

# PhD Positions (3) on "Integrated optimization-based and learning-based control of networks with hybrid dynamics"

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## Teaser

Bridging the gap between optimization and learning

## Job description

These 3 PhD projects are part of the European ERC Advanced Grant project CLariNet – a novel control paradigm for large-scale hybrid networks. The goal of CLariNet is to create a completely new paradigm for control of large-scale networks with hybrid dynamics by bridging the gap between optimization-based control and learning-based control. The breakthrough idea is to bridge that gap by using piecewise affine models and to unite the optimality of optimization-based control with the on-line tractability of learning-based control.

The 3 projects all have a strong fundamental flavour. In addition, applications for the case studies include multi-modal transportation networks and smart multi-energy networks.

### **Topic 1: Learning-based control for hybrid systems with constraints**

In this PhD project we will develop learning-based control methods for hybrid systems — in particular piecewise affine (PWA) systems — that allow to include explicit linear or convex, mixed constraints on the inputs, states, and outputs of the PWA system. Subsequently, the approach will be extended to a multi-agent setting using a combination of optimization-based and learning-based control for large-scale networks with PWA dynamics, with emphasis on the development of numerically reliable and computationally efficient algorithms.

### **Topic 2: Integrated optimization-based and learning-based control for hybrid systems**

In this PhD project we will develop integrated optimization-based and learning-based control methods for hybrid systems — in particular piecewise affine (PWA) systems. More specifically, the aim is to develop several innovative approaches to combine

model predictive control (MPC) and reinforcement learning so as to merge the advantages of both approaches.

### **Topic 3: Multi-scale multi-resolution models for large-scale networks with hybrid dynamics**

In this PhD project we will develop a framework for multi-agent integrated optimization-based and learning-based control of large-scale networks. More specifically, we address two challenges: (1) developing methods to determine spatial and temporal divisions that are appropriate for the proposed control structure, and (2) developing appropriate piecewise-affine models for use within the multi-agent control framework that allow different levels of spatial and temporal modeling detail according to the requirements, i.e., multi-scale multi-resolution models.

## **Requirements**

We are looking for a candidate with an MSc degree in systems and control, applied mathematics, computer science, electrical engineering, or a related field, and with a strong background or interest in:

- machine learning, optimization, and control (for Topic 1);
- systems & control, machine learning, and optimization (for Topic 2);
- distributed control and modeling (for Topic 3).

The candidate is expected to work on the boundary of several research domains. 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.

Challenge. Change. Impact!

## Faculty Mechanical, Maritime and Materials Engineering

The Faculty of 3mE carries out pioneering research, leading to new fundamental insights and challenging applications in the field of mechanical engineering. From large-scale energy storage, medical instruments, control technology and robotics to smart materials, nanoscale structures and autonomous ships. The foundations and results of this research are reflected in outstanding, contemporary education, inspiring students and PhD candidates to become socially engaged and responsible engineers and scientists. The faculty of 3mE is a dynamic and innovative faculty with an international scope and high-tech lab facilities. Research and education focus on the design, manufacture, application and modification of products, materials, processes and mechanical devices, contributing to the development and growth of a sustainable society, as well as prosperity and welfare.

Click [here](#) to go to the website of the Faculty of Mechanical, Maritime and Materials Engineering. Do you want to experience working at our faculty? This [video](#) will introduce you to some of our researchers and their work.

### Additional information

More information on this position can be obtained from Prof. Bart De Schutter, email: [b.deschutter@tudelft.nl](mailto:b.deschutter@tudelft.nl).

For information about the selection procedure, please contact Irina Bruckner, HR Advisor, email: [application-3mE@tudelft.nl](mailto:application-3mE@tudelft.nl).

### Application procedure

Are you interested in this vacancy? Please apply by May 31, 2021 via the application button and upload your letter of application along with a detailed curriculum vitae, an indication of which of the 3 topics you want to apply for, a motivation why the proposed research topic or topics interest you, a list of publications (if applicable), the abstract and/or summary of your MSc thesis, your BSc and MSc course program and the corresponding marks, names and addresses of two to three reference persons, and all other information that might be relevant to your application

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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