

PhD position

“Big data techniques for maintenance decision making under uncertainty”

at
Eindhoven University of Technology.

In the framework of the national NWA-ORC project “PrimaVera: Predictive maintenance for Very effective asset management”, there is a PhD position available in the Stochastics Section within the Department of Mathematics and Computer Science in Eindhoven University of Technology, in The Netherlands. The PrimaVera consortium, led by Twente University, consists of several Dutch higher education institutes and companies.

Just-in-time maintenance requires a very accurate, enhanced physically based data-driven assessment of the system’s health and its future evolution guaranteeing the reliability, availability and affordability of the system through accurate monitoring, prognostics and diagnostics. This is organized around the following key game changers:

- *Development of a big data health index.* Intelligent systems are equipped with sensors collecting data real-time. Analyzing the collected data can guarantee the reliability, availability and affordability of the system through accurate monitoring, prognostics and diagnostics. However, when dealing with especially large and complex systems, a key challenge for engineers is how to assess the present condition. By measuring the dynamics of the asset/network, modelling the dynamic behavior and by combining the real-time information, we aim to assess the present condition in the form of a health index and predict the remaining useful life (based on an assumed usage profile) using big data analytic techniques stemming from machine learning and artificial intelligence.
- *Causal discovery of failures and root cause analysis.* A key step in failure prevention is to understand why systems fail. Data-driven techniques are good at finding correlations between failure modes, but finding causal relations is challenging. Combinations with physical models and domain knowledge will create crucial actionable insight and condition assessment. These associations will be incorporated in a dynamic estimation and inference paradigm framework for extracting causal graph dynamics, which can be efficiently queried to find the root causes of specific failures.
- *Model-enhanced big data techniques for decision making under uncertainty.* To cope with the complex reality, we need hybrid approaches leveraging the advantages of statistical methods (guaranteed performance and uncertainty bounds), data mining approaches (superior in situations where rules are not yet known), and physics of failure models (causality). We propose to combine big data analytic techniques stemming from machine learning and artificial intelligence with the more classical decision-making approaches (stochastic dynamic programming, Markov decision models). This combination goes in two directions: (i) on the one hand, we propose to use big data analytics to automatically learn the health index model and other relevant failure models with the objective of optimally fitting the decision objective instead of the classical data fitting objective. (ii) On the other hand, we propose to use decision-making approaches to improve the data analytic techniques, e.g., by incorporating an exploration vs exploitation approach in the maintenance decision making to cope with the uncertainty in the information.

Job description

The project is methodologically oriented. It is on the interface of statistical operations research and machine learning, and it is strongly inspired by industrial challenges. The PhD project will be conducted in an international team and in close collaboration with academic and industrial partners of PrimaVera. The main goal of the PhD project is to develop mathematical tools/models/algorithms for (some of) the above-mentioned key game changers, and thus get a deeper insight. The research will be concluded with a PhD thesis. A small teaching load is part of the job.

Job requirements

Preference will be given to candidates in any branch of applied mathematics and to candidates from a different background (e.g. engineering) but with strong mathematical foundation. Research experience will be highly valued. Strong knowledge of applied probability, statistics and operations research is highly desirable.

The successful applicant will hold a Master's degree in Mathematics, Applied Mathematics, Computer Science, Engineering Sciences or related fields. All applications should include a cover letter, curriculum vitae, and transcripts. Proficiency in English is also required.

Team

The PhD project will be carried out at the stochastics section within the department of Mathematics and Computer Science (M&CS), TU/e. M&CS has a vibrant international environment, with almost 50% of the scientific staff being non-Dutch nationals and more than 100 PhD candidates. It has extensive experience in helping new (foreign) employees settle in. The research team consists of the candidate, Dr. Alessandro Di Bucchianico (a.d.bucchianico@tue.nl) and Dr. Stella Kapodistria (s.kapodistria@tue.nl). Collaboration with the academic and industrial members of the PrimaVera consortium is highly supported. In particular, within TU/e, there will be a close cooperation with the Smart Manufacturing and Maintenance research program of the Data Science Center Eindhoven, the Eindhoven AI Systems Institute (EAISI) and with PrimaVera researchers from the Department of Industrial Engineering and Innovation Sciences.

Terms of employment

- PhD candidates are appointed as temporary university employees for a four-year period (after nine months you will have an evaluation as to whether the research is expected to result in a PhD degree after four years).
- The terms of employment are governed by the Collective Labour Agreement of Universities in The Netherlands, with a monthly salary starting at 2325 Euro in the first year, and increasing to 2972 Euro in the fourth year, and an additional 8% holiday allowance and 8% end-of-year bonus. An extensive fringe benefits package is included. Further details can be found [here](#). Additional budget allows for extensive research visits abroad and conference attendance.
- For information regarding the university, please visit the website of [TU/e](#). [Here](#) you can find information about the sports facilities on campus. Information about Eindhoven can be found [here](#). The HR International Backoffice provides support with immigration procedures.
- Information about terms of employment can be obtained from the HR services office, ([pzwin\[at\]tue.nl](mailto:pzwin[at]tue.nl)).

Application procedure

In order to apply, please submit a

- Cover letter (2 page max), which includes a motivation of your interest in the vacancy and an explanation of why you would fit well for the project.
- Detailed curriculum vitae.
- List of courses you have taken in Master's and Bachelor's programs (including grades).
- Results of a recent English language test, or other evidence of your English language capabilities (TOEFL, IELTS, etc.).
- Name and contact information of references. Upon selection, letters of recommendation, evaluating the candidate's research experience, will be required from two or more references. Please include the contact information of at least two references in your submitted material.

Information

For further information, please contact or consult,

- about the research position: Dr. Alessandro Di Bucchianico, e-mail: a.d.bucchianico[at]tue.nl, phone: +31 40 247 2902 or Dr. S. Kapodistria, e-mail: s.kapodistria[at]tue.nl, phone: +31 40 247 5825
- about the employment conditions: HR advisor, e-mail: pzwin[at]tue.nl, phone +31 40 247 2321
- about the project: [click here](#)
- about the department: [click here](#)
- about the stochastics section: [click here](#)

Application deadline

The deadline for applications is **October 19, 2019**. However, if you are interested, we invite you to apply at [click here](#) as soon as possible. Selection will begin immediately and continue until the position has been filled.