Simon Le Cleac'h

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✓ Work authorization with Optional Practical Training

Education

Stanford University **Stanford**
Ph.D candidate in Mechanical Engineering, Specialization in Robotics, Optimization and AI. *2019–Present*
Co-advised by Zachary Manchester & Mac Schwager, my research focuses on developing fast optimization algorithms for simulation, planning, and control for robotic systems. I am designing and implementing a differentiable physics simulator and leveraging this tool for trajectory tracking [1, 2, 3, 4], trajectory optimization and reinforcement learning tasks in robotic locomotion and manipulation. Previously, I implemented optimization algorithms enabling game-theoretic reasoning for autonomous vehicles [6,7,9].

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.

Experience

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.

Robotic Autonomy Project, Stanford University **Stanford**
Implemented a robotic autonomy stack on a TurtleBot using ROS. *Fall 2019*

- Implemented a deep learning inference pipeline on board to detect and classify objects using camera input.
- Exploited LIDAR data to build a map of an unknown environment, then planned trajectories online to reach goal points.
- Designed an actuator controller to execute the planned trajectories.

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*

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.

Software

Silico: Single-level Differentiable Contact Simulation. **New York City**
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 games in the Julia language. *2020*
`https://github.com/RoboticExplorationLab/Algames.jl`

Skills

Programming: PYTHON, C++, JULIA

Computational: LATEX, GIT, LINUX, IPOPT, CVX/CONVEX.JL, MESHCAT

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

Publications

[1] **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 2023, submitted).
[2] **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).
[3] **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 2023, submitted).
[4] **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, submitted).
[5] T. Howell, **S. Le Cleac'h**, M. Schwager, Z. Manchester, Trajectory Optimization with Optimization-Based Dynamics, *International Conference on Robotics and Automation* (RA-L & ICRA 2022).
[6] **S. Le Cleac'h**, M. Schwager, Z. Manchester, ALGAMES: A Fast Augmented Lagrangian Solver for Constrained Dynamic Games, *Autonomous Robots* (AuRo 2021).
[7] **S. Le Cleac'h**, M. Schwager, Z. Manchester, LUCIDGames: Online Unscented Inverse Dynamic Games for Adaptive Trajectory Prediction and Planning, *International Conference on Robotics and Automation* (RA-L & ICRA 2021).
[8] R. Derollez, **S. Le Cleac'h**, Z. Manchester, Robust Entry Vehicle Guidance with Sampling-Based Invariant Funnels, *IEEE Aerospace Conference* (AeroConf 2021).
[9] **S. Le Cleac'h**, M. Schwager, Z. Manchester, ALGAMES: A Fast Solver for Constrained Dynamic Games, *Robotics: Science and Systems* (RSS 2020).
[10] **S. Le Cleac'h**, Z. Manchester, Fast Solution of Optimal Control Problems with L1 Cost, *Astrodynamics Specialist Conference* (AAS/AIAA 2019).

Talks and Presentations

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. *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*

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