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Professor Sebastian Engell
Technische Universität Dortmund

Optimization under lack of knowledge – the key to operational excellence

In the Chair: **Professor Nilay Shah, Director**
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Vote of Thanks: **Professor Costas Pantelides**
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Abstract: Pioneered by Roger Sargent at Imperial College, simulation and optimization technology for chemical processes has made tremendous progress during the last two decades. The formulation of large nonlinear stationary models of chemical plants and their use to validate and to evaluate process designs is nowadays standard practice in large enterprises. Dynamic simulation is also increasingly used, in particular in the so-called operator training simulators that are built before a plant is put into operation. These simulators are not only used to train the operating crews but also to test the control system and the control strategies before commissioning. Models, however, even very rigorous models, do not describe the full reality that is encountered in the operation of the real plant, and for many kinds of processes, e.g. in biotechnology, it is still impossible to build models with sufficient predictive power. The challenge in process operations is to make the best of the available equipment under lack of models that accurately predict the influence of all external parameters on the critical process variables. The key to achieve operational excellence is to combine model-based optimization with measurement-based feedback. Feedback enables to keep the process at the desired conditions despite the lack of knowledge on the exact relationships between manipulated and controlled variables. However, errors between the model that was used to design the controller and the real dynamics can also lead to instability of control loops. In the presentation, different approaches to obtaining optimal process operation in the presence of uncertainties will be discussed: selection of control structures that lead to near-optimal operation by regulatory control, control schemes that track optimality conditions using relatively simple controllers, and online optimizing control. Several applications to complex processes will be shown, including an implementation at a real industrial polymerization reactor. In order to cope with the critical issue of model uncertainty in optimizing control schemes, the concept of multi-stage optimization on a tree of scenarios of future evolutions of the process will be presented, and it will be shown that it can lead to significant improvements in the robustness of the online optimization with only small losses of performance. The same idea can be applied to planning and scheduling problems as well as to the design of plants in the presence of significant uncertainties.

Biography: Sebastian Engell is Professor of Process Dynamics and Operations in the Department of Biochemical and Chemical Engineering at Technische Universität Dortmund, Germany. He obtained a Dr.-Ing degree and the Habilitation in Control Engineering from Universität Duisburg, Germany, and worked as a group manager at Fraunhofer IITB, a public R&D organization, before being appointed to his present position in 1990. He served as Department Chair and Vice-Rector for Research of TU Dortmund. He obtained several best paper awards and recently was awarded an ERC Advanced Investigator Grant for the project MOBOCON – Model-based optimizing control – from a vision to industrial reality. He is a Fellow of IFAC, the International Federation of Automatic Control.

Thursday 6 December 2012 • 17.30

Lecture Theatre 1 (Room 250), Department of Chemical Engineering, ACE Extension Building,
South Kensington Campus, Imperial College London SW7 2AZ
Tea and coffee will be served before the lecture from 16.30 in the Common Room (Room 228), Department of Chemical

The Nineteenth Professor Roger W.H. Sargent Lecture

The Professor Roger Sargent Lecture is an annual event the Centre for Process Systems Engineering inaugurated as a tribute to Professor Sargent's vision, leadership, significant technical contributions and to his legacy in the field of Process Systems Engineering.