DEVELOPMENT OF MODEL FOR MOTOR POWER AND SUSPENSION SYSTEM OF ELECTRIC VEHICLE USING SIMULINK

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ABSTRACT:

This project is divided into two parts. The first part deals with the power needed to be supplied by the motor if it is travelling in an inclined surface where coefficient of friction, aerodynamic drag, and opposition due to weight is considered. The second part deals with the analysis of a damped suspension system which is used in vehicles and has a very innovative role in the functioning of electric vehicles. Here the input is the change in surface level while the output is the change in the height of the vehicle body.

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2. INTRODUCTION TO SIMULINK:

Simulink is a simulation and model-based design environment for dynamic and embedded systems, integrated with MATLAB. Simulink, also developed by MathWorks, is a data flow graphical programming language tool for modelling, simulating, and analysing multi-domain dynamic systems. It is basically a graphical block diagramming tool with customizable set of block libraries.

It allows you to incorporate MATLAB algorithms into models as well as export the simulation results into MATLAB for further analysis.

Simulink supports −

- System-level design
- Simulation
- Automatic code generation
- Testing and verification of embedded systems

There are several other add-on products provided by MathWorks and third-party hardware and software products that are available for use with Simulink.

The following list gives brief description of some of them −

- Stateflow allows developing state machines and flow charts.
- Simulink Coder allows the generation of C source code for real-time implementation of systems automatically.
- xPC Target together with x86-based real-time systems provide an environment to simulate and test Simulink and Stateflow models in real-time on the physical system.
- Embedded Coder supports specific embedded targets.
- HDL Coder allows to automatically generate synthesizable VHDL and Verilog.
- SimEvents provides a library of graphical building blocks for modelling queuing systems.

Simulink is capable of systematic verification and validation of models through modelling style checking, requirements traceability and model coverage analysis.

Simulink Design Verifier allows you to identify design errors and to generate test case scenarios for model checking.

3. MATHEMATICAL MODELLING AND EXPLANATION FOR MOTOR POWER AND SUSPENSION SYSTEMS:

Modelling of the motor power system.

Net power of the motor = F * target velocity

$F = F_g + F_r + F_d$

$F_g = W * \sin(phi)$

$F_r = C_r * W * \cos(phi)$

$F_d = 0.5 * D * C_d * A * V^2$

Modelling of the suspension system.

$x'' = (1/m) * [(k * (y - x)) + (c * (y'' – x''))]$

Input: y (Change in vertical level of the surface)

Output: x (Change in the vertical level of the body)

3. Simulink model for power system:

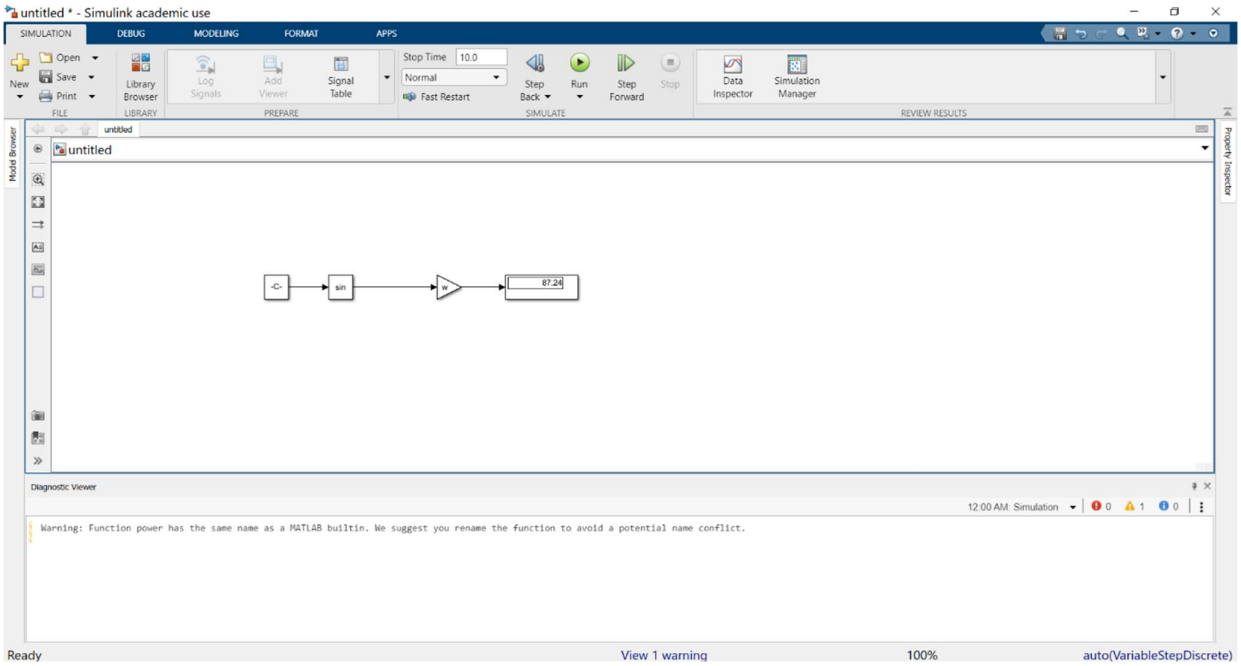

Figure 1: Calculates force due to weight component and then display it.

