

# A REVIEW PAPER ON DIFFERENT IMPLEMENTATION TECHNIQUES ASSOCIATED WITH ANTI-LOCK BRAKING SYSTEM

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## Abstract

With the advancement of the technology the safety issues which were associated with the automobiles and automation has been greatly reduced, one of such technology is Anti-Lock Braking System popularly kenneed as ABS system. In this review paper we will discuss sundry technologies and algorithms that were developed to make this system more efficient and cost efficacious additionally we will discuss the proposed scheme for reliable and efficient implementation of ABS system so that it can't be implemented in all types of conveyances so as to increment the safety of the passengers. Arduino will be utilized for developing a prototype of the system and to test the efficiency and reliability.

**Key Words:** Arduino, Antilock Braking System (ABS), Slip Ratio, Traction, Speed Sensors, Actuator.

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## 1. INTRODUCTION

Anti-Lock Braking system is a driver assistance system that greatly reduce the hazards associated with astringent braking and infelicitous road conditions. It is an automobile safety system that obviates the wheel from locking up and sanctions the driver to have control on the steering by maintaining opportune traction between the road and the tire. The rudimentary concept of the ABS is quite simple and can be understood with the avail of mu-slip curve 1. It defines the relationship between tire slip and the available braking force. It can be optically discerned by observing figure that maximum friction coefficient lies in between 0.2-0.3 value of slip and as the slip transcends this value the braking force reduces i.e. wheels commences to lock up and gets thoroughly locked up when slip value reaches 1 and at this point driver loses control on steering conveyance commences skidding due to lack of traction between tire and road. What ABS system do is, it endeavors to maintain the value of tire slip in vicinity of the region where traction is maximum by modulating the braking force applied. By doing this, the wheels never lock up and driver has consummate control on steering and withal it can be optically discerned that the available braking force is more immensely colossal than the locked tire thus it reduces the braking distance as well.

## II. ABS METHODOLOGIES

All the methodologies of the ABS endeavor to reduce the longitudinal tire slip which is achieved by processing the information obtained from wheel speed sensors. These sensors provides the wheel speed  $V_w$  which is the compared with conveyance reference speed  $V_v$  to detect any slip. The tire slip can't be directly calculated but it is calculated by the formula.,

$$S = 1 - \frac{V_w}{V_v}$$

Where,

$V_w$  = wheel speed and is calculated as  $\omega * R_{tire}$

$V_v$  = Vehicle Speed

$\omega$  = Angular velocity of the wheel

$R_{tire}$  is the radius of the wheel

To accomplish the controlling following variables and parameters are perpetually monitored by the ABS controller,

1. Wheel velocity - is the angular velocity of the wheel.
2. Conveyance Velocity - is the linear velocity of the conveyance.
3. Wheel Spin Expedition - is the angular expedition of each wheel.
4. Tire Slip – It is defined as the ratio of the difference between wheel velocity and vehicle velocity. When wheel and vehicle velocity are same slip is zero; when wheel velocity is zero slip is maximum and steering locks up.
5. Brake System Pressure - is the pressure engendered due to the application of the brake by the driver (input variable).
6. Wheel Brake Pressure — is the brake applied to the wheel assembly (output variable).

Hardware that are typically used are,

1. Electronic control unit (ECU) - This is the main control module of the ABS system it reads sundry variables and parameters and accordingly modulates the brake pressure on the wheels.
2. Speed sensors- Hall effect based speed sensor is dominantly used in the ABS system. The output of the hall effect based sensor is voltage whose frequency is equivalent

to the speed of the wheel. The output voltage relation is given by,

$$V_x = -I \cdot B / n \cdot e \cdot d.$$

3. Brake pressure modulator- This modulates the brake pressure on the wheel on the substructure of the control signal provided by the ECU.

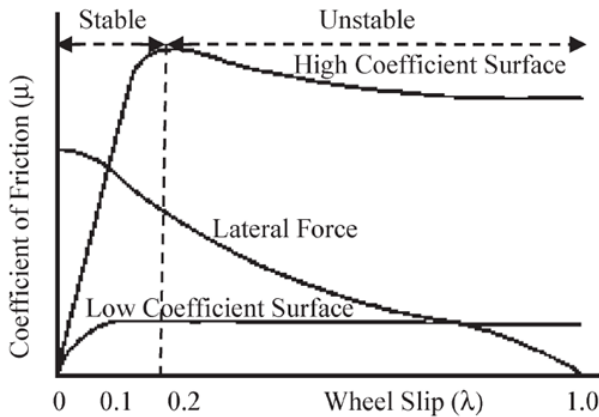


Fig.1: Relationship between wheel Slip and Coefficient of Friction

## 2. OVERVIEW ON PREVIOUS ANTILOCK BRAKING SYSTEMS

This part of the paper covers the previous technologies and algorithms that were proposed for designing an ABS system. All the techniques and algorithms has a prime objective of maintaining the wheel traction in a range where slip is less (as seen in Fig. 1) and the coefficient of friction between wheel and road is high thus preventing locking up of wheels and steering. The main modules of the ABS systems are the sensors (speed, traction) and a controller for processing the data from sensors. Hall Effect based speed sensors is the dominant sensor by considering the importance of high quality sensor data.

