Machine Learning and Data Mining Applications in Process Systems Engineering

PROJECT DESCRIPTION

"The project aims to develop machine learning approaches to augment traditional modeling approaches for chemical process systems, with the aim to use these models for systems engineering tasks such as estimation, monitoring, diagnosis, control and optimization. When process data is available, empirical methods of modeling can be used, but the large number of variables in these systems provides significant computational challenges; more importantly, no insight on physical, chemical and biological processes occurring in the system can be obtained from these empirical models. Thus, these systems require a hybrid modeling approach, where all the first principles knowledge available on the system in somehow placed in a composite model along with empirical sub-models. The focus in this project is to develop a framework to build such hybrid models, and to test the hybrid models in various application areas. The approach that will be used to build statistical models with intuition and knowledge built into them will be based on machine learning approaches. The idea is that for systems where data is available and we have some physical intuition about the system, but full models cannot be developed, the methods will use our knowledge of our system and optimally incorporate it into a model that has statistical validity and physical insight, too. Application areas are varied, and include oil sands and minerals processing, upgrading of heavy residues, reservoir engineering and microalgal systems.

The project is primarily simulation-based, and requires the student to modify and develop algorithms, and to code them in Matlab, R or other programming languages. Any student with an engineering / computers background should be well-placed to work on the project. Prior knowledge of Matlab (or programming languages) would be beneficial, but is definitely not necessary. Aside from the development of algorithms and models, there are many potential areas of application which can be tailored to the interests and background of the student.

The student's role in the project will be to develop and to code algorithms for the inclusion of intuition into process models, and to perform simulation studies using them. This involves the development of first-principles models and empirical models derived purely from data using statistical principles, and finding ways to build hybrid models based on both approaches. The simulations are expected to be developed and run in Matlab.The student will be able to draw upon work already done on the project by graduate students and build upon it. The student will also have the opportunity to interact with graduate students that have worked on related problems and obtain their advice and help. In addition, there are collaborations with other groups that specialize in the application areas (energy, mineral processing, reaction engineering and catalysis, cryopreservation), and there is the possibility of interaction of the student with these groups, too.

Contact: Brendan Cavanagh, Internship Coordinator (Inbound)
University of Alberta International
intern@ualberta.ca

FACULTY-DEPARTMENT

Engineering - Chemical and Materials Engineering

DESIRED FIELD OF (STUDENT) STUDY

Chemical Engineering, Process Systems Engineering, Computer Science/Engineering, Mathematics

INTERNSHIP LOCATION

University of Alberta Main Campus - Edmonton

NUMBER OF INTERNSHIP POSITIONS

2

INTERNSHIP START DATE

July 4, 2018

INTERNSHIP END DATE

October 3, 2018

ARE THE DATES FLEXIBLE?

Yes, I am flexible regarding the internship dates. Selected students can contact me to request a date change.

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