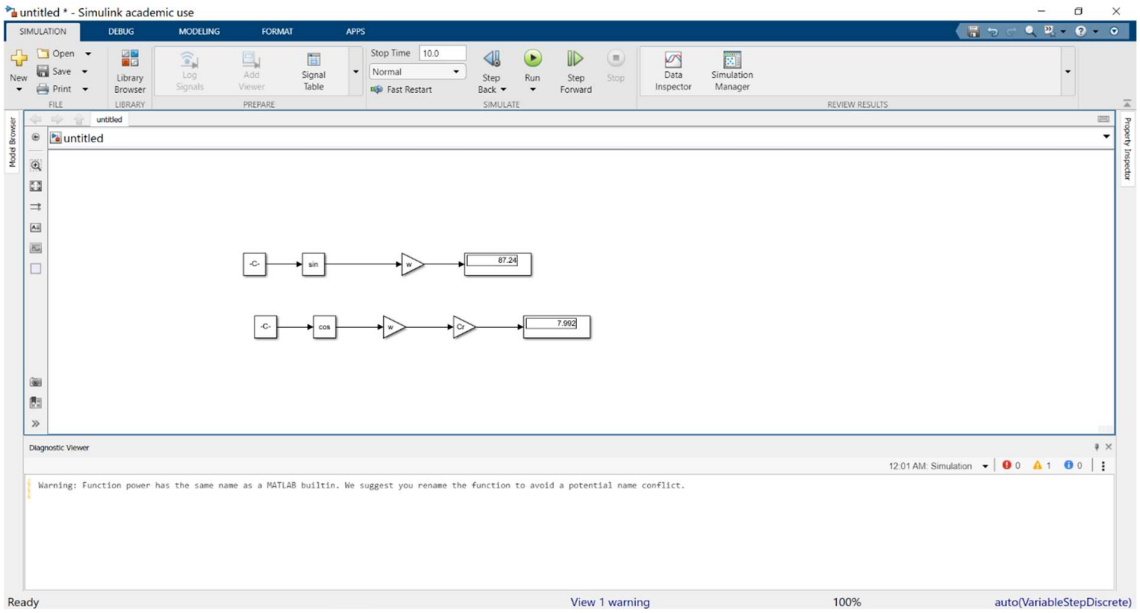

Figure 2: The friction component of force acting on the body along the incline.

