Simon Le Cleac'h

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Experience

Robotics and AI Institute **Cambridge, MA**
— Lead Research Scientist *April 2025 - Present*
Leading research team on RL-based whole-body manipulation

- Lead a team of 7+ research scientists and engineers developing reinforcement learning and imitation learning methods for dynamic whole-body contact-rich manipulation.
- Defined the research roadmap, technical direction, and experimental strategy, spanning algorithm design, large-scale simulation, and real-world robotic deployment.
- Developed RL-based manipulation systems combining off-policy reinforcement learning (SAC/TD3) with large-scale synthetic data generation, enabling zero-shot transfer from simulation to hardware.
- Drove external research impact through technical blog posts, videos (+750k views), open-source software, and peer-reviewed publications [2,3,4,5].
- Mentored researchers and engineers, recruited interns, and coordinated quarterly research planning with institute leadership.

— Research Scientist *June 2023 - April 2025*
Developed RL and optimization methods for whole-body and dexterous manipulation

- Developed contact-rich manipulation policies using PPO, SAC, TD3, and imitation learning, deployed on Boston Dynamics Spot and Unitree G1 humanoid robots.
- Introduced a training framework combining off-policy reinforcement learning with large-scale synthetic data generation, producing millions of simulated transitions and enabling zero-shot sim-to-real deployment for challenging manipulation tasks.
- Extended MJLab with custom RL environments, reward functions, observation spaces, and training curricula, enabling large-scale training of vision-based and proprioceptive state-based policies for robotic manipulation.
- Created **Judo**, an open-source sampling-based optimization toolbox for contact-rich manipulation, enabling large-scale GPU data generation and imitation learning workflows (200+ GitHub stars).
- Designed sampling-based optimization methods for dynamic in-hand manipulation and whole-body tasks, including dexterous manipulation with multi-fingered hands and large-object manipulation with legged robots.
- Demonstrated previously unexplored dynamic manipulation capabilities on hardware, including whole-body manipulation of large and heavy objects with a legged robot.

— Robotics Research Intern, Google Brain **New York**
Developed optimization methods for differentiable contact simulation and long-horizon planning *Summer 2022*

- Formulated collision detection and contact dynamics as a unified nonlinear optimization problem for rigid-body simulation.
- Developed an interior-point solver for nonlinear complementarity problems, enabling differentiable simulation of contact-rich robotic systems.
- Investigated optimization-based planning and differentiable physics for long-horizon robotic manipulation tasks.

— Software Engineering Intern, Aurora Innovation **Palo Alto**
Developed learning-based methods for autonomous vehicle interaction with pedestrians *Summer 2018*

- Developed a learning-based approach for autonomous vehicle decision making around pedestrians and cyclists.
- Designed feature representations and constructed training datasets from large-scale autonomous driving logs.
- Designed, trained, and evaluated deep neural networks for pedestrian interaction prediction and decision making.

— Research Assistant, Stanford AI Lab (Prof. Jeannette Bohg) **Stanford**
Developed deep learning methods for contact-based robotic perception *Winter 2018*

- Designed and trained a recurrent neural network to infer object physical properties from sequences of contact interactions.
- Developed a probabilistic sensor fusion framework combining vision and force/torque measurements for robotic state estimation.

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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