Simon Le Cleac'h

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Experience

Robotics and AI Institute **Cambridge, MA**

— Lead Research Scientist *April 2025 - Present*

Leading the research team on whole-body contact-rich manipulation

- Leading the technical and research direction for whole-body contact-rich manipulation team, spanning reinforcement learning and behavioral cloning policy synthesis.
- Drove external research impact through technical blog posts, videos (+750k views), open-source code and peer-reviewed publications [2,3,4,5].
- Managing and mentoring a team of research scientists and engineers, coordinating project execution from problem formulation to experimental validation and deployment.
- Setting research priorities, coordinating cross-functional efforts, and interfacing with Institute leadership on roadmap and resourcing.

— Research Scientist *June 2023 - April 2025*

Developed whole-body and dexterous manipulation capabilities

- Synthesized contact-rich manipulation policies via RL and behavioral cloning, deployed on legged-robot hardware for dynamic whole-body tasks.
- Co-developed **Judo**, an open-source sampling-based MPC toolbox for contact-rich manipulation, integrating RL policies and enabling large-scale (GPU) data generation for imitation learning (code, paper).
- Designed and validated a sampling-based optimizer (**Jacta**) for complex in-hand manipulation with a multi-fingered hand, synthesizing dexterous manipulation plans in simulation [5].
- Retargeted motion-captured human demonstrations of dynamic in-hand manipulation (pen spinning) into dynamically feasible trajectories via sampling-based optimization.

Robotics Research Internship, Google Brain **New York**

Developed optimization-based tools for contact simulation and long-horizon planning. *Summer 2022*

- Unified collision detection and contact dynamics as a single optimization problem.
- Implemented an interior-point solver for non-linear complementarity problems to simulate and differentiate contact dynamics.

Software Engineering Internship, Aurora Innovation **Palo Alto**

Involved in autonomous driving technology development as part of the motion planning team. *Summer 2018*

- Developed a learning-based approach to improve the interaction of the autonomous vehicle with pedestrians and cyclists.
- Designed classification features and built a pedestrian interaction dataset from autonomous vehicle logs.
- Designed, trained and tested a deep learning model to take decision with respect to pedestrians.

Research Assistant, Stanford AI Lab **Stanford**

Programming a deep learning application in robotics. *Winter 2018*

- Designed a Recurrent Neural Network for estimating an object's physical properties through contact interaction.
- Implemented a probabilistic filter to fuse sensory data containing images and force/torque measurements.

Education

Stanford University **Stanford**

Ph.D candidate in Mechanical Engineering, Specialization in Robotics, Optimization and AI. *2019–2023*

Co-advised by Zachary Manchester & Mac Schwager, my research focused on developing fast optimization algorithms for simulation, planning, and control for robotic systems. I designed and implemented a differentiable physics simulator and leveraged this tool for trajectory tracking [6,7,8,9], trajectory optimization and reinforcement learning tasks in robotic locomotion and manipulation. Previously, I implemented optimization algorithms enabling game-theoretic reasoning for autonomous vehicles [11,12,14].

Stanford University **Stanford**

Master of Mechanical Engineering, Specialization in Robotics and AI. *2017–2019*

GPA – 4.0/4.0

Coursework: Machine Learning, Convolutional Neural Network for Visual Recognition, Robotic Manipulation, Robotic Autonomy, Convex Optimization, Optimal Control, State Estimation, Aerial Robot Design.

Ecole Centrale Paris **Paris**

Master of Science in Engineering, Applied Mathematics. *2015–2017*

GPA – 4.2/4.0, ranked 4^{th} out of 535 students.
Coursework: Statistics, Probability, Discrete Optimization, Embedded Systems, Control Theory, Parallel Computing, Database.

Software

Judo: hackable sampling-based MPC toolbox. **Cambridge, MA**
Developed a highly interactive platform for contact-rich manipulation data-generation *2025*
`https://github.com/bdaiinstitute/judo`

Silico: Single-level Differentiable Contact Simulation. **New York**
Introduced a formulation unifying collision detection and contact dynamics as a single problem. *2022*
`https://github.com/simon-lc/Silico.jl`

Dojo: Differentiable Physics Engine for Robotics. **Stanford**
Developed a state-of-the-art physics engine for rigid-body contact simulation *2022*
`https://github.com/dojo-sim/Dojo.jl`

ALGAMES: Software Package for solving dynamic games. **Stanford**
Implemented a state-of-the-art solver for constrained dynamic game *2020*
`https://github.com/RoboticExplorationLab/Algames.jl`

Skills

Programming: PYTHON, C++ (basic)

AI & Robotics: PyTorch, MJLAB, IsaacLab, Mujoco, ROS2, Ipopt, CVX

Software & Tools: Git, Linux, Docker, Bazel, Blender, Latex, DaVinci

Language: English (bilingual), French (native), Spanish (conversational), German (basic skills)

Research Communication

- **Blog Post:** Combining Sampling and Learning for Dynamic Whole-Body Manipulation, RAI Institute, 2025.
- **Video:** Dynamic Whole-Body Manipulation with Spot, RAI Institute YouTube, 2025.