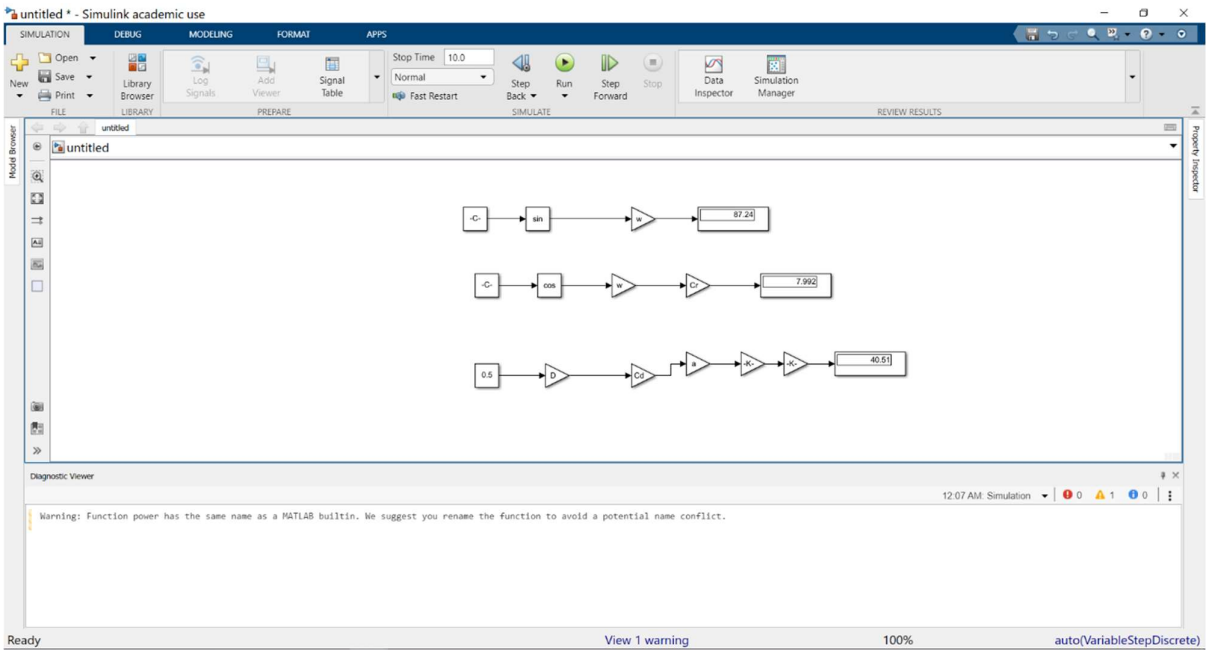

Figure 3: The third line is the modelling of aerodynamic drag acting on the body

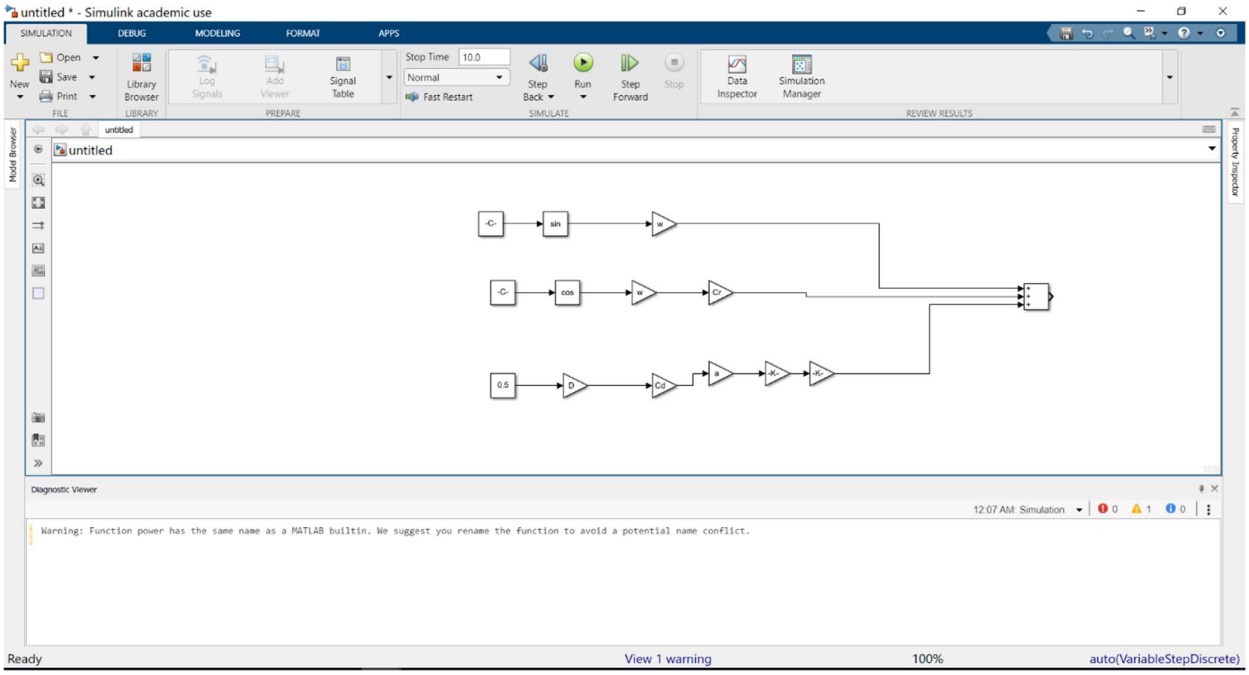

Figure 4: The net force on the body is calculated by summing all the forces.

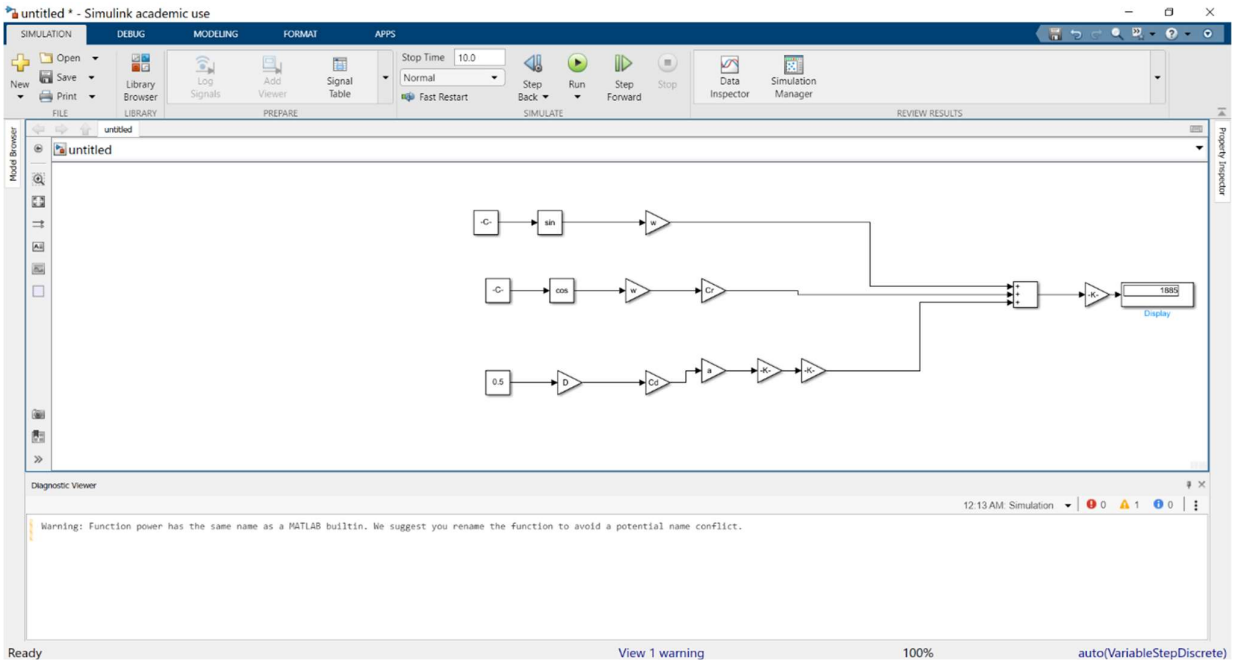

Figure 5:Net force is multiplied with the target velocity to get the motor power output.