The prime objective of ABS is to assure the safety under harsh braking conditions, but as the condition of the road becomes harsh the performance of ABS degrades. In this paper, a hybrid control system using recurrent neural network is developed, which consists of a principal controller which acts as the main controller and a compensation control which reduces the error in expected and system uncertainty. [1]

In this paper ABS system is designed using fuzzy logic controller using 11 rules which define different conditions in dry, wet pavement, ice and wheel blockage condition at any point only one rule is activated. The system shows better results for dry pavements but in ice the noise present in the slip ratio increases. [2]

In this paper, design of an optimal fuzzy controller is proposed for ABS systems, the objective function is defined so as to maintain the wheel slip in the optimum range, and error based global optimization approach is used for fast convergence of error near optimum range. [3]

In this paper, design using Fuzzy-PID Controller is proposed, the objective function is defined, and comparison

with individual PID and Fuzzy controller shows that Fuzzy-PID controller gives better result and higher stability.

## 3. AN OVERVIEW OF THE PROPOSED SCHEME

Auto-motives are the greatest revelation that greatly reduces the human effort associated with a particular work. But, with the incrementation in automation a threat is associated as the no. of accidents has greatly incremented. According to a survey a contingency takes place in India in every 3 minutes. So, by including the Anti lock braking system along with the mundane brakes, these figures can be greatly reduced. As we have discussed sundry techniques and algorithms of ABS system, now we will discuss the proposed scheme for efficient implementation of ABS system, in the proposed scheme Tire Algorithm is utilized for programming the ECU the simplicity and efficacy of the tire algorithm provides the flexibility of utilizing variety of micro-controllers. As we have observed in Fig \ref{Fig.mu-slip curve} we have culled a desired region of operation of the system and withal desired value of wheel slip is surmised to be 0.28 any deviation from this value will be provided as a feedback in a closed loop system and accordingly the brake pressure is modulated.

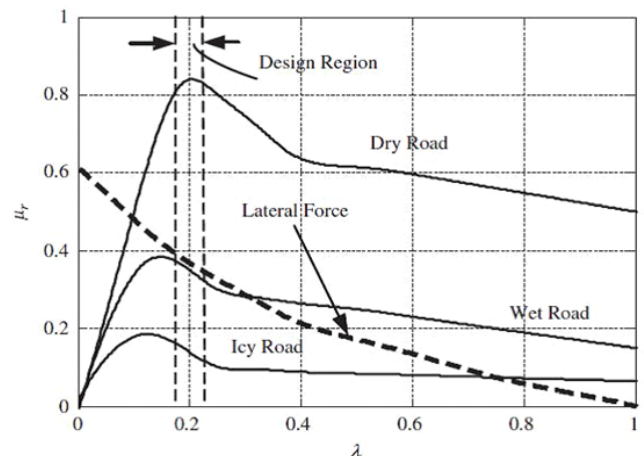


Fig.2: Desired Region for Design

The proposed system is shown in figure 3,

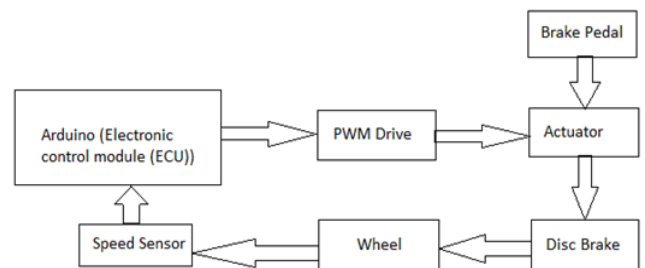


Fig.3: Block Diagram of the ABS system

A.)Speed sensors- Hall effect based speed sensor is dominantly used in the ABS system. The output of the Hall Effect based sensor is voltage whose frequency is equivalent

to the speed of the wheel. The output voltage relation is given by,

$$V_x = -I^*B/n^*e^*d.$$

#### B. Disc brake

The disc brake is consisted of a disc and a caliper assembly which. Whenever brake pressure is applied the hydraulic pressure to the piston increases which pushes brakes closer to the disc and braking pressure increases.

#### C. Hydraulic modulator (Actuator)

This part of the mechanical system is responsible for the action of the ABS system the brake pressure is modulated using Hydraulic modulator by electrical control signals obtained from the ECU.

## 4. SAMPLE WORKING

We will be utilizing Arduino development board for testing and then will be shifting to specialized microcontroller for final implementation. When the braking force is applied, the modulator gets activated. The modulator's output signal and the PWM signal together operates the brake and modulates the brake pressure on the basis of the sensory information obtained from the speed sensor which continuously monitors the wheel speed so as to maintain the wheel slip and traction in the desired range of design. The microcontroller collects all these data and on the basis of algorithm used for controlling generates the control signal. So, it manipulates the wheel speed maintaining the wheel slip in an optimum range by modulating the control using PWM drive and hence the steerability and stability is maintained.

## CONCLUSION

In this review paper, we have gone through the sundry technologies utilized for implementation of Anti Lock Braking System (ABS). Utilizing Hall Effect predicated speed sensor we will be able to get precise reading of the conveyance speed. Utilizing Arduino we will be able to develop a low cost highly reliable ABS system which can then be implemented on the more frugal conveyances as well which not only will increment the safety but will additionally reduce the number of accidents that takes place due to skidding of the wheels. In future, after the working and efficiency of this system is checked in Arduino board, we will be shifting to specialized microcontroller for developing ASIC. In the second phase of the project I will be moving to the development of the algorithm, hardware, obtained result and performance comparison of the result with different techniques discussed.

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