PhD Position on Data-Driven Distributional Inference for Reliable Control of Complex Systems

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Job description

Decisions under uncertainty are ubiquitous in control engineering and seek to provide quantitative solutions when complexity or lack of knowledge about the underlying systems require the probabilistic modeling of their components. Such random elements are often dynamic and the designer needs to make inferences about them using a limited amount of data. Furthermore, the data may only reveal partial-state information about the process, which is often corrupted by noise. All these factors hinder the possibility of making accurate inferences about the underlying probabilistic models and their usage for control design.

To address these issues, this PhD project will leverage tools from state estimation and uncertainty quantification to fuse information from both the data and the known system dynamics and provide robust uncertainty descriptions for reliable decisions and control. The goal is to obtain plausible models about the evolving uncertainty from small data sets based on first-principles assumptions like the classes where the unknown distributions of random initial conditions, parameters, and noise elements belong [1, 2]. Specifically, one seeks to build ambiguity sets of probability distributions that contain the evolving true distribution of the data with high probability and exploit them to take reliable control actions.

The approach will combine techniques across control engineering and applied mathematics, including tools from filtering and nonlinear state estimation, optimization, uncertainty quantification, optimal transport, and high-dimensional probability [3, 4]. The developed data-driven inference and control algorithms will be applied to domains like robotics, power systems, and transportation.

Related work and literature:

[1] D. Boskos, J. Cortés, and S. Martínez, Data-driven ambiguity sets with probabilistic guarantees for dynamic processes, IEEE Transactions on Automatic Control, 66(7), 2021, to appear, (arXiv:1909.11194).

[2] D. Boskos, J. Cortés, and S. Martínez, High-confidence data-driven ambiguity sets for time-varying linear systems, 2021, (arXiv:2102.01142).

[3] F. Santambrogio, Optimal transport for applied mathematicians, Birkäuser, NY, 2015.

[4] R. Vershynin, High-dimensional probability: An introduction with applications in data science, Cambridge university press, 2018.

Department
The department Delft Center for Systems and Control (DCSC) of the faculty Mechanical, Maritime and Materials Engineering, coordinates the education and research activities in systems and control at Delft University of Technology. The Centers' research mission is to conduct fundamental research in systems dynamics and control, involving dynamic modelling, advanced control theory, optimisation and signal analysis. The research is motivated by advanced technology development in physical imaging systems, renewable energy, robotics and transportation systems.

Requirements

The ideal candidate has an MSc degree in systems and control, applied mathematics, mechanical or electrical engineering, computer science, or a closely related field with a strong background in mathematics and control. Further familiarity with topics like deterministic or stochastic state estimation, measure-theoretic probability, and functional analysis is an asset. The candidate is expected to perform interdisciplinary research across control theory, statistics, estimation, and optimization.

A good command of the English language is required.

Conditions of employment

TU Delft offers PhD-candidates a 4-year contract, with an official go/no go progress assessment after one year. Salary and benefits are in accordance with the Collective Labour Agreement for Dutch Universities, increasing from € 2395 per month in the first year to € 3061 in the fourth year. As a PhD candidate you will be enrolled in the TU Delft Graduate School. The TU Delft Graduate School provides an inspiring research environment with an excellent team of supervisors, academic staff and a mentor. The Doctoral Education Programme is aimed at developing your transferable, discipline-related and research skills.

The TU Delft offers a customisable compensation package, discounts on health insurance and sport memberships, and a monthly work costs contribution. Flexible work schedules can be arranged. For international applicants we offer the Coming to Delft Service and Partner Career Advice to assist you with your relocation.

TU Delft (Delft University of Technology)

Delft University of Technology is built on strong foundations. As creators of the world-famous Dutch waterworks and pioneers in biotech, TU Delft is a top international university combining science, engineering and design. It delivers world class results in education, research and innovation to address challenges in the areas of energy, climate, mobility, health and digital society. For generations, our engineers have proven

to be entrepreneurial problem-solvers, both in business and in a social context. At TU Delft we embrace diversity and aim to be as inclusive as possible (see our Code of Conduct). Together, we imagine, invent and create solutions using technology to have a positive impact on a global scale.

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Additional information

For more information about this vacancy please contact Dimitris Boskos, Assistant Professor, email: D.Boskos@tudelft.nl

Application procedure

If you are interested in this vacancy, please apply by June 15, 2021 via the application button and upload:

1. a letter of motivation (max two pages),
2. a detailed Curriculum Vitae,
3. contact details of two professional referees,
4. a list of courses with grades from your BSc and MSc program,
5. a summary of your MSc thesis, and
6. a list of publications (if any).

A pre-employment screening can be part of the selection procedure.

You can apply online. We will not process applications sent by email and/or post.

Acquisition in response to this vacancy is not appreciated.

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