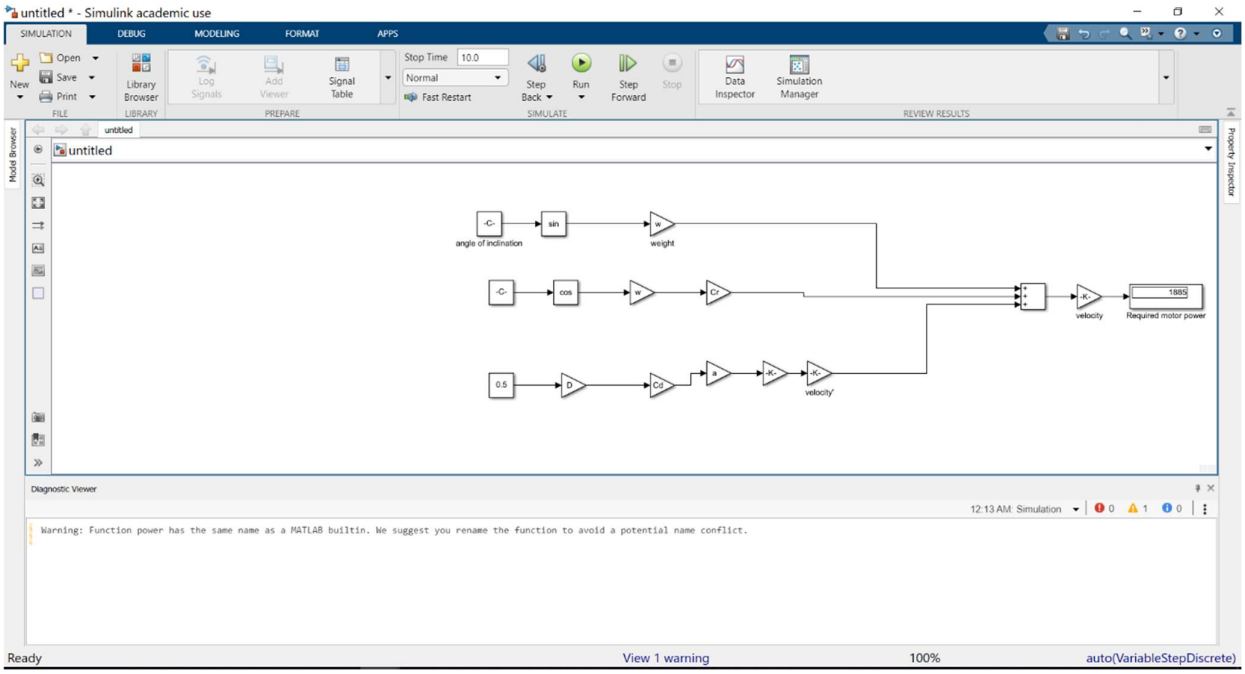

Figure 6: Labelling the output box

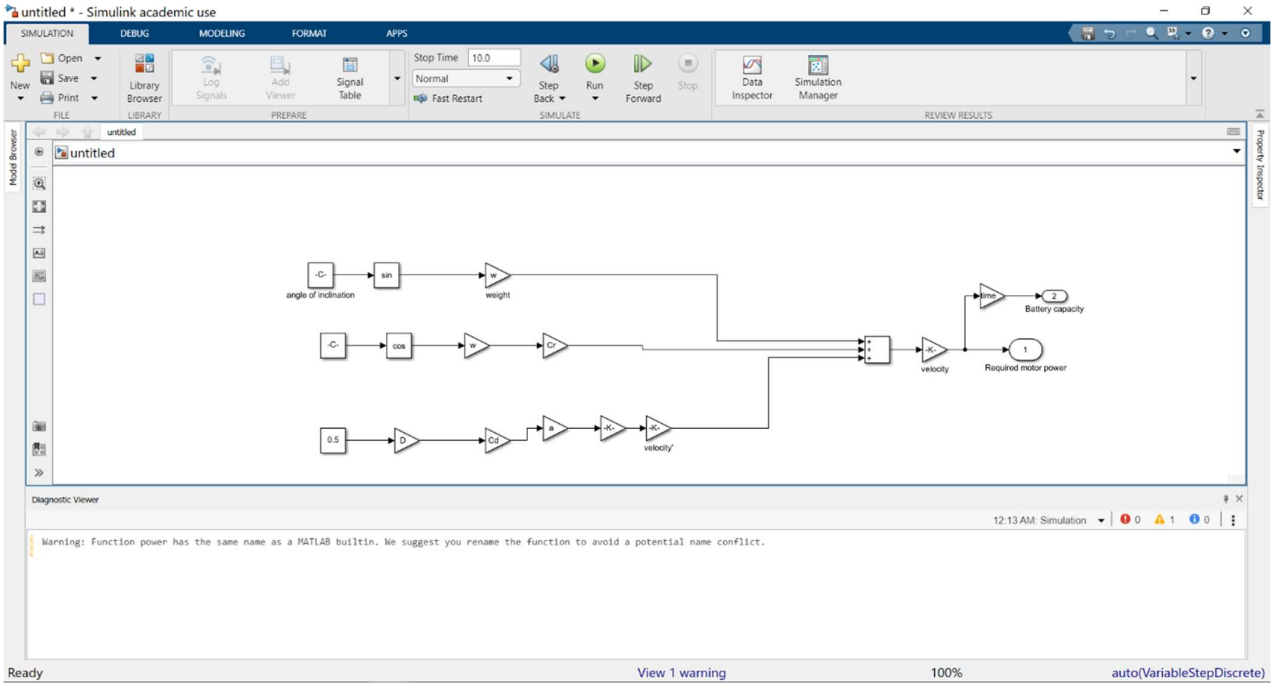

Figure 7: Labelling all the necessary parameters and calculating the battery capacity

4. SIMULINK MODEL FOR SUSPENSION SYSTEM:

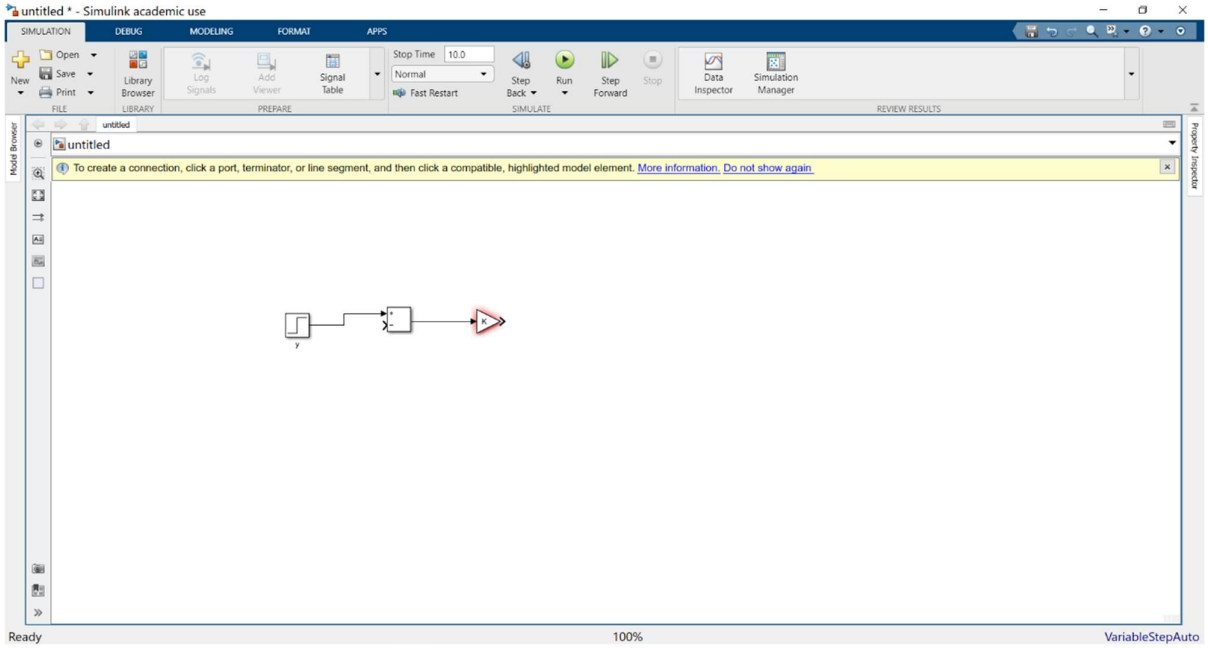

Figure 8: Calculating terms of the derivative x" term.