Publications

[1] J. Zhang, M. Sorokin, J. Brüdigam, B. Hung, S. Phillips, D. Yershov, F. Niroui, T. Zhao, L. Fermoselle, X. Zhu, C. Cao, D. Ta, T. Pang, J. Wang, P. Culbertson, Z. Manchester, **S. Le Cleac'h**, Sumo: Dynamic and Generalizable Whole-Body Loco-Manipulation, *Under Review*.

[2] L. Brudermuller, B. Hung, X. Zhu, J. Wang, N. Hawes, P. Culbertson, **S. Le Cleac'h**, Generative Models from and for Sampling-Based MPC: A Bootstrapped Approach for Adaptive Contact-Rich Manipulation, *Robotics and Automation Letters* (RA-L 2026).

[3] A. Li, B. Hung, A. Ames, J. Wang, **S. Le Cleac'h**, P. Culbertson, Judo: A User-Friendly Open-Source Package for Sampling-Based Model Predictive Control, *International Conference on Robotics and Automation* (ICRA 2026).

[4] X. Zhu, Y. Chen, L. Sun, F. Niroui, **S. Le Cleac'h**, J. Wang, K. Fang, Versatile Loco-Manipulation through Flexible Interlimb Coordination, *Conference on Robot Learning* (CoRL 2025).

[5] J. Brüdigam, A. Abbas, M. Sorokin, K. Fang, B. Hung, M. Guru, S. Sosnowski, J. Wang, S. Hirche, **S. Le Cleac'h**, Jacta: A Versatile Planner for Learning Dexterous and Whole-body Manipulation, *Conference on Robot Learning* (CoRL 2024).

[6] **S. Le Cleac'h**, M. Schwager, Z. Manchester, V. Sindhwani, P. Florence, S. Singh, Single-Level Differentiable Contact Simulation, *Robotics and Automation Letters* (RA-L & IROS 2023).

[7] **S. Le Cleac'h***, T. Howell*, Z. Kolter, M. Schwager, Z. Manchester, Dojo: A Differentiable Physics Engine for Robotics, *Transactions on Robotics* (T-RO 2023, submitted).

[8] **S. Le Cleac'h**, H. Yu, M. Guo, T. Howell, R. Gao, J. Wu, Z. Manchester, M. Schwager, Differentiable Physics Simulation of Dynamics-Augmented Neural Objects, *Robotics and Automation Letters* (RA-L & IROS 2023).

[9] **S. Le Cleac'h***, T. Howell*, S. Yang, C. Lee, J. Zhang, A. Bishop, M. Schwager, Z. Manchester, Fast Contact-Implicit Model Predictive Control, *Transactions on Robotics* (T-RO 2023).

[10] T. Howell, **S. Le Cleac'h**, M. Schwager, Z. Manchester, Trajectory Optimization with Optimization-Based Dynamics, *Robotics and Automation Letters* (RA-L & ICRA 2022).

[11] **S. Le Cleac'h**, M. Schwager, Z. Manchester, ALGAMES: A Fast Augmented Lagrangian Solver for Constrained Dynamic Games, *Autonomous Robots* (AuRo 2021).

[12] **S. Le Cleac'h**, M. Schwager, Z. Manchester, LUCIDGames: Online Unscented Inverse Dynamic Games for Adaptive Trajectory Prediction and Planning, *Robotics and Automation Letters* (RA-L & ICRA 2021).

[13] R. Derollez, **S. Le Cleac'h**, Z. Manchester, Robust Entry Vehicle Guidance with Sampling-Based Invariant

Funnels, *IEEE Aerospace Conference* (AeroConf 2021).
[14] **S. Le Cleac'h**, M. Schwager, Z. Manchester, ALGAMES: A Fast Solver for Constrained Dynamic Games, *Robotics: Science and Systems* (RSS 2020).
[15] **S. Le Cleac'h**, Z. Manchester, Fast Solution of Optimal Control Problems with L1 Cost, *Astrodynamics Specialist Conference* (AAS/AIAA 2019).

Talks and Presentations

Control Through Contact via Differentiable Optimization (slides)
Advanced Mechanical Bipedal Experimental Robotics (AMBER) Laboratory, Caltech. *November 2023*

Single-Level Differentiable Contact Simulation (video) (slides) (poster)
International Conference on Intelligent Robots and Systems (IROS), Detroit. *October 2023*

Differentiable Physics Simulation of Dynamics-Augmented Neural Objects (video) (slides) (poster)
International Conference on Intelligent Robots and Systems (IROS), Detroit. *October 2023*

Towards Efficient Optimization Through Contact: Simulation, Gradients, and Algorithms (poster)
RSS Pioneers Workshop, Daegu, South Korea. *July 2023*

Numerical Optimization for Robotics Control and Simulation (slides)
The Boston Dynamics AI Institute, Cambridge, MA. *March 2023*

