Simulation Apps for Teaching Engineering Delivered Via COMSOL Server™

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Abstract

In the Chemical Engineering Department at Worcester Polytechnic Institute we use COMSOL Multiphysics® not only as a modeling tool for research and to teach applied math modeling to advanced students, but also as a convenient tool to help undergraduates learn engineering fundamentals. In a laboratory class, for example, we use simulations to connect theory to experiment by solving and presenting the velocity, pressure, temperature, and concentration profiles within chemical process equipment. The simulations are used as pre-lab exercises to review fundamentals and prepare for subsequent encounters with the physical equipment.

Until now, we have delivered the simulations using the full COMSOL Multiphysics® software via a Class Kit License. For each simulation, the students, most of whom have never used COMSOL Multiphysics®, make changes in the model parameters and rerun a model at various prescribed conditions to gain insight into the process studied. This requires them to follow a detailed step- by-step written tutorial designed to walk them through changing the existing model, running the simulation, and examining the results. The step-by-step procedure also prompts them to write down answers to questions about what they are learning from the model. They subsequently submit the answers to the questions for grading via a separate online survey program.

In this presentation we describe our experience in converting these simulations and tutorials into applications and delivering them via COMSOL Server™. Each application is a self-contained control panel for a virtual experiment that allows changing input parameters, running the experiment, and viewing the results without opening COMSOL Multiphysics® and manipulating the model tree. The applications also include built-in quiz questions that students answer and submit directly from the application via email to a grader. With this implementation, students should spend more time thinking about the underlying physics and results than following a tedious procedure to help them navigate an unfamiliar program.

Comparison between the two simulation delivery methods with regard to instructor preparation time and student satisfaction and learning will be presented.