

VIRTUAL LABORATORY OF ELECTRICAL MACHINE IN LABVIEW

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ABSTRACT

This article is aimed at description of possibility of creating electrical machine's virtual laboratory in LabVIEW. There is generally described the possibility of creating virtual laboratory, mathematical description of DC machine and possibility of creating virtual laboratory in LabVIEW. In conclusion the possibility of next evolution of electrical machine's virtual laboratory is summarized.

1. INTRODUCTION

A virtual laboratory can be understood as one of the E-learning elements. A virtual laboratory can be simply defined as a laboratory that uses virtual reality means to simulate activities in a real laboratory. Virtual laboratories should be used in daily studies especially as a supplement to laboratory training. In the combined form of study, they should replace, to certain degree, real measurements in laboratories. In practice, three attitudes towards creating virtual laboratories can be found. The first possibility is using a compiled program, so-called applet, written in Java, or using simulation in Flash. These applications are mostly started using plug-ins in the web browser. The second possibility is creating an independent program in one of programming languages. So-called remote laboratories are sometimes included, incorrectly, among virtual laboratories. Remote laboratories enable measuring real systems via network (most often via the Internet). For a remote laboratory to operate, it is necessary to have a physically connected task in which devices are connected to the Internet via PC. On the user side, the task must be controlled using suitable software. The last possibility is combination of first and second possibility.

DC machine with independent excitation was chosen as the first machine for virtual laboratory. This machine has a relatively simple mathematical description.

2. MATHEMATICAL DESCRIPTION OF DC MACHINE

DC machine with independent excitation can be described by a number of mathematical models. One of these models comes out from diagram (Fig.1, equation 1 and 3), equation of generated voltage (2), electromagnetical torque (5) and equation of motion (4).

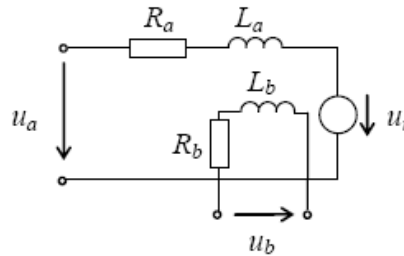


Fig. 1. Diagram of DC machine with independent excitation

$$u_a = R_a \cdot I_a + L_a \cdot \frac{di_a}{dt} + u_i \quad (1)$$

$$u_i = c \cdot k_\phi \cdot i_b \cdot \omega \quad (2)$$

$$u_b = R_b \cdot i_b + L_b \frac{di_b}{dt} \quad (3)$$

$$m_m = m_i - J \frac{d\omega}{dt} \quad (4)$$

$$m_i = c \cdot k \cdot i_b \cdot i_a \quad (5)$$

This mathematical description presumes, for simplification, that excitation is linearly dependent on excitation current, based on constant k_ϕ (equation 2 a 5). This mathematical description can be simulated in various programs (e.g. Simulink – Fig.2).

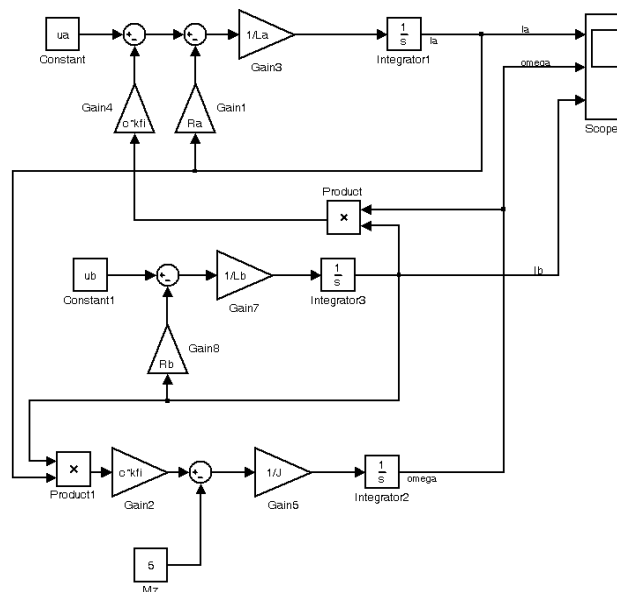


Fig.2. Simulation of DC machine with independent excitation in Simulink

3. SIMULATION IN LABVIEW

LabVIEW is program, which is aimed at support of measuring and controlling by PC. LabVIEW can be coupled about various toolkits and modules. The Simulation Module for creating of virtual laboratory can be used. Simulation module makes it possible to simulated system within block diagram (Fig.3.). Procedure of simulation's creation is very similarly as in Simulink (see Fig.2. and 3.).

