The Third Annual Conference on Learning for Dynamics and Control

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1. Introduction

Over the next decade, the biggest generator of data is expected to be embedded devices that sense and control the physical world. The explosion of real-time data that is emerging from the physical world requires a rapprochement of areas such as machine learning, control theory, and optimization. The conference series on Learning for Dynamics and Control (L4DC) aims to facilitate this rapprochement.

Control theory has for decades been firmly rooted in the tradition of model-based design. The availability and scale of data (both temporal and spatial) that is becoming available will require rethinking the foundations of the discipline. On the other hand, over the past decade, machine learning has had tremendous impact in numerous areas such as computer vision and language translation. The abundance of real-time data from embedded devices, however, requires the development of machine learning methods that go beyond pattern recognition and address problems in data driven control and decision making, as well as learning based optimization of dynamical processes.

While this research agenda is very important for the future of various areas (control, optimization, reinforcement learning, data-driven decision learning), until recently there was no natural forum to bring together researchers from the diverse areas needed to advance the state of the art in Learning for Dynamics and Control. Large automatic control conferences such as the IEEE Conference on Decision and Control have in recent years featured dedicated sessions for researchers interested in learning-based control, safe learning, or constrained learning. These efforts, however, mainly attract researchers with a control background and are not visible to most researchers in machine learning. On the other hand, in core machine learning conferences such as NeurIPS, COLT, and ICML, there is limited interest in learning for dynamical and decision systems. Many researchers in other related areas (signal processing, optimization, robotics) have growing efforts on the interface with machine learning, emphasizing mostly prediction and less decision making in dynamic systems. Finally, the recently established Conference on Robot Learning (CoRL) is also addressing issues at this interface but with a focus on the application domain of robotics.

To fill this niche, our goal with the L4DC conference series is to create a forum that brings together pioneers and state of the art research in the areas of control systems, optimization, machine learning, and related disciplines. An elite conference on this topic can have tremendous impact not only scientifically by bridging distant areas, but also by creating a community that nurtures a growing number of junior researchers working on this emerging interface. By enabling interactions across control, optimization and learning, L4DC aspires to provide a natural home for professional development for students and faculty that may feel marginalized in the current conference landscape.

Following the success of the inaugural L4DC workshop held in 2019 at MIT and the virtual 2nd Annual Conference on Learning for Dynamics and Control (L4DC2020) hosted by U.C. Berkeley,

the third instalment of the series, L4DC2021, was hosted by ETH Zurich, again in a virtual format. In the long term, we would like to continue this event as an annual conference, where best results on this emerging interface are presented. We aim to create a new community that spans the related disciplines, asks novel questions, and develops the foundations of this new scientific area.

2. Conference scope

The conference focuses on the foundations and applications of learning for dynamical and control systems. In 2021, in addition to a series of invited talks, we invited submissions of short papers addressing topics including, but not limited, to:

- Foundations of learning of dynamics models
- System identification
- Optimization for machine learning
- Data-driven optimization for dynamical systems
- Distributed learning over distributed systems
- Reinforcement learning for physical systems
- Safe reinforcement learning and safe adaptive control
- Statistical learning for dynamical and control systems
- Bridging model-based and learning-based dynamical and control systems
- Physics-constrained learning
- Physical learning in dynamical and control systems applications in robotics, autonomy, transportation systems, cognitive systems, neuroscience, etc.

While the conference is open to any topic on the interface between machine learning, control, optimization and related areas, its primary goal is to address scientific and application challenges in real-time physical processes modeled by dynamical or control systems.

3. Earlier L4DC events

The inaugural conference took place at MIT during May 30-31 2019, assembling invited speakers across the disciplines of machine learning, dynamics, control systems, optimization and related disciplines. Poster sessions including many other invited researchers were also featured. With a total of 400 registered attendees, the event quickly reached the maximum that the space allowed and registration had to be closed. Details of the event schedule and posters are available at the L4DC2019 website, https://l4dc.mit.edu/.

As part of L4DC2019, there was a discussion about the format of the conference for future years. There was great support for turning the event into a regular conference with submitted papers for review, while recognizing that a fair number of invited speakers should be kept as the conference is so new. It was also announced that the conference will be held in Berkeley CA in 2021. We took

the outcome of these discussions into account and in July 2019 we started planning for L4DC2020, securing a location on the Berkeley campus (Wheeler Auditorium) suitable for 700 participants.

Unfortunately the pandemic forced a change of these plans. Due to the global travel restrictions, L4DC2020 had to take place as a virtual event, held during June 11-12, 2020, hosted by U.C. Berkeley. The event featured live presentations by 5 invited speakers and 14 contributed papers, as well as a virtual forum for the posters; details of the program are available at the L4DC2020 website, https://sites.google.com/berkeley.edu/l4dc/home. The talks were given on Zoom and streamed live on YouTube, with moderators collecting questions from the YouTube forum to convey to the speakers; attendance of the YouTube stream peaked at around 500 participants. In addition, an OpenReview forum gave the opportunity to the audience to interact with the authors of papers presented as posters.

4. New at L4DC2021

L4DC2021 was planned as a physical event to be held in Zurich in June 2021. The pandemic once again forced a change of plans, and L4DC2021 once again became a virtual event, held during June 7-8, 2021, hosted by ETH Zurich. The program featured invited and contributed talks (held live on Zoom and streamed on YouTube and Gather.Town). New this year are the live poster sessions, held virtually on Gather.Town during both days of the conference. Interest from the community has once again been strong; at the time of writing there were close to 600 registrations for the virtual event.

For the invited talks, we were fortunate to secure a stellar group of invited speakers:

- Aude Billard, EPFL
- Raffaello D'Andrea, ETH Zurich
- Sandra Hirche, T.U. Munich
- Michael Jordan, U.C. Berkeley
- Daniel Lee, Cornell University

In addition, we invited submissions of papers addressing the topics listed above through an open call for papers to the relevant communities. We were happy to receive 140 contributions. All were reviewed by members of the program committee and debated through a rebuttal phase with the authors. At the end of the process, 14 of these contributed papers were accepted for oral presentation and an additional 90 for poster presentation. We are grateful to the authors and the Program Committee for their invaluable contribution to the success of the L4DC series.

In the spirit of the inaugural conference, the L4DC2021 program also included a dedicated session at the end of the first day to discuss the format of the conference for future years, with an open invitation to the program committee and the wider audience to put forward ideas. The complete program of L4DC2021 can be found on the conference website, https://l4dc.ethz.ch/.

5. L4DC 2021 Organizing Committee

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