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Analysis of Antilock Braking System with Fuzzy Controller

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ABSTRACT - The purpose of this function is the anti-lock braking system (ABS), which can prevent the brake from locking in emergency situations. During braking conditions, control of the brakes is in the hands of the driver. On the other hand, when the wheel appears to be close to locked during stopping or on frozen roads, the ABS module takes control. ABS replaces the brake line regardless of the force applied to the pedal. This is done to take into account wheel speed, which is important for good performance. Traffic models are often non-linear. The controller must provide the necessary torque control to ensure effective wheel slippage. Slip is expressed in terms of vehicle speed and wheel spin. In this Mat test, ABS prototypes were made for a single wheel and the same results were obtained. It is used to achieve a complete four-wheel simulation software. In this project, a fuzzy PID controller improves the control performance of the brake system compared to the traditional PID controller. Improved anti-collision braking system (ABS) using the car's quarter model and brake actuator. Create fuzzy logic rules for detection and prevention of locking system and use Simulink in MATLAB software to simulate the design to achieve high braking torque, better value and shorter braking distance and time.

I.INTRODUCTION

Anti-lock braking systems (ABS) prevent the brakes from locking up during braking. Under normal braking conditions, the driver controls the brakes. However, under hard braking or on slippery roads, when the driver causes the wheels to lock, the anti-lock system takes over. ABS modulates brake line pressure independently of pedal force to return wheel speed to the range of slip levels necessary for optimal braking performance. The anti-lock braking system consists of wheel speed sensors, a hydraulic modulator and an electronic control unit. ABS has a feedback control system that modulates brake pressure in response to wheel deceleration and wheel angular velocity to prevent the controlled wheel from locking up. The system turns off when the vehicle speed drops below a preset threshold. These are explained below

Braking distance Stopping distance is a function of vehicle weight, initial speed and braking force. Stability Although slowing down and stopping vehicles is the basic purpose of braking systems, maximum frictional force may not be desirable in all cases, for example not when the vehicle is on a so-called p-split surface (for example, asphalt and ice), so that on one side of the vehicle, substantial greater braking forces than on the other side. Applying maximum braking force to either side will result in a yaw moment that will tend to pull the vehicle to the high-friction side and contribute to vehicle instability, forcing the operator to make excessive steering corrections to counter the yaw moment. If the anti-lock system can keep the slip of both rear wheels at a level where the lower of the two coefficients of friction peaks, then the lateral force is reasonably high, although not maximized. This contributes to stability and is the goal of anti-lock systems.

II. OBJECTIVE

- The introduction of fuzzy logic has revolutionized ABS design.
- The introduction of Fuzzy ABS has led to the idea of introducing fuzzy logic to many automotive applications.
- The main purpose is to reduce the distance during parking using fuzzy logic controller. For comparison purposes, two methods are used to calculate the distance of the car.
- A fuzzy-based protection system is used to reduce distance during stopping, thus preventing skidding and improving the vehicle's ability to control or stop in an emergency situation.

