

Simulating Experiments with the COMSOL Application Builder for Teaching Scientific Research Methods

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Abstract

The scientific method requires techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge [1]. The Oxford English Dictionary defines the scientific method as "a method or procedure that has characterized natural science since the 17th century, consisting in systematic observation, measurement, and experiment, and the formulation, testing, and modification of hypotheses " [2].

For universities, it is important to teach the principles of scientific methods as soon as possible. However, in case of performing experiments, students need to have some knowledge and skills before starting to do measurements. In this case, COMSOL Multiphysics® software can be helpful by simulating the experiments before actual doing it. A COMSOL app created using the Application Builder is especially very suitable because it provides a way for students to play with virtual experiments with almost no prior (COMSOL) software experience. Students can learn from this, before doing the real experiment.

For example: (1) Simulated sensor data provide a way to do data analysis in an early stage; (2) Studying the disturbances (systematic errors) of the process by placing sensors; (3) Design of the experiment and improvement of the expected sensor responses. The paper presents an introduction of a 2nd year course on scientific methods for building physics, a description of the experiment, the use of COMSOL to simulate the experiment and how students learned from all this. It is concluded that COMSOL is very suitable for this type of education.

Reference

[1]. Goldhaber & Nieto 2010, p. 940

[2]. From the Oxford English Dictionary definition for "scientific".

Figures used in the abstract

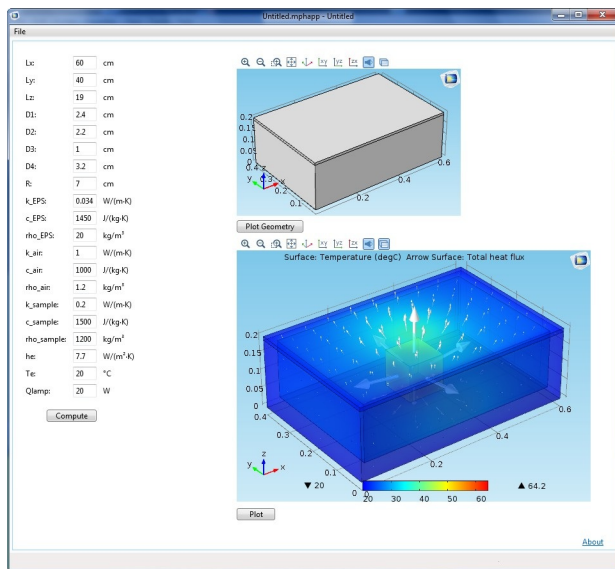


Figure 1: The COMSOL app for simulating a 3D heating experiment.