Tembryo

New analysis techniques from machine learning and dynamical systems theory have the potential to radically improve the early detection of faults in industrial process equipment. Tembryo is interested in the discovery of target applications for this technology within the chemicals industry and seeks validation with an industrial partner.

Problem

Sensors in modern chemical plants collect large quantities of data, but without appropriate analysis tools this data is overwhelming and difficult to interpret. Current fault detection techniques ignore important information in the data corresponding to the underlying dynamics of the process or rely on limiting assumptions such as the process dynamics being linear. The result is that the data collected by sensors is often underutilised and faults that could be detected early are missed, which leads to costly unscheduled maintenance.

Solution

We propose to leverage cutting edge research from machine learning and dynamical systems modeling to detect faults earlier and more robustly than the current fault detection methods used in the industry. These techniques use existing sensor data to learn nonlinear models of the fault-free operating behaviour of the process, and then detect deviations from these models that could indicate malfunction. By presenting this information to plant operators and managers in a visual and intuitive way, our solution will help reduce costly unscheduled down-time. A significant advantage of this approach is that it makes use of existing sensor data and so does not require any additional sensors to be installed.

Team

Richard Mason holds a PhD in Optimisation and Control Theory from the University of Oxford. His PhD research considered methods of exploiting sparsity in a number of analysis and synthesis problems found in control theory. He has attended international conferences on Control Systems and Fault Detection, and one of his papers was awarded the O. Hugo Schuck prize in 2015.

Quirin Fischer studied computer science at the Technical University of Munich. Starting on an early-study programme for high school students, he completed his Bachelor's degree in 2013 with a thesis on artificial intelligence in robotics and worked on computer vision for his Master's thesis. He has ten years of programming experience, competed on a university team at an international programming contest and spent two years developing and implementing new techniques for geometry processing at the Fortiss institute.

Tembryo is supported by Entrepreneur First, a pre-seed incubator based in London that works with Europe's top technical talent to develop deep-tech startups.

Proposed Plan of Action

The first step would be to conduct meetings with relevant stakeholders at BASF in order to identify an application target within BASF and devise the steps required to carry out an effective pilot project.

The second step would be a proof of concept study of the performance of the developed algorithms on standard benchmark models. One suggested testbed would be the Tennessee Eastman Process (TEP), a simulation of a chemical process created by the Eastman Chemical Company that is a well established tool for evaluating fault detection methods.

The third step would be a paid pilot study of the performance of the fault detection algorithm on historical data from a chemical process plant provided by BASF. Subject to satisfactory performance, the aim would be to set up a follow-up project to develop an online monitoring system.