Four-year PhD position, position 2: TU Eindhoven (Netherlands) with SDG Milan (Italy)

Two 4-year Marie Curie PhD positions are available at TU Eindhoven, starting date March 1, 2019. Research topics may include numerical linear algebra, big data, large-scale optimization, modeling, model reduction, probability and statistics.

This is a description of Position 2 at TU Eindhoven, joint with SDG Milan, http://www.sdgroup.com/en. This position is “ESR6” (Early-stage researcher), part of the EU Marie Curie EID (European Industrial Doctorate) project BIGMATH, http://itn-bigmath.unimi.it, including 7 PhD positions in total, at universities in Milan, Novi Sad, Lisbon, and Eindhoven.

You will be a member of the Centre for Analysis, Scientific Computing and Applications (CASA), within the Department of Mathematics and Computer Science at TU Eindhoven. Your daily advisors will be:

Moreover, at TU Eindhoven, you may also work with

Additionally, you will spend 2 months at the University of Milan and work with
- Alessandra Micheletti (Associate Prof of Probability and Mathematical Statistics) http://www.mat.unimi.it/users/michel/.

Keywords: Data science, numerical linear algebra, algebraic modeling, predictive modeling, predictive manufacturing, data reduction, model reduction, optimization, statistics, machine learning.

Main tasks:
- Carrying out innovative math research, developing new methods and algorithms, writing papers, presenting them at conferences, writing a PhD thesis.
- Some programming to implement and test the methods, e.g. in Julia, Matlab, Python, or R.
- Teaching 300 hours spread over the 4 years (total work time ca 6800 hours, so the teaching is < 5% of the time).

Offered:
- A very attractive Marie Curie PhD position at TU Eindhoven, joint with SDG Milan and in collaboration with the University of Milan.
- Several advanced courses and international conferences.
- Gross salary 2325 (in first year) to 2972 euros (in fourth year) monthly; 40 hours/week.
- Start March 1, 2019 (or a bit earlier if mutually agreed).

Asked (selection criteria):
- MSc in applied or pure mathematics, good grades and strong math skills, with a clear interest in the mentioned topics
- High motivation, perseverance
- Good analytical and English communication skills
- Willing to move a few times between Eindhoven and Milan (as indicated below)
- Speaking Italian is a plus
- Because of EU regulations, this position is not open to people who spent more than 12 months in The Netherlands in the last 3 years prior to the start of the position.

To apply: For informal inquiries please contact Dr. Michiel Hochstenbach, TU Eindhoven by email. To apply, please go to https://jobs.tue.nl/en/vacancy/phd-student-scientific-computing-with-sdg-375897.html

Please include all of this: motivation letter, CV (math interests, languages, some personal info, hobbies), list of BSc and MSc courses with grades, MSc thesis (or draft), list of ca 3 people for recommendation. Scanning of the applications will start immediately; closing date December 5, 2018.

You are also very welcome to obtain informal information about the project and SDG via Maurizio Sanarico, maurizio.sanarico@sdggroup.it.

For further information about employment conditions you may contact Jonelleke Kamperman, HR advisor TU/e, pzwin@tue.nl.

Project description

Please find below a brief description from the BIGMATH proposal. Here “RO” stands for research objective. This position is ESR6 (ESR = Early-stage researcher).

Project 6 (ESR6): Prediction of failure events in complex productive systems (TU/e & SDG)

With the advent of Industry 4.0, many current industrial processes are subject to continuous monitoring of their efficiency by sensors, which provide numerical data of various types, with a high frequency. The data gathered by these systems have various uses. Two important but difficult objectives are (1) prediction of events that can impair (damage) the process output, and (2) prediction and optimization of the quality of the process end-product. However, the availability of vast amount of data leads business users to even more ambitious objectives: (3) understanding the causes of failures and varying quality, and (4) taking actions to improve the process, to avoid failures or to reduce the failure rates. These goals are very challenging. Good and reliable prediction usually requires both linear and nonlinear models and algorithms, which are often difficult to interpret, so that causal relationships remain unclear. On the contrary, interpretable models often are unable to represent complex, nonlinear and dynamic relationships. Therefore, ESR6 will develop efficient models that are able to predict with a good reliability the occurrence of process impairment, and to tell which features mostly contribute to the damage in the given conditions. Three key mathematical ingredients that we will use are: (a) compositionality: building complex models from simpler components; (b) model reduction: simplification of the model, so that it can be simulated and the parameters identified, without losing much accuracy (RO3); (c) causality: understanding what is causing what and take improvement-oriented actions (RO4).

Current trends for impairment prediction frequently use deep learning models, which are flexible and often provide good results, but usually very hard to interpret. In this project, ESR6 will introduce innovative more interpretable models. Such models will support the development of innovative methods for process optimization and control by ESR7.
The relevant research objectives:

**RO3:*** Develop model reduction or feature selection techniques for the construction of fit-for-purpose models, which may reduce the complexity of a system, increasing the interpretability of cause-effect relationships.

**RO4:*** Develop interpretable statistical models for classification in imbalanced classes and for the prediction of rare events (i.e. classification into 2 imbalanced classes). The aim is to overcome the application of “black box” machine learning techniques, using models that can interpret the interrelationships and the causal effects among different features.

**Some information on SDG**
SDG is a global consulting firm with a broad focus on data analytics in all its aspects. The data science practice is firmly rooted in strong mathematical and statistical know-how and a sound computing expertise. SDG is constantly growing by hiring many young people coming directly from universities, and some more experienced people to support the growth in a consistent way.