III. LITERATURE REVIEW

The Insurance Institute for Highway Safety (IIHS) researched the effectiveness of motorcycle ABS and concluded that non-ABS motorcycles over 250 cc are 37% more likely to be involved in a motorcycle accident. This can be further reduced by motorcycle ABS. Because difference check fuzzy logic is the best way to solve this problem. Most automotive controls involve complexity, and the optimization of these components is controlled by intelligent engineering with little use of mathematical models. Fuzzy logic provides a great platform for finding solutions to problems through small calculations. Fuzzy logic uses a different language that eliminates arbitrary calculations [1] This method is used to determine the PID value of the Malaysian-made passenger anti-lock system (ABS). The research work includes experimental data collection, development of the brake model, changing simulation model parameters and finding the PID value. Malaysian-made cars are equipped with equipment that will record the car's behavior in emergency situations and during braking. The data collected are stopping distance and longitudinal speed. Data collected during normal braking is used to create a two-degree-of-freedom (2 DOF) braking model, while data collected during emergency braking is used to call the PID switch that controls the operation of the ABS system. The model braking system simulation is consistent with the experimental data, and the change in the PID algorithm shows that the ABS is controlled by the PI system. [2] Sudden stops, slippery roads, etc. Vehicle stability control, which can keep the vehicle's direction constant even in difficult situations. When the brakes are used, the speed of the car and the wheel begins to decrease. However, reducing vehicle speed is not always associated with reducing wheel speed. The device allows the brakes to be used as long as the wheel rotates slowly. However, if the brake is pressed too much and the wheel stops turning and starts to slide, the device starts to work. [3] This work introduced the hydraulic anti-lock braking system (ABS) for motorcycles. ABS has hydraulic regulator and intelligent control. The hydraulic modulator is inspected and then placed on the scooter for testing. The intelligent controller controls the hydraulic modulator by estimating the vehicle speed and calculating the wheel slip rate in real time. Evaluate the performance of hydraulic modulators and smart controllers through hardware-in-the-loop (HIL) simulation and testing methods. In the HIL simulation, ABS is tested at different initial braking speeds on roads with different adhesion coefficients. Additionally, HIL simulations and method evaluations were performed on both single-phase and three-phase methods. [4] Anti-lock braking system (ABS) is one of the safety features offered by the automobile industry. Due to the use of this safety feature, braking of the vehicle is reduced and the stability of the vehicle is increased. Thanks to the use of ABS, performance also increases due to the reduction of friction between the road and the mode. However, the system does not work well in a bad way. To overcome this shortcoming, the automobile industry has recently implemented a new development called electronic brake force distribution [5]

IV. EXISTING SYSTEM

- The governor must provide the controlled torque necessary to maintain the optimum value of the wheel slip ratio.
- Slip ratio is represented by vehicle speed and wheel rotation. In this research study of Mat lab ABS model developed for single wheel, results are obtained for the same.



- The complete simulation of four wheels CARSIM simulation software is used for the existing system. The existing model of the ABS system is developed for hatchback and van segments, and the results of both simulation software are compared.

V. PROPOSED SYSTEM

- In our proposed model, a simple and efficient fuzzy logic controller is designed for the anti-lock braking system (ABS) to improve the braking performance and directional stability of the car during braking and steering-braking maneuvers on uniform and non-uniform (μ -split) friction surfaces.
- The system consists of two controllers working in tandem. The first controller works on the longitudinal slip and the second controller is responsible for controlling the lateral slip of the vehicle.
- Complete simulation model, control block mainly consists of road condition identifier and fuzzy controller. Conventional ABS actuators operate only in discrete intervals (quantization regulation). The output discretization of the fuzzy controller therefore reflects some limitations imposed by the actuator design.
- The fuzzy logic controller is implemented on a four-wheel nonlinear model of a vehicle with a nonlinear type of behavior.
- Optimal cut-off pressure is the result of defuzzification of the linguistic variable pressure. Finally, a three-stage controller determines the position of the solenoid valves, whether the pressure is to be increased and held steady or decreased.

