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Building a process control loop demonstrator kit for use in undergraduate process control studies

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ABSTRACT

Process control concepts can be difficult to understand intuitively as an undergraduate with no industry experience/exposure, particularly areas such as process dynamics and interactions. As control systems grow increasingly complex, understanding how they translate from simple control loop block diagrams to real-world systems can be a challenge. Interacting directly with physical examples of the processes and systems that are being studied has been shown to be beneficial for student understanding, thus, providing students with unrestricted access to authentic industry-level hardware and software is expected to assist them in gaining an intuitive understanding of process control concepts.

This study aims to develop a control loop kit that will monitor and adjust a self-contained process as a learning aid for undergraduate students studying process control. The demo kit will provide students with a more intuitive understanding of process control, as well as help them develop a greater appreciation for the complexities of developing control systems for industry processes and assist them in the application of theory to real-world practice. Feedback will be collected from undergraduate students that interact with and use the control loop demo kit; instruments such as surveys and interviews will be used to collect data and evaluate the success of the kit as a way to teach and reinforce process control concepts. A process monitoring the temperature of inlet and outlet streams of a heat exchanger will be developed for students to analyse using the demonstrator kit; using this specific process will allow students to focus on understanding new process control concepts within the scope of what they have already covered in their undergraduate studies.

The goal of this study is to provide undergraduate students with a more intuitive understanding of process control by allowing them to interact with and learn from authentic industry equipment. Class activities will be developed to allow students to apply their knowledge from course content to the kit, which will be designed to mirror the course content being studied, so as to reinforce their knowledge and understanding. The effectiveness of physical kits as a way to teach undergraduate process control will be evaluated, as well as an understanding of what areas of process control students struggle with. Additionally, the effectiveness of drawing parallels between theoretical and actual control systems as a way to develop an intuitive understanding of process control in undergraduate students will be analysed.

KEY WORDS

Experiential learning, Control systems, Process dynamics

BIOGRAPHY

Dr Joanne Tanner is a Senior Lecturer in the Department of Chemical and Biological Engineering at Monash University and Director of SAMPL, the Student Analytical Makerspace and Pilot Laboratories, which include the Monash Engineering Pilot Plant. Her work focuses on sustainable chemical processing, biorefinery systems, and process scale-up, supporting the development of cleaner industrial technologies. She works closely with industry and research partners to translate laboratory innovations into real-world engineering applications while advancing experiential learning opportunities for engineering students.

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