Learning For Dynamics & Control (L4DC)
June 07-08, 2021

Program:

all times in PT

Monday, June 7, 2021

8:00 – 8:15	Welcome & Introduction by Organizers
8:15 – 8:45	Michael Jordan (U.C. Berkeley)
8:45 – 9:30	Oral Presentations 1.A: Reinforcement Learning
9:30 – 9:45	Coffee Break
9:45 – 10:30	Poster Sessions 1.A & 1.B → Gather.Town Hall A&B
10:30 – 11:00	Sandra Hirche (T.U. Munich)
11:00 – 11:15	Coffee Break
11:15 – 12:00	Oral Presentations 1.B: Adversarial Learning
12:00 – 12:30	Aude Billard (EPF Lausanne)
12:30 – 13:30	Brainstorming on Future L4DCs → Gather.Town Hall A, Keynote Room

Tuesday, June 8, 2021

8:00 – 8:05	Welcome to the Second Day
8:05 – 8:35	Daniel Lee (Cornell University)
8:35 – 9:35	Oral Presentations 2.A: Learning Dynamics
9:35 – 9:45	Coffee Break
9:45 – 10:30	Poster Sessions 2.A & 2.B → Gather.Town Hall A&B
10:30 – 11:30	Oral Presentations 2.B: Learning Controllers
11:30 – 11:45	Coffee Break
11:45 – 12:15	Raffaello D'Andrea (ETH Zurich)
12:15 – 12:30	Concluding Remarks

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Invited Talks Monday, June 7, 2021:

Michael Jordan (U.C. Berkeley)

Title: On Dynamics-Informed Blending of Machine Learning and Microeconomics

Abstract: *Statistical decisions are often given meaning in the context of other decisions, particularly when there are scarce resources to be shared. Managing such sharing is one of the classical goals of microeconomics, and it is given new relevance in the modern setting of large, human-focused datasets, and in data-analytic contexts such as classifiers and recommendation systems. I'll discuss several recent projects that aim to explore the interface between machine learning and microeconomics, including the study of exploration-exploitation tradeoffs for bandits that compete over a scarce resource, the use of Langevin-based algorithms for Thompson sampling, leader/follower dynamics in strategic classification, and the robust learning of optimal auctions.*

Sandra Hirche (T.U. Munich)

Title: *"To Sample or not to Sample?" –*
Efficient Online Learning in Closed Loop Control Systems

Abstract: *Online learning in closed loop control systems is very attractive because it allows the automated identification of highly nonlinear dynamical systems as well as a fast adaptation to dynamically changing environments.*

Yet, depending on the application the data collection and the training of models is costly if not even prohibitive for the following reasons: i) The training is computationally expensive and might compromise real-time performance. ii) The generation of training data often requires costly sensor calibration. iii) In human-in-the-loop systems calibration routines are perceived as inconvenient and burdensome. Due to these costs, data should be carefully selected for learning.

In this talk we will demonstrate that the control task in addition to the underlying system dynamics has a strong influence on the required sample complexity. Employing Bayesian principles, we explore methods to quantify epistemic uncertainty with respect to control objectives and how they can be exploited to achieve a high sample efficiency for learning in the closed loop system. Additionally, approaches for efficient non-parametric online learning are investigated to allow the application of the presented methods under real-time constraints.

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Invited Talks Monday, June 7, 2021:

Aude Billard (EPF Lausanne)

Title: Learning closed-form control laws for robots to react in milliseconds

Abstract: *We want autonomous cars, wheelchairs and other mobility devices to transport us autonomously with limited human intervention. We want robots in our homes to cook, clean and entertain us. We want robots on our body to replace a lost limb or to augment our capabilities. All the robots listed above share one common challenge: they must cope with unexpected changes in their environment. For instance, an intelligent wheelchair will have to negotiate its path in a crowd without hitting pedestrians. It will have to do so, while avoiding to brake too abruptly for risk of letting its user fly over. How can the robot recompute a path within milliseconds at time critical situations?*