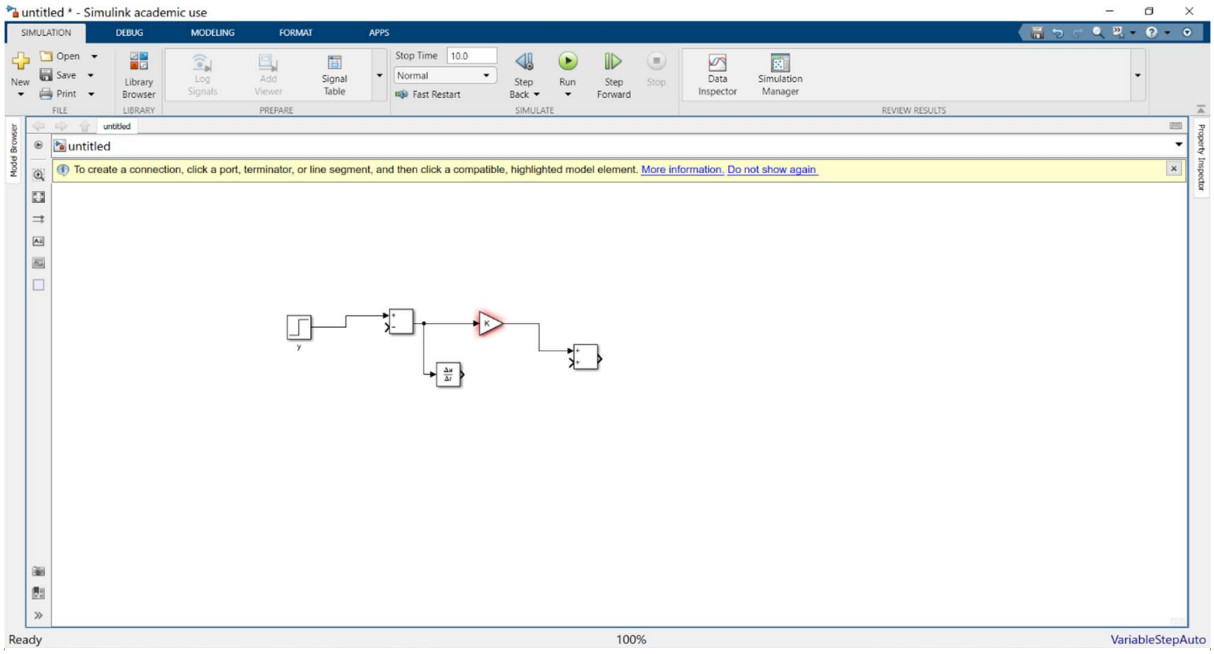

Figure 9: Calculating more terms.

