Behaviour of an Educational Simulation Model Depending on the Initial Conditions of the Simulation

Petr Michalík, Department of Computer Science and Educational Technology, University of West Bohemia, Pilsen, Czech Republic

ABSTRACT

When using simulation experiments in classes, it sometimes happens that students, after creating a simulation model, execute the simulation in order to verify the behaviour and working principle of an electronic circuit, but find that the outputs are completely different from the theoretical assumptions. The problem hardly ever lies in the model being erroneously assembled, but is usually caused by the simulation being run with default initial conditions whose suitability has not been verified with regard to achieving the intended educational objective. The same situation is also experienced by teachers using simulations of electronic systems in their classes. The situation described above can negatively influence secondary-school students’ attitude towards computer simulations and give the false impression that simulations do not work well. The aim of this article is not only to warn teachers and others interested in simulations of electronic circuits about such a situation, but also to demonstrate its possible solution with an illustrative example.

Keywords: Electronic Systems, Multisim NI Programme, Simulation, Simulation Models, TMAX

1. SIMULATION EXPERIMENTS IN CLASSES

1.1. Simulation Models and Simulations

Nowadays, there is no doubt that simulation should be part of the educational process. After all, a computer simulation provides a new and unique method of investigation (Hartmann, 1996), which makes it possible to verify the behaviour of models of unreal situations or situations difficult to perform (Michalík, 2014). The computer simulation model must be created in such a way that it can be executed on a computer. To achieve this, special programming environments are used; in electronics, virtual computer electronic labs can be used. These laboratories comprise

DOI: 10.4018/IJKSR.2015040106
a great number of models of real discrete components that are used to build up a macro model of an entire circuit.

In its most general meaning, a simulation is understood as a process running on a computer (e.g., Hartmann, 1996). Therefore, the term ‘computer simulation’ has become a set expression. In the field of research and development, simulation plays a significant role, as it makes it possible to verify a circuit design before building up a prototype of an electronic system. This method makes it possible to effectively verify the behaviour of a circuit under various conditions and situations which are very difficult or complex to perform in a prototype circuit. While some concepts rigidly distinguish between the terms ‘modelling’ and ‘simulation’ (e.g., Křivý, Kindler, 2003), at present ‘simulation’ is often the only term used (e.g., Hubálovský, 2011), comprising the creation of a computer simulation model including the conceptual one. In the educational process, a simulation has the potential to develop the creativity of students and can also be applied in project teaching (Maňák, Švec, 2003). According to Hubálovský (2011), a simulation can be understood as the transformation of a conceptual model describing a real system into a simulation model.

1.2. Advantages and Disadvantages of Simulation of Electronic Systems in Classes

The advantages and disadvantages of computer simulations are generally listed by Sokolowski and Banks (2009). From the point of view of the educational process, the main advantage is considered to be the fact that the simulation makes it possible to shorten or to accelerate the behaviour of processes and phenomena, that is, to influence the real time of the simulation, thus to contribute significantly to achieving educational objectives.

Running classes in virtual computer electronic laboratories makes the teaching and learning process to a certain extent unique. What makes it specific is predominantly the fact that in classes, students work with models of electronic systems (models of the particular discrete components, partial or complete circuit arrangements) and the accuracy of simulation outputs depend to a certain extent on the quality of the models.

Another fact making the model-aided teaching specific is the educational simulation model being structured to meet specific educational objectives. To illustrate, models of A/D converters will look one way if the educational objective to be achieved is to comprehend and verify their working principle, and another way if the converters are structured to show conversion errors. While in the first case, ideal models of operational amplifiers will be used in the converter assembly, in the other case, a model of a real component will be selected from the component library.

Using simulation of electronic systems in classes seems to have the following advantages (Michalík, 2014):

• Modelling a circuit (wiring a circuit) in a virtual electronic lab is easy and relatively fast. Soldering of components is not necessary;
• The process of modelling meets the educational objectives. Certain simplifications can be applied and virtual components can be used;
• The screen with the modelled circuit (even a semi-finished one) can be saved and opened any time later;
• It is possible to set various parameters of the components, even parameters beyond the values normally specified by their producers, including extreme parameters hardly viable in practice;
• Usually, a considerable number of models of various component types are available, sorted in individual libraries;
Related Content

Role of Web Interface in Building Trust in B2B E-Exchanges
www.igi-global.com/chapter/role-web-interface-building-trust/52132?camid=4v1a

Ethics, Law and Information Technology: The Transformative Role of Rhetoric
www.igi-global.com/chapter/ethics-law-information-technology/29113?camid=4v1a
Developing Professional Knowledge and Confidence in Higher Education
[www.igi-global.com/article/developing-professional-knowledge-confidence-higher/49202?camid=4v1a](www.igi-global.com/article/developing-professional-knowledge-confidence-higher/49202?camid=4v1a)

How People Really Use the Mobile Web: A Framework for Understanding Motivations, Behaviors, and Contexts
[www.igi-global.com/chapter/people-really-use-mobile-web/52416?camid=4v1a](www.igi-global.com/chapter/people-really-use-mobile-web/52416?camid=4v1a)