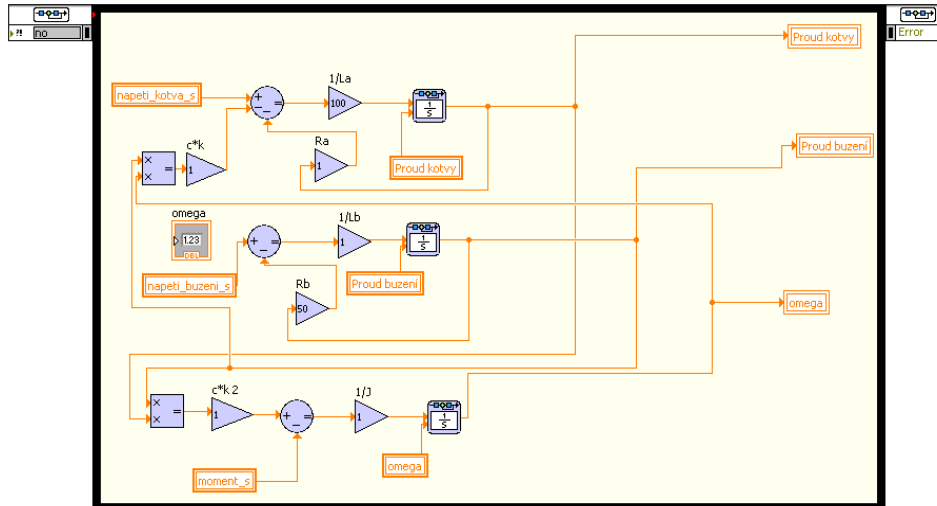


Fig. 3. Simulation loop in LabVIEW with simulation of DC machine

LabVIEW Front panel is created for control of measuring in, by means of can be virtual laboratory controlled.

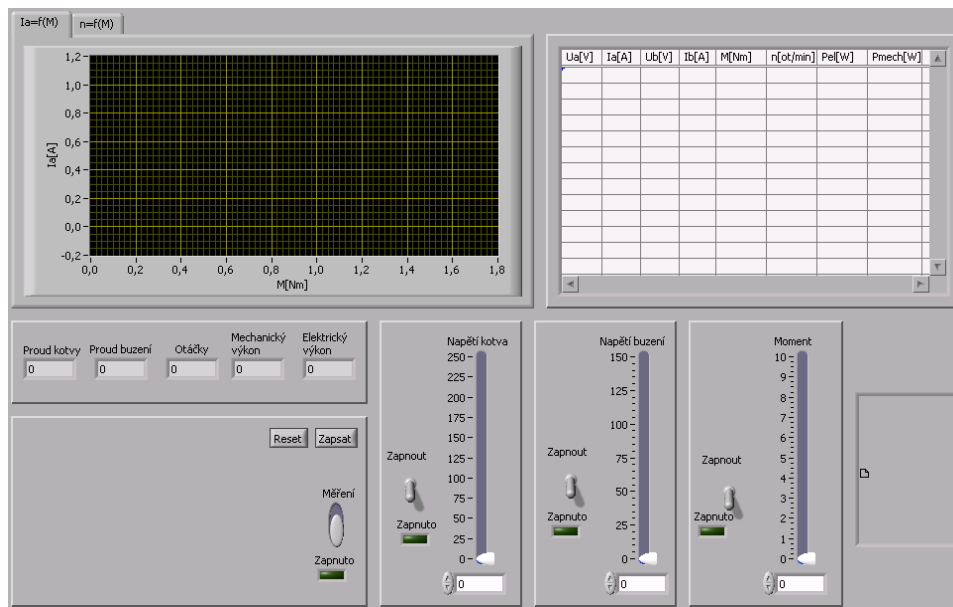


Fig. 4. Front panel of virtual laboratory

Virtual laboratory could be accessed by web. To connected, user must have LabVIEW Run-Time Engine installed. This program allows communication between web browser (Fig.5.) and task in LabVIEW, which is running on remote PC.

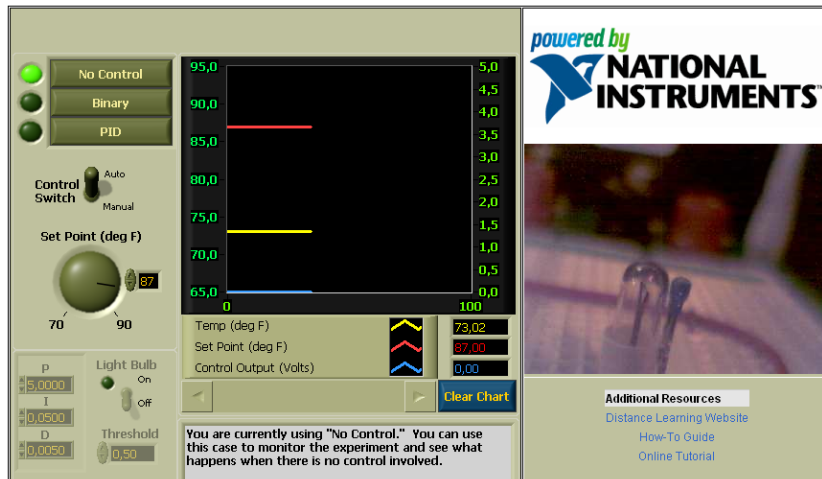


Fig. 5. Measuring interface for the Temperature Control Experiment task in LABVIEW [3]

The dependences of current and revolution on torque will be measured on DC machine. User will increase load torque step by step and will read needed value.

4. CONCLUSION

As next step of creation virtual laboratory the claw-pole alternator and the acid-lead accumulator will be add to DC machine's virtual laboratory. Every virtual laboratory will be accessible by web browser and booking system, which will provide access at reserved time. Booking system was created at University of Maribor [4] (Slovenia) and runs on LabVIEW too.

Every task will be running on computer, which will be running 24 hours a day.

5. ACKNOWLEDGEMENT

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