

## **PhD position in Data-Driven Learning of Linear Parameter-Varying Models, Eindhoven University of Technology, The Netherlands.**

### **Job description**

This PhD research is within the scope of the APROCS (Automated Linear Parameter-Varying Modeling and Control Synthesis for Nonlinear Complex Systems) initiative funded by the European Research Council (ERC) and it aims to overcome current limitations of the Linear Parameter-Varying (LPV) framework. Specifically, this PhD project focuses on developing LPV modelling methods in terms of an automated toolset that facilitates system oriented LPV control design for Non-Linear (NL) and/or Time-Varying (TV) systems. In the APROCS project, currently, a radical paradigm-shift is developed in the LPV framework to focus control synthesis on the resulting controlled behavior with the targeted physical system, providing directly a NL/TV controller with stability and performance guarantees; i.e., the LPV concept is used as a solution approach for the underlying NL/TV controller design problem. However, this requires further development of existing data-driven modeling tools to achieve control oriented LPV modeling, i.e., developing automatically LPV models of physical systems that only capture that part of the underlying behavior which is necessary to achieve the control specifications set by the user. These methods are required to efficiently explore and identify uncertainties of known relations of the system. Hence novel parametrization of dynamical sub-modes for system identification under given priors is targeted enabling to introduce control oriented identification methods with plug & play (P&P) modelling capabilities. Furthermore, full exploration of the steps of the identification cycle from incremental experiment design to verification of model completion (validation) is required, exploring issues of informativity of data sets w.r.t. such P&P approaches.

This PhD project aims to surmount these challenges by establishing an innovative synergy between the Machine Learning (ML) and the LPV framework. The aim is to develop computationally efficient model learning approaches capable of supporting control synthesis. The emerging ML framework provides powerful data-driven approaches to facilitate non-parametric learning of complicated data-relations. The flexibility of the ML framework in defining learning objectives (aim-relevant estimation) and its ability to facilitate optimal recovery of structural relationships (model structure selection) provide novel perspectives in terms of developing dedicated methods to solve the limiting problems the current identification LPV theory.

This research will be conducted in close collaboration with other APROCS and industrially related projects, hence the results will be applied to modeling and control problems in complex mechatronic systems such as high-performance positioning applications, robots, suspension systems, etc.

### **Tasks:**

- Study the literature of machine learning, LPV identification and modelling.
- Development of control-oriented data-driven modeling approaches which are capable to surmount the current challenges.
- Achieve controller objectives based model learning in a P&P setting to support control synthesis directly by the developed identification approaches.
- Stochastic analysis of consistency and convergence of the results and empirical validation of the techniques on complex physical/chemical and/or electrical/mechatronic systems.
- Exploration of the steps of the identification cycle for the developed methods from incremental experiment design to verification of model completion (validation).
- Dissemination of the results of your research in international and peer-reviewed journals and conferences.
- Writing a successful dissertation based on the developed research and defending it.
- Assume educational tasks like the supervision of Master students and internships

### **Job requirements**

We are looking for a candidate who meets the following requirements:

- You are a talented and enthusiastic young researcher.
- You have experience with or a strong background in systems and control, mathematics, statistics and signal processing. Preferably you finished a master in Systems and Control, (Applied) Physics, (Applied) Mathematics, Information Technologies, Electrical Engineering or Mechanical Engineering.
- You have good programming skills and experience (Mathematica and/or Matlab is an asset).
- You have good communicative skills, and the attitude to partake successfully in the work of a research team.
- You are creative and ambitious, hard-working and persistent.
- You have good command of the English language (knowledge of Dutch is not required).

#### Conditions of employment

- A challenging job for 4 years in a dynamic and ambitious university and a stimulating research environment;
- Support with your professional and personal development;
- A gross salary per month of €2325,- (first year) as a PhD up to €2972,- (final year) in accordance with the Collective Labor Agreement of the Dutch Universities
- Plus 8% holiday allowance + 8.3% end of the year allowance.
- An extensive package of fringe benefits, e.g., support in moving expenses, excellent technical infrastructure, on-campus child care, and excellent sports facilities.

#### Information and application

##### **Information**

For more information about the advertised position, please contact:

Dr.ir. R. Toth, r.toth[at]tue.nl

More information on employment conditions can be found here: <http://www.tue.nl/en/university/working-at-tue/working-conditions/> .

##### **Application**

If interested, please use '**apply now**'-button at the top of this page. You should upload the following:

- a cover letter explaining your motivation and suitability for the position;
- a detailed Curriculum Vitae;
- a written scientific report in English (MSc thesis, traineeship report or scientific paper)
- copies of diplomas with course grades (transcripts).