Dojo: Differentiable Physics Engine for Robotics (slides)
Skydio, San Mateo, CA. *March 2023*

Joint Prediction and Planning for Autonomous Vehicles (slides)
NVIDIA Autonomous Vehicle Research Group, Santa Clara, CA. *March 2023*

Numerical Optimization for Robotics Control and Simulation (slides)
Figure AI, Sunnyvale, CA. *March 2023*

Control Through Contact via Differentiable Optimization (slides)
Honda Research Institute (HRI), San Jose, CA. *February 2023*

Composable Optimization for Robotics Simulation and Control (slides)
PhD Defense, Stanford. *January 2023*

Differentiable Physics: Simulation, Planning and Control (slides)
Toyota Research Institute (TRI), Los Altos, CA. *November 2022*

Dynamics-Augmented Neural Objects (poster)
Bay Area Robotics Symposium, BARS 2022, University of California, Berkeley. *November 2022*

Dojo: A Differentible Physics Engine for Robotics (slides) (poster)
Differentiable Physics for Robotics workshop, RSS 2022, New York City. (w/ T. Howell) *July 2022*

Fast Contact-Implicit Model-Predictive Control (slides) (poster)
The Science of Bumping into Things workshop, RSS 2022, New York City. (w/ T. Howell) *July 2022*

Leveraging Differentiable Physics for Contact-rich Robotic Control (slides)
Google Brain Robotics, New York City. *August 2022*
National Institute for Research in Digital Science and Technology (INRIA) Willow Team, Paris. *June 2022*
Interactive Perception and Robot Learning Laboratory, Stanford University. *May 2022*

NeRF-ysics: Dynamics-Augmented Neural Objects (poster)
Motion Planning with Implicit Neural Representations of Geometry workshop, ICRA 2022, Philadelphia. *May 2022*

Dojo: A Differentiable Simulator for Robotics (slides)
Apple Research. *August 2022*
Search-based Planning Laboratory, Carnegie Mellon University. *August 2022*
Microsoft Research. (w/ T. Howell) *May 2022*
Scientific Machine Learning (SciML) webinar, Carnegie Mellon University. (w/ T. Howell) *April 2022*
SystemX lunch seminar, Stanford University. (w/ T. Howell) *March 2022*

Contact-Implicit Model-Predictive Control (slides)
Machines in Motion Laboratory, New York University. (w/ T. Howell) *December 2021*
Locomotion Seminar, Carnegie Mellon University. (w/ T. Howell) *November 2021*

Linear Contact-Implicit Model-Predictive Control (poster)
Dynamic Walking 2021. *May 2021*

ALGAMES: A Fast Solver for Constrained Dynamic Games (video)
Robotics: Science and Systems, RSS 2020. *June 2020*

ALGAMES: A Fast Solver for Constrained Dynamic Games (poster)
Bay Area Robotics Symposium, BARS 2019, University of California, Berkeley. *November 2019*

Teaching

Teaching Assistant, Stanford University **Stanford**
CS231N: Convolutional Neural Networks for Visual Recognition taught by Fei-Fei Li. *Spring 2019*
CS326: Topics in Advanced Robotic Manipulation taught by Jeannette Bohg. *Fall 2018*
ME300B: Partial Differential Equations in Engineering taught by Sanjiva Lele. *Winter 2017*

Awards

RSS Pioneers 2023: 1 of 30 selected as "the world's top early career researchers" in Robotics.
Walter-Zellidja Fellowship, received from the Académie Française, the most prestigious institution for the French language and culture, to support my studies in the United-States.

Professional Activities

Mentoring

John Z. Zhang (2025), currently PhD Student at MIT
Ali Abbas (2024), currently research scientist at the RAI Institute and PhD candidate at the Northeastern University.
Lara Brudermüller (2024), currently applied scientist at Amazon Robotics
Maks Sorokin (2024), currently research scientist at the RAI Institute
Jan Brüdigam (2023), currently research scientist at the RAI Institute
John Tucker (2022), currently PhD candidate at Stanford University

Professional Service

Co-organizer, Workshop on the Path Towards Generalizable Contact-Rich Robotics: Control and Representation, International Conference on Robotics and Automation (ICRA), 2026.
Co-organizer, Workshop on Leveraging Models for Contact-Rich Manipulation, International Conference on Intelligent Robots and Systems (IROS), 2023.

Associate Editor

International Conference on Robotics and Automation (ICRA) Associate Editor for Manipulation and Grasping 2025

Academic Reviewer

Conference on Robot Learning (CoRL): 2023, 2025
Robotics: Science and Systems (RSS): 2023, 2024, 2026
Learning for Decision and Control (L4DC): 2022, 2024
Transactions on Robotics (T-RO): 2021, 2022, 2023
Robotics and Automation Letters (RA-L): 2023
International Conference on Robotics and Automation (ICRA): 2022, 2023
International Conference on Intelligent Robots and Systems (IROS): 2020

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