VI. SYSTEM FUNCTION

A. BLOCK DIAGRAM OF SIMULATION SETUP IN MATLAB SIMULINK

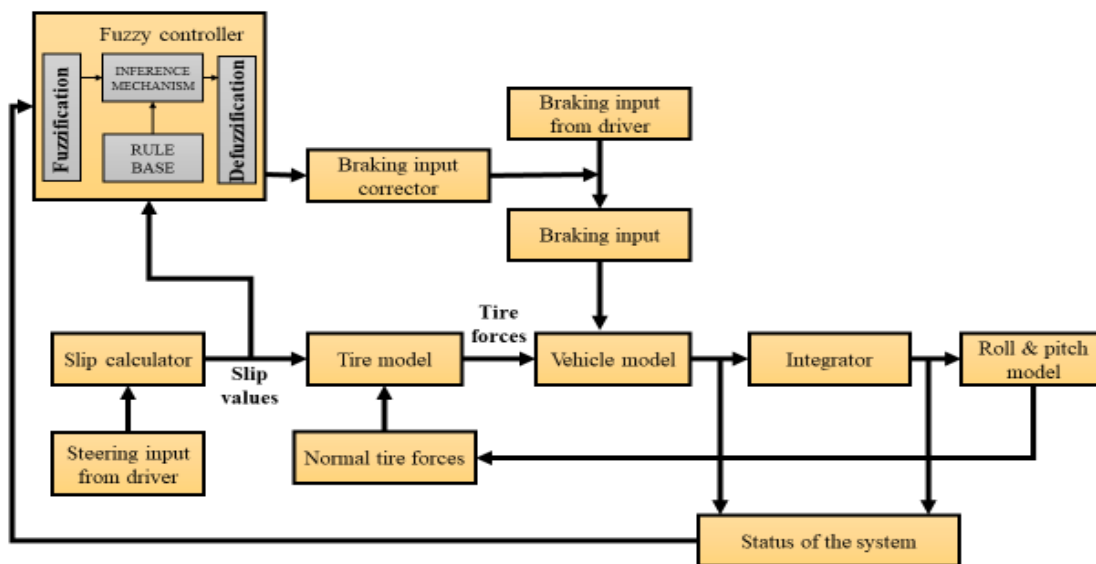


Fig. No.1. Block diagram of simulation setup in MATLAB Simulink

B. SIMULATION DIAGRAM

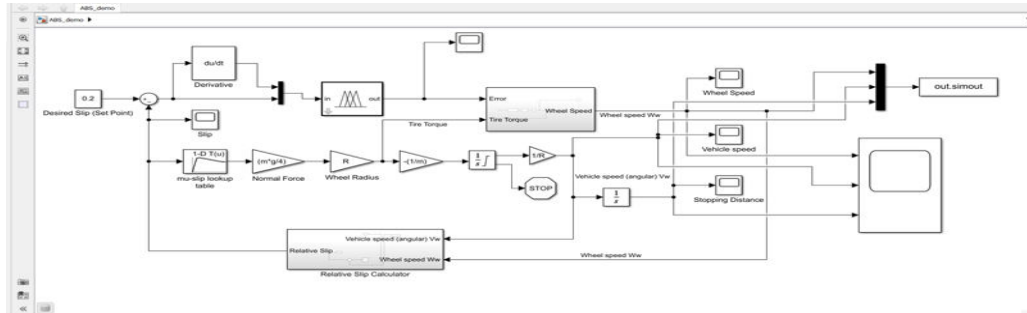


Fig .4.2 Simulation diagram for proposed system

VII. MATLAB/SIMULINK

MATLAB (Matrix Laboratory) is a fourth generation high-level programming language and interactive environment for numerical calculations, visualization and programming.

MATLAB is developed by Math Works.

Enables matrix manipulations plotting functions and data implementation of algorithms, creation of user interfaces, interfacing with programs written in other languages, including C, C++, Java, and FORTRAN, analyze data, develop algorithms, and create models and applications.

It has numerous built-in commands and math functions to help you perform mathematical calculations, generate graphs, and perform numerical methods.

1.Uses of MATLAB

MATLAB is widely used in science and engineering as a computational tool that extends physics, chemistry, mathematics and all branches of engineering. It is used in many applications such as:

- Signal processing and communications
- Image and video processing
- Machine control
- Testing and measurement
- Accounting
- Computer Biology

2. MATLAB - Simulink

Simulink is a MATLAB-integrated simulation and modeling environment for dynamic and embedded systems. Simulink, also developed by Math Works, is a dataflow graphical programming language tool used to model, simulate and analyze many dynamic systems. It is a graphical block diagram tool with customizable layouts.



Allows you to integrate MATLAB algorithms into your model and export simulation results to MATLAB for further analysis.

Simulink Support

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

Math Works and third party hardware and software products also support Ob Simulink There are other additional tools that can be used.

The following list gives a brief description of some of them.

- State flows enable the development of state machines and graphs.
- Simulink Coder allows real-time generation of C source code -
- XPC Target, together with x86-based real-time, provides an environment for real-time simulation and experiments on Simulink and state flow models. Physical systems.
- Embedded Encoder supports special purposes.
- HDL Coder allows automatic generation of synthesizable VHDL and Verilog.

3. Creating a Simulink Model:

Creating a Simulink model of a system will select the appropriate model and connect it to represent the mathematical model.

The best way to learn a simulation tool is to use it, and in the first training you will be explained a simple example. We will create a block diagram of a simple model with balanced sinusoidal feedback with constant gain as shown below.

