NUST School of Electrical Engineering and Computer Science

Faculty Member:______________ Date: ______________

Semester:_____________ Section: ______________

Department of Electrical Engineering

EE-379: Control Systems

LAB 6: Model verification

Student name	Reg. No.	Log book Marks / 5	Lab completion Marks / 5	Lab report Marks / 5	Total/15

Prepared by: Dr. Ammar Hasan, Mr. Saqib Nazir and Mr. Tawakal Hasnain

LAB 6: Model verification

1. Objectives

- Learn how to do model verification using LabVIEW.

2. Model Verification

In the lab on modeling we derived mathematical models of the DC motor and the pendulum. These models were derived based on the first principles. We didn't test if these models do in fact represent the actual hardware or not.

In the past few labs we have learned data acquisition and obtaining time response of systems. We can use these tools to verify our derived models. We can apply a signal, e.g. a step, to the *actual plant* using data acquisition and get its output. We can also apply the same signal to the *derived model* and get its output. If the derived model is correct then both the outputs should be similar.

If the outputs do not match, then the model is of course incorrect or inaccurate. In this case we can either check our derivation of the model for any errors or we can use system identification techniques to estimate the system parameters.

In your text book (Norman Nise, 5th edition), you are introduced to basic system identification. In this lab you will use some of the techniques learnt in sections 4.3 and 4.6 of your text books to identify and verify your models.

In this handout you will use the concepts/skills that you have learned in you lectures and previous lab handouts. Therefore, unlike the previous handouts, this handout only outlines what you have to do and doesn't include each and every small step.

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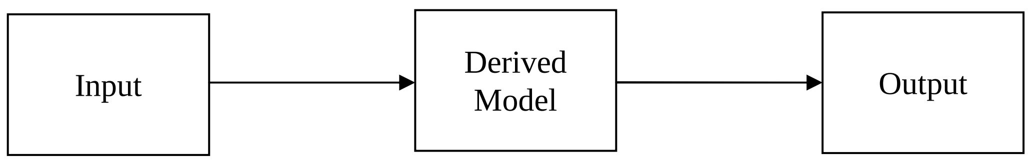
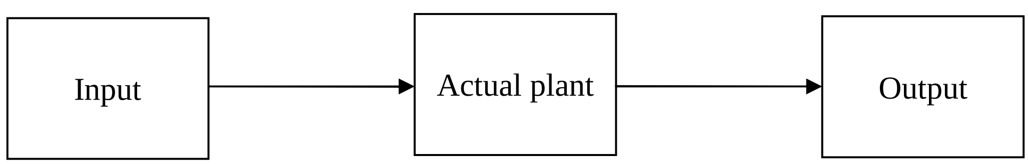
3. Model Verification Procedure

In Lab 3, we learnt how to derive the models of systems. The derived models rely on the values of physical parameters e.g. the mass, length, some constants etc. Sometimes the values these parameters are known or specified, as was the case in Lab 3.

Using the techniques learnt in Lab 5, we can find the response of the derived model to different inputs. The figure below shows a graphical representation of the derived model, applied input and the output. We have already seen how to do this in MATLAB, Simulink and LabVIEW.



Lab 4 was on data acquisition and we learnt how to interface the actual system with the computer. Using LabVIEW and data acquisition we can apply different inputs to the actual system and we can also acquire the output of the actual system. The figure below shows the input and output of the actual system.



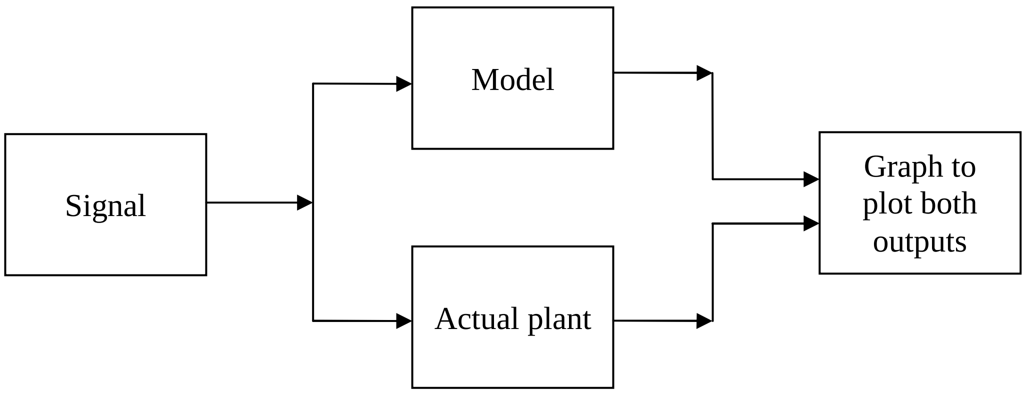
If the derived model is accurate then its behavior should be similar to the actual plant. Therefore, if the derived model is accurate and the same input is applied to the derived model and the actual plant, then their outputs should be similar. This is a simple test to verify the derived model.

If the output of the derived model and the actual system are not similar, then our derived model is not accurate. In this case we will have to apply the system identification techniques we learnt in the text book to find out the various system parameters. The basis of system identification techniques in the text book is that you apply a step input to the actual plant and then try to find the parameters in the step response expression obtained from the derived model.

Exercise 1

Create a VI to do model verification of DC motor speed. Verify the model that you have derived for the DC motor speed for various signals e.g. step, square wave, triangular wave, sine wave, etc. Comment on any differences you see in the output of the model and the actual plant.

Your VI should have a structure similar to the one shown in the figure below. Remember to use the data acquisition VI and the models that you have created in earlier labs.



If the output of the actual plant matches the output of the derived model, then our derived model is verified. Otherwise, apply the system identification techniques that are given in your text book to find the values of constants in your derived model. Once the new values of constants are obtained, try to verify the model again.

Exercise 2

Do the above exercise for DC motor position. Besides the signal listed above also verify the model for a single pulse input.