MHRD – GLOBAL INITIATIVE OF ACADEMIC NETWORKS (GIAN)

PROCESS DATA ANALYTICS (05.12.2016 - 16.12.2016)

Department of Instrumentation Engineering
Madras Institute of Technology Campus, Anna University, Chennai-44.

Last Date for Registration: 15-11 -2016

Course overview

This 2 credit course consisting of 25 lecture hours, over a period of 2 weeks, by Professor Sirish Shah (University of Alberta, Canada) will present a new set of smart analytic tools and techniques that cohesively analyze alarm data, process data and process connectivity information to provide a holistic view of the process. Such data-based tools and methodologies enable engineers to systematically carry out process and performance monitoring, system identification, fault detection plus isolation and alarm design, monitoring and rationalization.

Who should attend this course?

The course is suitable for graduate students in engineering and science, engineers working in industry and faculty members.

Objectives

Process data analytic methods rely on the notion of sensor fusion whereby data from many sensors or units are combined with process information, such as physical connectivity of process units, to give a holistic picture of health of an integrated plant. Typical analytic methods require the execution of following steps: i) understanding the process and the purpose of the analytics exercise; ii) data collection and quality assessment; iii) outlier detection, noise filtering and data reconciliation; iv) data segmentation followed by process and performance monitoring including root cause detection of faults or development of an inferential soft-sensor or system identification for model building. The entire process is iterative and may require re-visiting earlier steps again and again.

For efficient and informative analytics, data analysis is ideally carried out in the temporal as well as spectral domains on a multitude and NOT singular sensor signals to detect process abnormality. Such multivariate process data analytics involves information extraction from routine process data, that is typically non-categorical, plus alarm data which is mainly in binary form and process connectivity information that can be inferred from the data through causality analysis or as obtained from piping and instrumentation diagrams of a process.

The following topics will be discussed in this course:

05/12/2016 Monday Day-1	10.00 AM - 10.30 AM	Inaugural Function	
	10.30 AM - 11.00 AM	Course Overview	
	11.15 AM - 12.15 PM & 01.30 PM - 03.00 PM & 03.15 PM - 03.45 PM	Lectures 1 and 2 (3 hours)	Overview of Process data analytics. Data quality assessment: Use of the Fisher Information matrix as a metric for data quality; Data distributions and methods for visualizing process data.
06/12/2016 Tuesday Day-2	10.00 AM - 11.00 AM	Lecture 3 (1 hour)	Big data versus good data: data quality, outlier detection and filtering.
	11.15 AM - 12.15 PM & 1.30 PM 3.00 PM & 03.15 PM 03.45 PM	Lectures 4 and 5 (3 hours)	Examining data in a multivariate framework (in the temporal as well as the spectral domains). Discussion of basic time series analysis. Linear regression; classification and Tree-based methods; clustering.
07/12/2016 Wednesday Day-3	10.00 AM - 11.00 AM & 11.15 AM 12.15 PM & 01.30 PM 03.00 PM & 03.15 PM 03.45 PM	Lectures 6 and 7 (4 hours)	More regressions methods: Multiple least squares, LASSO, Step-wise regression, Random forests and boosting.
08/12/2016 Thursday Day-4	10.00 AM - 11.00 AM & 11.15 AM 12.15 PM & 01.30 PM 03.00 PM & 03.15 PM 03.45 PM	Tutorial Sessions 1 & 2 (4 Hours)	Hands-on sessions/Discussions/ Solving assignments on the Topics covered in Lectures 1-3
09/12/2016 Friday Day-5	10.00 AM – 11.00 AM & 11.15 AM 12.15 PM & 01.30 PM 03.00 PM & 03.15 PM 03.45 PM	Tutorial Sessions 3 & 4 (4 Hours)	Hands-on sessions/Discussions/ Solving assignments on the Topics covered in Lectures 4-7
12/12/2016 Monday Day-6	10.00 AM - 11.00 AM & 11.15 AM 12.15 PM & 01.30 PM 03.00 PM & 03.15 PM 03.45 PM	Lectures 8 and 9 (4 hours)	Process data analysis for system identification (under open and closed loops); controller performance monitoring and process monitoring.
13/12/2016 Tuesday Day-7	10.00 AM - 11.00 AM & 11.15 AM 12.15 PM & 01.30 PM 03.00 PM & 03.15 PM 03.45 PM	Lecture 10 (2 hours)	Principal components analysis (PCA) for process monitoring and Partial Least Squares (PLS) for soft-sensor design.
		Lectures 11 and 12 (2 hours)	Data-based causality analysis for identification of process topology. This would be useful for detection and diagnosis of plant-wide oscillations or disturbances.
14/12/2016 Wednesday Day-8	10.00 AM - 11.00 AM & 11.15 AM 12.15 PM & 01.30 PM 03.00 PM & 03.15 PM 03.45 PM	Tutorial Sessions 5 & 6 (4 Hours)	Hands-on sessions/Discussions/ Solving assignments on the Topics covered in Lectures 8-12
15/12/2016 Thursday Day-9	10.00 AM - 11.00 AM & 11.15 AM 12.15 PM & 01.30 PM 03.00 PM & 03.15 PM 03.45 PM	Lectures 13 and 14 (2 hours) & Tutorial Sessions 7 (2 hours)	Alarm data analytics: Methods for visualizing alarm data and how to minimize false and missed alarms; dealing with chattering alarms, alarm configuration and rationalization.
16/12/2016 Friday Day-10	10.00 AM - 11.00 AM & 11.15 AM 12.15 PM	Lecture 15 (2 hours)	Simulated as well as industrial case studies will be presented to demonstrate the power and utility of new analytic methods.
	01.30 PM - 03.00 PM	RECAP	Recap of the topics covered in the Course
	03.15 PM 03. 45 PM	Valedictory Function & Course Feedback	