On-line reactivity is not just an issue of having enough CPU on-board of the robot. It requires inherently robust control laws that can re-plan in milliseconds. Most importantly, it needs control laws that are ensured to provide feasible solutions. This talk will show how we can learn a manifold of feasible motions that can be expressed in closed-form, hence ensuring speedy retrieval. We show how traditional regression and classification optimization can be rephrased to provide guarantees on the learned dynamics. The talk will show application of this to learn the nonlinear dynamics of flying objects so as to catch these in flight, and to learn high-dimensional representation of the robot's joint workspace for whole-body real-time obstacle avoidance. Lastly, a few examples of applications for learning variable force and impedance control for safe human-robot interaction and for safe navigation with a wheelchair travelling in a heavy crowd of pedestrians.

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Learning For Dynamics & Control (L4DC)
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Invited Talks Tuesday, June 8, 2021:

Daniel Lee (Cornell University)

Title: *Learning for Robot Perception, Planning and Control*

Abstract: *Conventional computational architectures for robotics segregate representations and processing modules for perception, planning and control. Recent advances in deep learning have shown success in applying end-to-end approaches to robot learning but require large amounts of expensive training data. In this talk, I will contrast these two approaches and present some recent work on statistical bounds in learning-enabled modules and hybrid computational architectures for robot learning.*

Raffaello D'Andrea (ETH Zurich)

Title: *Optimal Information Gathering for Optimal Decision Making*

Abstract: *A discussion on the role of flying sensors in the supply chain.*

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Oral Presentations Monday, June 7, 2021:

Oral Presentations 1.A: Reinforcement Learning (3x 15min)

Chenyu Liu, Yan Zhang, Yi Shen and Michael Zavlanos, *Learning without Knowing: Unobserved Context in Continuous Transfer Reinforcement Learning*

Rafael Rafailov, Tianhe Yu, Aravind Rajeswaran and Chelsea Finn, *Offline Reinforcement Learning from Images with Latent Space Models*

Brandon Amos, Samuel Stanton, Denis Yarats and Andrew Gordon Wilson, *On the model-based stochastic value gradient for continuous reinforcement learning*

Oral Presentations 1.B: Adversarial Learning (3x 15min)

Benoit Landry, Hongkai Dai and Marco Pavone, *SEAGuL: Sample Efficient Adversarially Guided Learning of Value Functions*

Anshuka Rangi, Mohammad Javad Khojasteh and Massimo Franceschetti, *Learning-based attacks in Cyber-Physical Systems: Exploration, Detection, and Cost trade-offs*

Udaya Ghai, David Snyder, Anirudha Majumdar and Elad Hazan, *Generating Adversarial Disturbances for Controller Verification*

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Oral Presentations Tuesday, June 8, 2021:

Oral Presentations 2.A: Learning Dynamics (4x 15min)

Anas Makdesi, Antoine Girard and Laurent Fribourg, *Data-Driven Abstraction of Monotone Systems*

Guillaume O. Berger, Raphaël M. Jungers and Zheming Wang, *Chance-constrained quasi-convex optimization with application to data-driven switched systems control*

Sarah Dean and Benjamin Recht, *Certainty Equivalent Perception-Based Control*

Andrea Sassella, Valentina Breschi and Simone Formentin, *Data-driven design of switching reference governors: theory and brake-by-wire application*

Oral Presentations 2.B: Learning Controllers (4x 15min)

Yang Zheng, Yujie Tang and Na Li, *Analysis of the Optimization Landscape of Linear Quadratic Gaussian (LQG) Control*

Fernando Gama and Somayeh Sojoudi, *Graph Neural Networks for Distributed Linear-Quadratic Control*

Nicholas Boffi, Stephen Tu and Jean-Jacques Slotine, *Regret Bounds for Adaptive Nonlinear Control*

Anders Rantzer, *Minimax Adaptive Control for a Finite Set of Linear Systems*

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