

Web Based Laboratories for Teaching Electromagnetics

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Abstract

This paper presents a successful step towards the development of a full web-based laboratory for teaching basic, and even advanced, electromagnetic concepts. The main idea is to develop a reusable model for the student to use exactly as a hardware experiment in a physical laboratory, where he/she can change the experiment's parameters and get corresponding results. The two main problems which had to be solved are 1) the model should be accessed remotely through the Internet using any browser and taking into account the fact that the student has no COMSOL installed on his/her computer; 2) the model should not require student's experience in using COMSOL, which means that only input variables and output data should be visible to student. The approach used to develop this experiment is based on the client server model of COMSOL, where a model is built using COMSOL Multiphysics and then exported to COMSOL Multiphysics Server. The client in this case is a MATLAB® script. Now, when the user (student) log in into the system, he/she finds a web form containing some text boxes and dropdown lists. Using this form, the user can change some parameters in the experiment (model) and submit the form. The webpage containing the form validates the data entered by the user through JavaScript, then calls a Java Web Service asynchronously (using AJAX). This webservice runs a MATLAB® script which connects to COMSOL Multiphysics Server that hosts the model. The MATLAB® script sets the required parameters of the model and runs the solution. Consequently, the calculated results are stored in a file on the server as well as the required plots. Finally, a request is made from JavaScript to retrieve both the numeric results and images. The outline of the proposed approach and data flow is shown in Figure 1. The described technique has been tested on a simple experiment that deals with the calculation of the magnetic flux density due to parallel current carrying conductors. For this purpose, a model has been created which includes three parallel current carrying conductors. The experiment has mainly three objectives: a) verification of Ampere's law to determine the magnetic flux density "B" inside a cylindrical conductor, where in this case only the center conductor is activated and the student will be able to visualize and plot the variation of the "B" inside the conductor; b) determination of the "B" due to, and far from, a single current carrying conductor; and c) calculation of the magnetic flux density "B" due to two (and three) parallel current conductors, where in this section the three conductors' currents are activated with different possible configurations.

Reference

- [1] <http://code.google.com/p/matlabcontrol/>
- [2] Introduction to LiveLink for MATLAB®, COMSOL version 4.2, 2012.
- [3] LiveLink for MATLAB® User's Guide, COMSOL version 4.2, 2012.

Figures used in the abstract

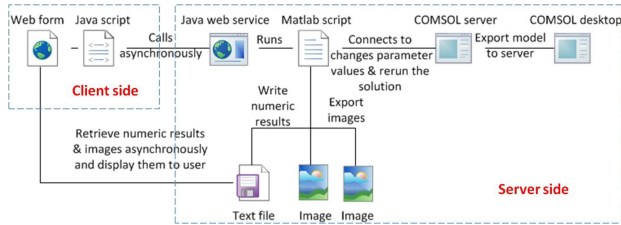


Figure 1: Outline of the proposed approach and data flow.