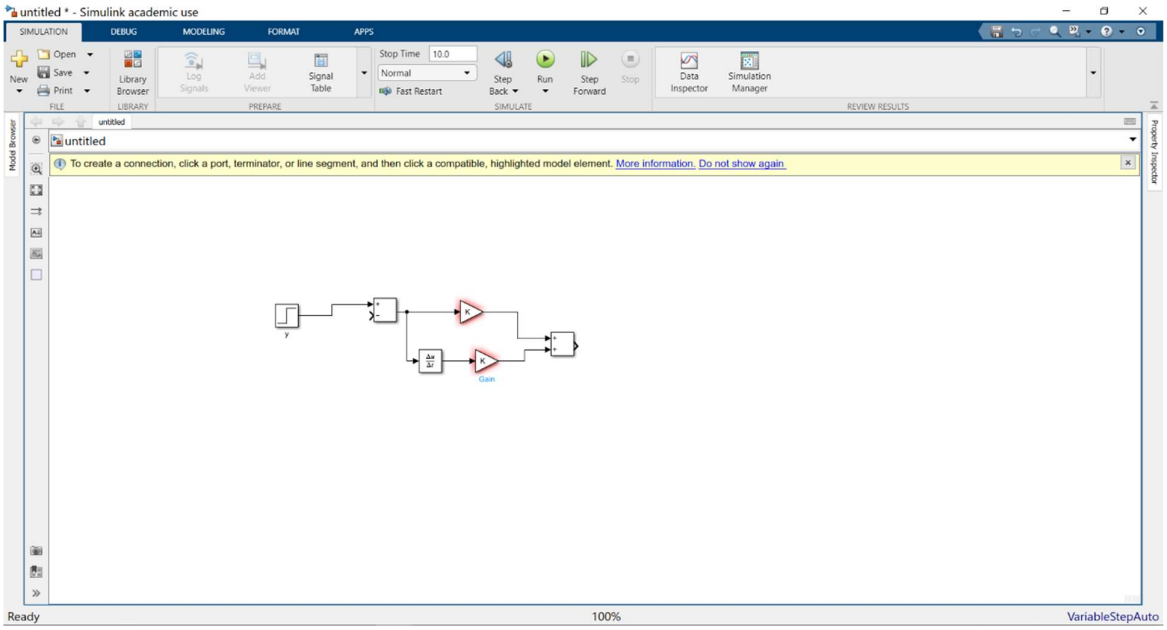

Figure 10: Addition of the parallel blocks

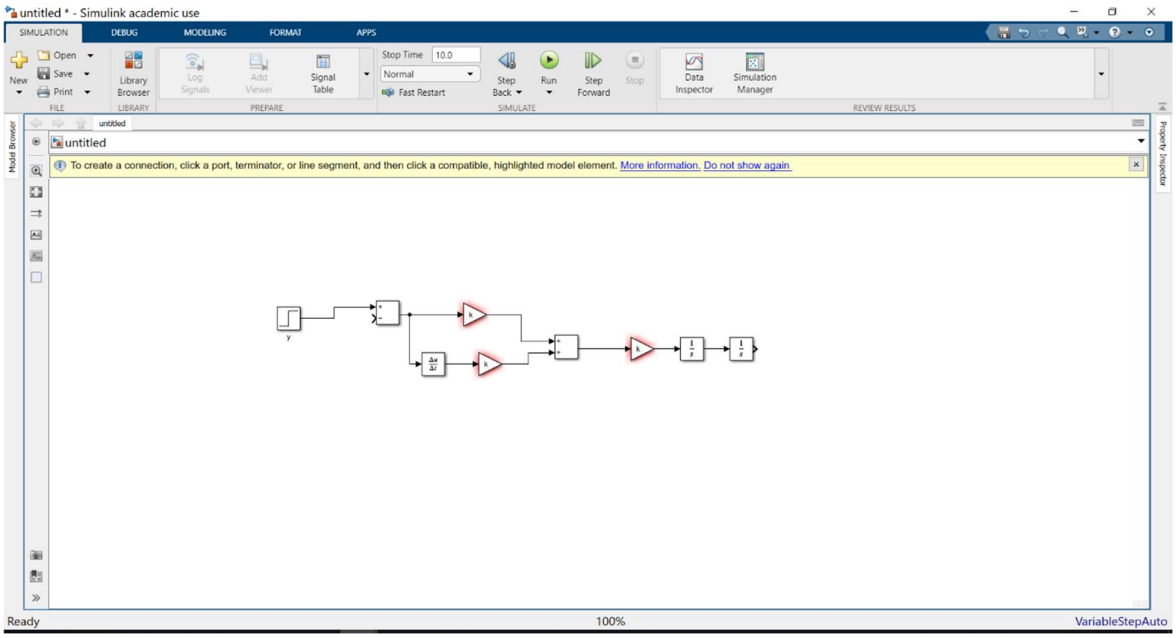

Figure 11: Multiplying 1/m factor and double integrating.

