

T. Y. B.Tech (Electrical and Computer Engineering)

Trimester: V

Subject: Electric vehicle technology

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Experiment No: 05

Name of the Experiment: PWM based PSWM motor simulation for studying torque characteristics

Performed on:

Submitted on:

Marks	Teacher's Signature with date

Aim: To understand PWM based PSWM motor simulation for studying torque characteristics

Resources: Matlab 2022, Simscape toolbox

Theory: This lab experiment explores the use of Pulse Width Modulation (PWM) to control a Permanent Magnet Synchronous Motor (PMSM) through a simulated PSWM (Position Sensor-less Vector Control) scheme. By simulating the motor and its control system, we can analyse the relationship between the applied PWM signal and the resulting torque generated by the motor.

Procedure:

Start Simulink: Open MATLAB and start Simulink by typing simulink in the MATLAB command window.

Create a New Model: In the Simulink window, click on "File" -> "New" -> "Model" to create a new Simulink model.

Add Blocks: Drag and drop blocks from the Simulink library browser onto the model canvas. Depending on the level of detail you require, you can choose from simple blocks like the "Battery" block or more complex blocks like "State-Space Battery" or "Equivalent Circuit Battery" blocks.

Connect Blocks: Connect the battery blocks with appropriate connections to represent the flow of signals and energy within the battery system. For example, connect the battery block's electrical ports to the rest of the powertrain model or charging system.

Model Setup:

- Open Simulink and create a new model.
- From the Simulink library, search for and place the following blocks:

- DC Voltage source
- PWM Generator
- Controlled Voltage Source (for motor)
- PMSM block
- Scope
- Connect the DC voltage source to the PWM generator.
- Connect the PWM generator output to the control input of the Controlled Voltage Source.
- Connect the Controlled Voltage Source output to the PMSM block.
- Connect the PMSM block's torque output to the Scope.

Parameter Configuration:

- Double-click on the DC Voltage source and set the voltage value (e.g., 24V).
- Configure the PWM Generator:
 - Set the carrier frequency (e.g., 1kHz).
 - This defines the switching frequency of the PWM signal.
- Open the Controlled Voltage Source block and select the average voltage type. This block converts the PWM signal to an average voltage for the motor.
- Configure the PMSM block according to its specifications (refer to motor datasheet).

Run Simulation: Click on the "Run" button in the Simulink toolbar to start the simulation. Monitor the simulation progress and check for any errors or warnings in the simulation console window.

Analyse Results: After the simulation completes, use Simulink's built-in visualisation tools to analyse and plot simulation results. You can visualise battery voltage, current, state of charge (SOC), temperature, power flow, and other relevant variables over time.

Iterate and Optimise: Iterate on your model, fine-tuning parameters, adjusting control algorithms, and optimising the design based on simulation results. Repeat the simulation process as needed to refine your model and achieve desired performance.

Documentation and Reporting: Document your Simulink model, including block diagrams, parameter settings, simulation results, and analysis findings. Prepare a report or presentation summarising your simulation methodology, results, and conclusions.

Reference link: https://www.youtube.com/live/tLGKy_Qebu0?si=nhD0rzla2W2Xio0x

Conclusion- By incorporating Pulse Width Modulation (PWM) based Position Sensorless Vector Control (PSWM) simulation within the MATLAB/Simulink environment, we can gain valuable insights into the relationship between applied PWM signals and the resulting motor torque.

