

The Delft Center for Systems and Control (DCSC) at Delft University of Technology (DUT), The Netherlands, announces an open

PhD position  
on the subject  
Intelligent Observer and Control for Pharmaceutical Batch Crystallization

### Project description

Recently the potential of a certain approach towards model-based control/optimization of seeded batch crystallization (growth rate control) was shown<sup>1</sup>. This approach has three basic requirements:

1. Sufficient mature level of instrumentation; sensors, actuators, computing power and the full integration of these three.
2. Detailed knowledge of the process behaviour in the form of a first principle dynamic model.
3. Good understanding of the objectives of the crystallization process at hand; e.g. quality and throughput requirements.

There is a clear opportunity to exploit the potential of this approach in the pharmaceutical industry. However in this specific industrial context all requirements are not completely met. To meet the requirements a DSTI project<sup>2</sup> with two universities, several technology suppliers and several industrial end users was formulated.

Meeting the first requirement boils down to development of a measurement skid and its full integration with a real time control environment. Most of this work related to this requirement will be done by the laboratory of Process and Energy (P&E) at DUT and IPCOS. The second requirement is not completely satisfied because of the uncertainty in the constitutive part (e.g. kinetics) of the first principle dynamic models. This point will be addressed by DCSC in close cooperation with Control Systems Group (CSG) at Eindhoven University of Technology (TU/e). The third requirement implies good interaction with two industrial partners in this project (Friesland Foods and Albemarle).

As the PhD-candidate you are expected to improve model-based control/optimization of seeded batch crystallization for the pharmaceutical industry by:

1. Addressing model uncertainty. One can think of quantifying the (allowable) model uncertainty and lowering model uncertainty by identification and/or parameter estimation or even model-free extensions based on experimental data.
2. Achieving effective closed-loop model-based control/optimization. This boils down to feedback by means of frequent updating the model predictions via a form of non-linear state estimation. In order to do this real-time non-linear model reduction is necessary.

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<sup>1</sup> A. Mesbah, A.N. Kalbasenka, A.E.M. Huesman, H.J.M. Kramer, P.J. Jansens, P.M.J. Van den Hof, Real-time dynamic optimization of crystal yield in fed-batch evaporative crystallization of ammonium sulphate. In Proceedings of 14th International Workshop on Industrial Crystallization, 2007.

<sup>2</sup> <http://dsti.nl/>

### What do we ask?

We are looking for a motivated candidate with a MSc degree and a good background in process systems and process control. The candidate should be willing to start on short notice. A good command of the English language is required.

### What do we offer?

We offer the opportunity to do research that is scientifically challenging and of industrial relevance. The research will be supervised by DCSC, CSG and P&E and there will be a constructive cooperation with (some of) the other partners of the project. Participation in two research schools (DISC and OPST) is foreseen. The appointment will be for 4 years. As an employee of the university you will receive a competitive salary starting of EUR 2042 gross per month in the first year and rising to a maximum of 2612 gross per month based on a full-time appointment, as well as excellent secondary benefits in accordance with the Collective Agreement (CAO) of the Association of Universities in the Netherlands (VSNU). Assistance with accommodation can be arranged.

### How to apply?

If you are interested in this position, send a detailed curriculum vitae, a motivation why the proposed research topic interests you, a publication list (if applicable), your BSc and MSc course program and corresponding grades, names and addresses of two reference persons, and all other information that might be relevant for your application to Ir. A.E.M. Huesman (email: [a.e.m.huesman@tudelft.nl](mailto:a.e.m.huesman@tudelft.nl)) and Prof. dr. ir. P.M.J. Van den Hof (email: [p.m.j.vandenhof@tudelft.nl](mailto:p.m.j.vandenhof@tudelft.nl)) as soon as possible.