Lunch Break: 12.15 PM -1.30 PM
Coffee break : 11.00 AM -11.15 AM & 3.00 - 3.15 PM

Prerequisites: Basic knowledge of Statistics, Linear Algebra, Signal Processing, System Identification and Control.

Course Registration:

Procedure to be followed to register for the 'Process Data Analytics' GIAN course:

Step 1: The registration for this course is only possible through the GIAN web portal. GIAN course registration fee is Rs 500/- (One time payment needed to register the participant details under GIAN and makes the participant eligible to register for any course/courses listed in GIAN).

Step 2: For "Process Data Analytics" course registration, select "Process Data Analytics" while doing the course registration.

Step 3: The course coordinator will shortlist the participants based on the merits of the application and will send separate e-mails to the shortlisted candidates.

Step 4: On receiving the email, the Participants should send the completed registration form (registration format will be shared in mail) with DD to the course coordinator.

Step 5: The registration fee would be collected in the form of Demand Draft (DD) drawn in favour of **"The Director, CTDT, Anna University"** payable at chennai as mentioned in the registration form.

Students (UG/PG/Research Scholar)	: Rs.2,000/-
Faculty Members	: Rs.4,000/-
Industry/Research Organization	: Rs.8,000/-

The above fee is towards participation in the course, the course material, computer use for tutorials and assignments, and laboratory equipment.

Maximum Number of Participants: 50

Accommodation: The participants will be provided with hostel accommodation, depending on availability, on payment basis.

Faculty

Sirish L. Shah has been with the University of Alberta since 1978, where he held the NSERC-Matrikon-Suncor-iCORE Senior Industrial Research Chair in Computer Process Control from 2000 to 2012. He is the recipient of the Albright & Wilson Americas Award of the Canadian Society for Chemical Engineering (CSChE) in recognition of distinguished contributions to chemical engineering in 1989, the Killam Professor in 2003, the D.G. Fisher Award of the CSChE for significant contributions in the field of systems and control, the ASTECH award in 2011 and the IEEE Transition to Practice award in 2015. He has held visiting appointments at: Oxford University and Balliol College as a SERC fellow, Kumamoto University (Japan) as a senior research fellow of the Japan Society for the Promotion of Science (JSPS) , the University of Newcastle, Australia, IIT-Madras India and the National University of Singapore. The main area of his current research is the application of data analytic tools for process and performance monitoring, system identification and analysis and rationalization of alarm systems. He has co-authored three books, the first titled, Performance Assessment of Control Loops: Theory and Applications, a second titled 'Diagnosis of Process Nonlinearities and Valve Stiction: Data Driven Approaches", and a more recent monograph on " Capturing connectivity and causality in complex industrial processes". He is a fellow of the Canadian Academy of Engineers.

Course Coordinator

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