



PhD Position Data-enabled systems and control co-design for large-scale wind turbines

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Develop data-enabled system and control co-design algorithms, synergizing control theory with novel machine learning techniques, to reinforce the performance of future-engineered systems.

Job description

In the last decades, the classical control theory has proven its effectiveness in terms of analysis and control (design) methodologies. Control theory has been a key enabler in the realization of complex systems. However, increasing system complexity leads to an increasingly indirect relationship between linear to practically meaningful performance. Moreover, the intricate requirements for system performance complicate controller design through the sole use of the classical control theory. Synergizing established fundamental control with promising data-enabled machine-learning techniques could effectively solve these present-day design challenges.

You will develop algorithms to effectuate efficient data-enabled systems and control co-design approaches. Therefore, you will tightly synergize the established control theory with novel data-enabled techniques from the fields of machine learning (ML) and artificial intelligence (AI). This allows for the design and efficient calibration of the system and controller in unison.

The algorithms that you develop will be applied to wind turbines, both in simulation and experimentally on lab-scale wind tunnel set-ups. The application area is highly relevant, as wind turbines see a rapid increase in system complexity. Next-generation large-scale wind turbines are becoming ever larger with increasing performance demands to satisfy the net-zero emission targets. This size increase leads to greater complexity through dynamic interactions. The exponential growth of data from wind turbines motivates the development and application of novel co-design techniques to achieve next-level performance, ultimately lowering the costs of renewable energy.

You will join our data-driven control research group, which is part of the department of Delft Center for Systems and Control (DCSC) of the faculty of Mechanical, Maritime, and Materials Engineering (3mE). At the DCSC, our mission is to conduct fundamental research in systems dynamics and control, involving dynamic modeling, advanced

control theory, and optimization. Our group has a strong history in control for wind energy, with a strong impact through practical applicability.

Techniques that are actively used in our group are classical control theory (i.e., observer/control design, frequency domain analysis, loop-shaping), machine learning (including Gaussian processes and neural networks), (first principles) system modeling, adaptive and learning control, system identification, and multivariable control.

Requirements

This position is perfect for you if you possess profound knowledge of system modeling, system analysis, and (classical) control engineering, and when you have experience with or special interest in ML/AI techniques.

You will have ample space to display your auto-didactic skills and independently conduct ground-breaking research. You have a strong research-oriented attitude, good communication skills, and the ability to transfer knowledge and effectively present your challenges and results. Also, you are willing to grow as a positive (graduate) student supervisor. Working from elsewhere is permitted, however, there is a requirement for being present at least four days per week at the TU Delft faculty.

You also have:

- An MSc in systems and control (control engineering), mechatronics, mechanical engineering, aeroelastics, machine learning, or a related field.
- Excellent programming skills in MATLAB/Simulink.
- Excellent command of the English language.

Make sure to apply when this position does spark excitement in you. If you do not tick all the boxes but are in possession of a profound understanding of control engineering, we'd definitely like to get to know you!

Doing a PhD at TU Delft requires English proficiency at a certain level to ensure that the candidate is able to communicate and interact well, participate in English-taught Doctoral Education courses, and write scientific articles and a final thesis. For more details please check the [Graduate Schools Admission Requirements](#).

Conditions of employment

Doctoral candidates will be offered a 4-year period of employment in principle, but in the form of 2 employment contracts. An initial 1,5 year contract with an official go/no go progress assessment within 15 months. Followed by an additional contract for the remaining 2,5 years assuming everything goes well and performance requirements are met.

Salary and benefits are in accordance with the Collective Labour Agreement for Dutch Universities, increasing from € 2541 per month in the first year to € 3247 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 as one of our core [values](#) and we actively [engage](#) to be a university where you feel at home and can flourish. We value different perspectives and qualities. We believe this makes our work more innovative, the TU Delft community more vibrant and the world more just. Together, we imagine, invent and create solutions using technology to have a positive impact on a global scale. That is why we invite you to apply. Your application will receive fair consideration.

Challenge. Change. Impact!

Faculty Mechanical, Maritime and Materials Engineering

From chip to ship. From machine to human being. From idea to solution. Driven by a deep-rooted desire to understand our environment and discover its underlying mechanisms, research and education at the 3mE faculty focusses on fundamental understanding, design, production including application and product improvement, materials, processes and (mechanical) systems.

3mE is a dynamic and innovative faculty with high-tech lab facilities and international reach. It's a large faculty but also versatile, so we can often make unique connections by combining different disciplines. This is reflected in 3mE's outstanding, state-of-the-art education, which trains students to become responsible and socially engaged engineers and scientists. We translate our knowledge and insights into solutions to societal issues, contributing to a sustainable society and to the development of prosperity and well-being. That is what unites us in pioneering research, inspiring education and (inter)national cooperation.

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? These [videos](#) will introduce you to some of our researchers and their work.

Additional information

The PhD project is co-supervised by Sebastiaan Mulders (assistant professor) and Jens Kober (associate professor). For more information about this vacancy, please contact: Sebastiaan Mulders, Assistant professor, email: s.p.mulders@tudelft.nl.

Application procedure

Are you interested in this vacancy? Please apply by 15 April 2023 via the application button and upload:

- 1) a detailed curriculum vitae that explicitly states your educational record, and (if applicable) working experience, recent major achievements, list of publications,
- 2) a separate motivation letter stating why the proposed research topic interests you,
- 3) the names of three persons who could be contacted for a reference and any other information that might be relevant to your application,
- 4) (Draft) MSc graduation thesis.

For more information about the selection procedure, you can contact Irina Bruckner, HR Advisor, email: recruitment-3me@tudelft.nl.

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.

Please do not contact us for unsolicited services.

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