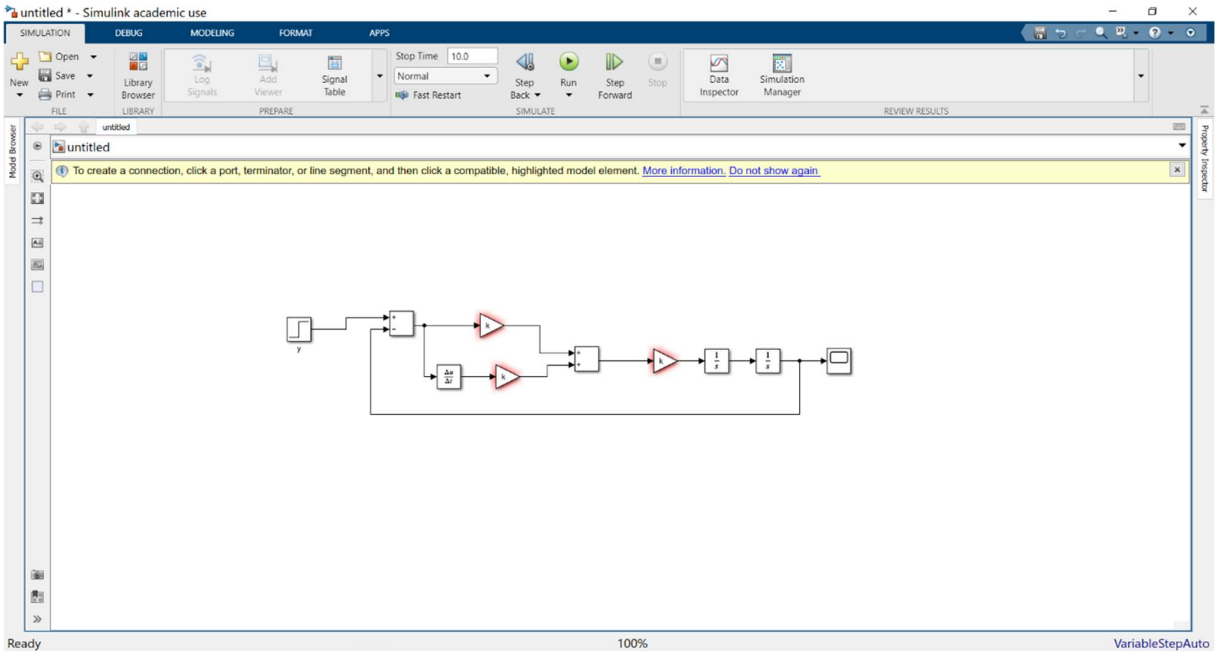

Figure 12: Adding scope block to visualize output graph

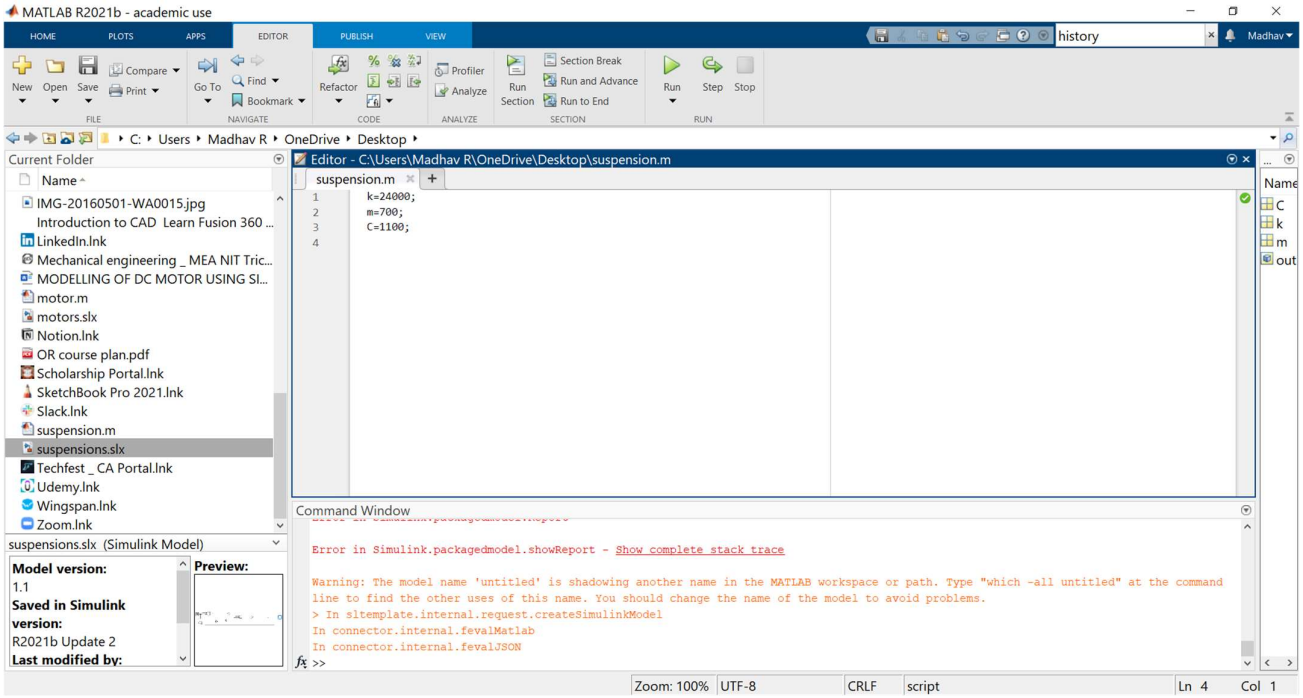

Figure 13: MATLAB file where the variables are initialized.

