany

Service

Organization of Scientific Conferences

07/24 Program Committee Chair for the RSS Pioneers Workshop at the Robotics Science and Systems Conference, Delft, Netherlands

06/24 Volunteer at the Canadian Robotics Council 2024, Toronto, Canada

05/22 Co-Organization of the New Frontiers of Parallel Robotics Workshop with Dr. Sébastien Briot, Prof. Jessica Burgner-Kahrs, Prof. Marco Carricato and Prof. Giuseppe Loianno at the IEEE International Conference on Robotics and Automation, Philadelphia, US

10/17 Organization of the Poster Session at the 16th Annual Meeting of the German Society for Computer- and Robot-Assisted Surgery e.V., Hanover, Germany

University Service

03/23 Invited Q&A Panelist at the UTRAHacks 2023 Hackathon organized by the University of Toronto Robotics Association, University of Toronto

04/22 Interviewing Ukrainian Students for a Research Summer Program, Department of Computer Science, University of Toronto

03/22 Participant of Graduate Student Panel and Research Blitz, Computer Science Graduate Visit Week, University of Toronto

11/20 Assisting in Conducting the 3MT Competition of the Robotics Institute Fall Workshop, University of Toronto

Outreach

05/23 & 11/23 Organization and Conduction of Robotics Events and Workshops for Middle and High School Students at the Robotics Institute, University of Toronto

04/23 Representation of the University of Toronto Robotics Institute at the Ontario Association for Mathematics Education Conference, Toronto, Canada

11/17 & 02/18 Organization and Conduction of Full-Day Robotics Events for High School Students at the Laboratory for Continuum Robotics, Leibniz University Hannover

Reviewer

IJRR, IEEE T-MECH, ASME JMR, Frontiers in Robotics and AI, IEEE T-RO, IEEE RA-L, IEEE L-CSS, IEEE IROS, IEEE ICRA, RSS

Member

IEEE Robotics and Automation Society (RAS) Member