Chemical Engineering Teaching Across the Atlantic

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Abstract

We report on the first cross Atlantic joined teaching effort between the Departments of Chemical Engineering at MIT (US) and the University of Cambridge (UK). The UK students performed an exercise on process dynamics and control by running an experiment using a heat exchanger located in the Department of Chemical Engineering at MIT. They connected to the experiment via the Internet. Using material taught in lectures on process control, the students tuned a controller for the hot water inlet temperature. The control and observation of its response was done via a web interface. The MIT iLab heat exchanger was initially designed to demonstrate the principles of heat transfer. In our work assignment, we focused on the controller for the hot water inlet temperature and the actual heat exchanger was treated only as a black box. The equipment was designed to run over long periods of time with minimal maintenance, and once set up properly by the MIT staff it could be run for the complete course with only occasional supervision. The experiment was controlled via a LabVIEW interface which is widely used in industry; the students thereby gained experience that they are likely to find useful later in their professional life. In addition to the experiment interface, a chat client was provided to allow the students to communicate with each other and the tutor during the experiment. In the first part of the experiment, the students made observations of a system under P, PI and PID (proportional-integral-derivative) control, respectively using parameters obtained by applying the Cohen-Coon method to open loop test data. In the next part they improved these parameters by observing the response of the system to disturbances and applying knowledge of the equations governing PID control. Finally, the students recorded the responses to three different step changes. The equipment and interface performed technically without fault during the duration of the course (ten three hour sessions). Feedback was obtained by issuing questionnaires; the students very much appreciated doing a real experiment and being able to see, firsthand, the effects on the system of each of the control parameters. This new teaching activity was funded in part by 'The Cambridge-MIT Institute' (CMI), a co-operation between MIT (US) and the University of Cambridge (UK).