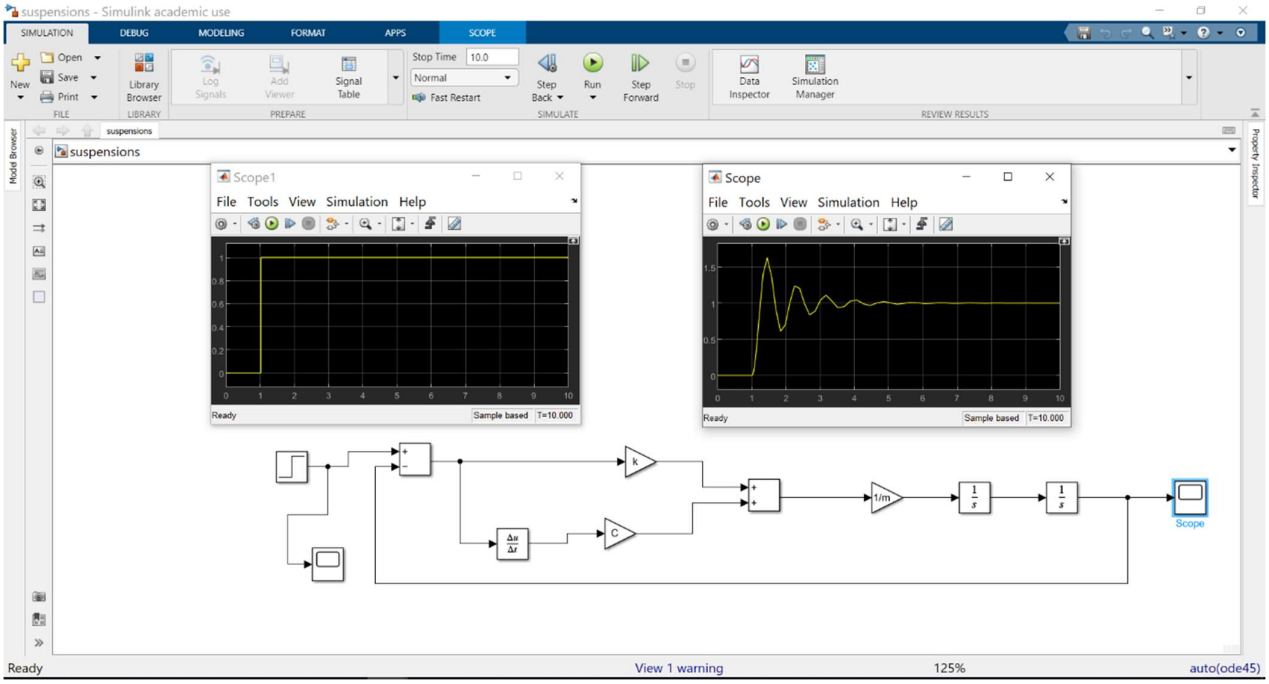

Figure 14: Output graphs of the suspension system

5.Results and conclusion:

The modelling of both motor power and suspension system is done successfully with the help of MATLAB and Simulink.