**SIMULINK MODEL OF ANTI-LOCK BRAKING SYSTEM WITH ROAD FRICTION COEFFICIENT ESTIMATION**



Prepared for



The Society of Automotive Engineers

Collegiate Club Number - SAEICCBIS022  
National Institute of Technology Karnataka

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ABSTRACT

<Write in Less than 150 Words>

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# SECTION – I INTRODUCTION

## Timeline

|  |  |  |
| --- | --- | --- |
| Month | Week | Task Accomplished |
| Dec-20 | One | Introductory Meet – Project Start |
| Dec-20 | Two | Completed Matlab Fundamentals Course from mathworks |
| Dec-20 | Three | Learnt Simulink from SAE KEP |
| Jan-21 | Three | Started Learning Basic Vehicle Dynamics – (Brake Bias) |
| Feb-21 | One | Learnt Load Transfer Calculations for a Half Car Model |
| Feb-21 | Four | Project Review – 01 |
| Mar-21 | Two | Literature Review for ABS Simulink Model |
| Apr-21 | Four | Started Making Simulink Model of Braking System (Open Loop) |
| May-21 | One | Added PID Controller to the Open Loop Model and Tuned |
| May-21 | Two | Added Drag and Downforce to the Simulink Model |
| May-21 | Two | Project Review – 02 (Final Review) |
| May-21 | Three | Documentation and Submission of Final Report |

## Tools and Technologies

|  |  |  |
| --- | --- | --- |
| S. No | Tool / Technologies used | Remark |
| 1 | MATLAB | Coding input Parameters |
| 2 | Simulink | Solver for ABS |
| 3 | Microsoft Excel | Plotting friction coefficient graph |

## Brief Introduction

An Anti-Lock Braking System is an active safety feature in aircrafts and land vehicles used to prevent wheel lock up and skidding during braking. This allows the driver to maintain more control over the vehicle. It can decrease the breaking distance on dry and regular roads.

The ABS consists of wheel speed sensor, hydraulic modulator and an Electronic Control Unit (ECU). It has a feedback system which finds out the error between the actual and desired slip ratio and adjusts the Brake Pressure accordingly to get the optimum slip ratio and maximum traction. They System Shuts down if the vehicle speed is under the pre-set threshold.

## Scope of the current study

In this project, we have used ABS for a quarter car model. As this is a simulation model, there is no chance of using a real-time sensor for getting the wheel speed and vehicle speed. We have used newton’s kinematic equations to get the values of the same. For the sake of simplicity and to focus on the main part of the project. We have avoided the hydraulic modulator and we are directly adjusting the brake torque from the feedback loop. We have added the aerodynamic components i.e., the drag and downforce components to the quarter car model. We have done the simulation only for dry asphalt road.

## Literature Review

Sharkawy has studied the changes in coefficient of friction at various road conditions. We have extracted friction formula from this literature and have plotted the same at various velocities.

Bhivate has made the Simulink model of Antilock brake system without the aerodynamic compenents. He has used state space equations of motion to model the Simulink model. In this project we did the Simulink model with direct calculation and the results were reasonable matching. Direct calculation is a much simpler method.

# SECTION – II CONCEPT DEVELOPMENT AND EVALUATION

## Methodology

<START HERE>

## Results and Discussion

<START HERE>

## Conclusion

<START HERE>

## Future Scope

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References:

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