4. Six Distinct Blocks:

The Simulink model will have 6 different modules such as Sine, Interval, Multiplexer, clock and going to work. Sine is a basic block that produces a sinusoidal input signal. The signal is sent to the gain module over the line in the direction shown by the arrow. The gain module modifies its input (scales to 5) and outputs the new signal from the line. The output of the gain module and the output of the sine wave are combined in the multiplexer (Mux) to create a vector signal. The vector signal is transmitted over a line to an oscilloscope module that displays the signal, just like an oscilloscope.

VIII.RESULTS

Observe the wheel speed of these four kinds of road conditions, it is obvious that when the adhesion coefficient is larger, the wheel speed does not change due to the brake and the fluctuation is small. While the adhesion coefficient is smaller, the wheel speed fluctuation is larger. At the same time, for all adhesion coefficients, the speed of the wheel during initial braking is more clearly reduced, then it tends to be flat.

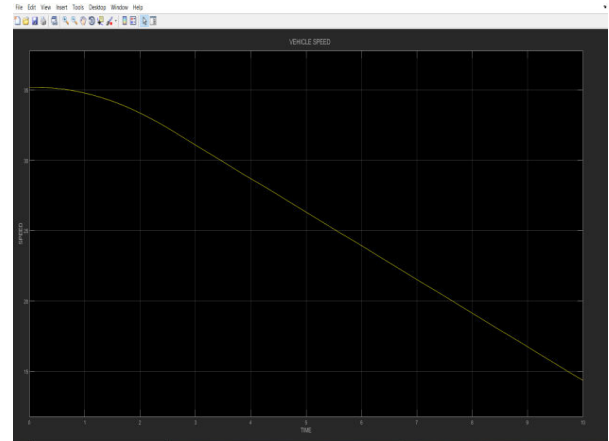
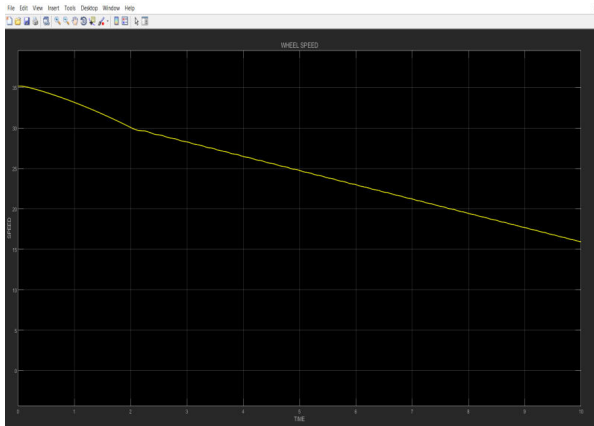


Fig no: 8 Vehicle Speed

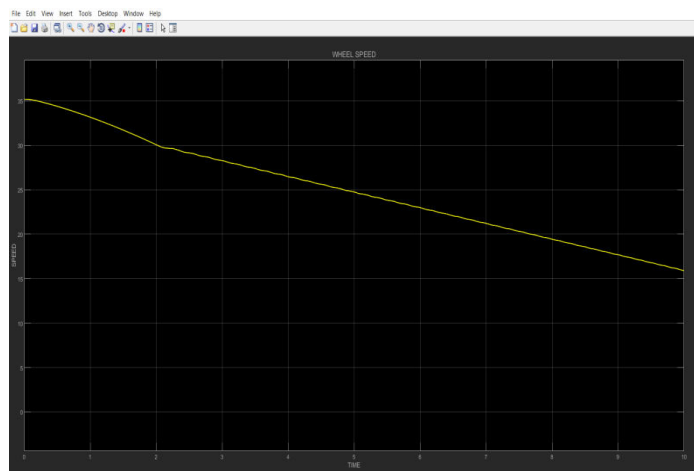


Fig no:9 Wheel speed

IX. CONCLUSION

In this work slide, management is used as the criterion for this inspection work. The frictional force and normal reaction are a function of the slip ratio and conversely the whole equations were non-linear. The second-order differential equations were written as three state equations and the solutions are obtained by the time integration method and directly achieved by the MATLAB Simulink model. This project focuses on modeling an automatic braking system using fuzzy logic vehicles that can solve the problem of drivers not braking in time in an emergency situation and can automatically reduce speed due to obstacle detection.

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