552c Design Criteria for Constructing a Web-Accessible Virtual Control Laboratory

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This paper discusses specific design criteria that leads to a design of a Virtual Control Laboratory (VCL) conceived for pedagogical purposes and for deployment via the Internet. It is argued that a most desirable feature is the ability to deliver access to the students using standard web-browser interfaces. This feature has the benefit of maximizing the flexibility of the environment, making the resource more readily available for student use. An effective VCL should deliver an environment that supports flexible as well as discovery learning activities.

An example is given in the form of a DC motor, a simple plant that features a design comprised of three parts: (i) an animation panel, (ii) an interaction panel, and (iii) a navigation panel. In the animation panel the student is able to see two- or three-dimensional animations of the motor in motion, where the rotation is simulated using graphics routines. A set of gauges display the key states of interest, and the mode of the control (manual of automatic) is revealed to the user in an intuitive fashion. The interaction panel allows the user to change the parameters of the controller, as well as the parameters of the model of the plant. The user can change the configuration of the controller selecting alternative manipulated variables.

The most important element is the navigation panel, which presents to the user several windows accessible via a tabbed interface. The first tab provides information to the user regarding the nature of the plant, and describes the experimental studies that can be carried out with the system. Another window provides an opportunity for doing analysis work, providing the user with classical analytical tools such as step-response plots, pole-zero plots, and Bode diagrams. All the analytical features can be executed for the open-loop system or for the closed loop. A final tabbed window provides an environment where the student can carry out open-loop and closed-loop simulation studies. In particular, it is possible to change the set-point at will to conduct servo studies for various purposes, such as for conducting successive controller-tuning evaluations. A wave-form generator produces various different signals of interest, including step, and sinusoidal patterns.

The example presented serves as a paradigm for further development of systems of general chemical engineering interest, such as reactors, distillation columns, etcetera.