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A Review On Anti Lock Braking System and Its Control

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ABSTRACT

In the present review paper we briefly describe the methods and control used in the design of ABS system to improves the braking performance.Antilock braking systems are used in modern cars to prevent the wheels from locking after brakes are applied.ABS prevents locking of wheels during braking.The anti-lock braking system modulates the air pressure in the brake chambers to prevent wheel lockup and provide precise braking control during over-braking.ABS modulates the brake line pressure independent of the pedal force, to bring the wheel speed back to the slip level range that is necessary for optimal braking performance.ABS improves the braking performance.

KEYWORDS: ABS; Sensor; Stability; Intelligent Control; Performance; Brake

1. INTRODUCTION

The anti-lock braking system modulates the air pressure in thebrake chambers to prevent wheel lockup and provide precisebraking control during over-braking. However, during severe braking or on slippery roadways, when the driver causes the wheels to approach lockup, the antilock system takes over. ABS modulates the brake line pressure independent of the pedal force, to bring the wheel speed back to the slip level range that is necessary for optimal braking performance.[1]. It is obvious that efficient design of braking systems is to reduce accidents. Vehicle experts have developed this field through the invention of the first mechanical antilock-braking system (ABS) system which have been designed and produced in aerospace industry in 1930 [2,3].

Benefits of Antilock Braking Systems

- It improve the vehicle stability.
- maintains steer ability and generally reduces the braking distance
- It prevents vehicle combinations from jackknifing
- To reduces tyre wear and stopping distance.
- To ensure stable braking characteristics on all road surfaces.

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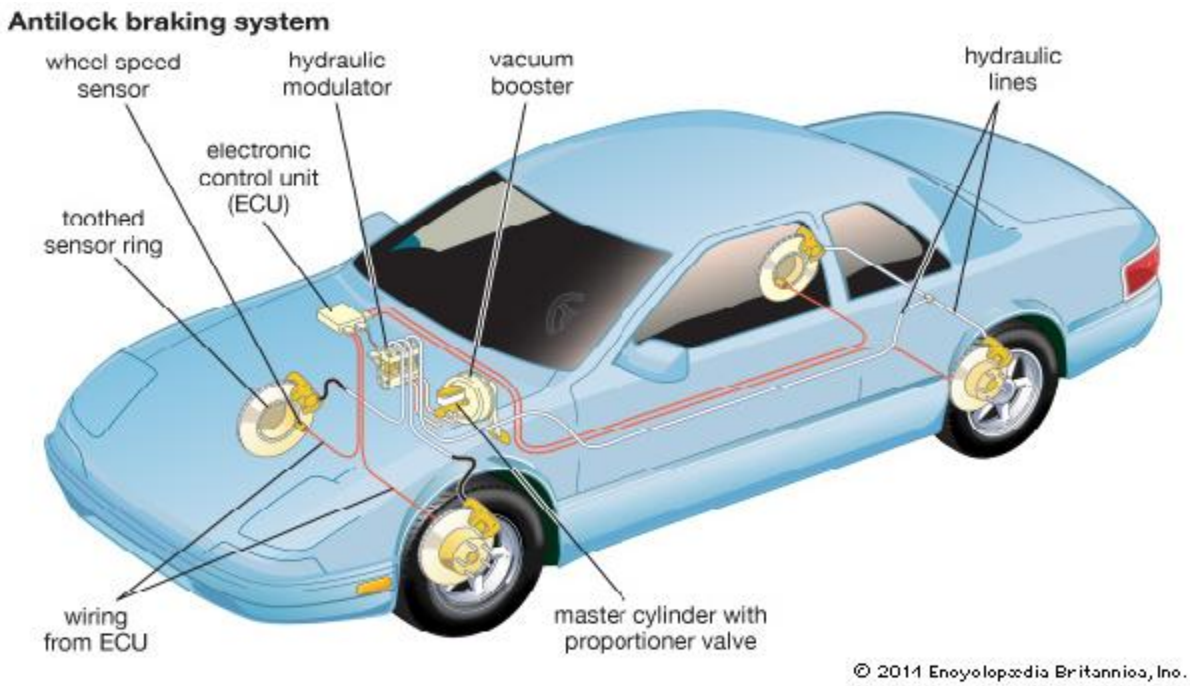

FIG. 1.1—Basic schematic diagram of Anti-Lock Braking System .[6]

2.ANTILOCK BRAKING SYSTEMS

Anti-lock braking system (ABS) is an automobile safety system that allows the wheels on amotor vehicle to maintain tractive contact with the road surface accordingTo driver inputs while braking, preventing the wheels fromLocking up and avoiding uncontrolled skidding.

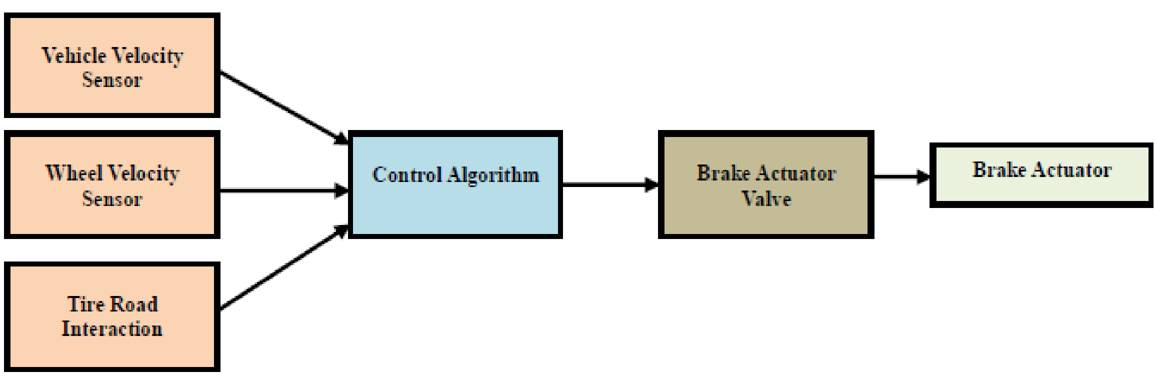

Fig. 2.1 Block representation of an ABS.

2.1 Stability

A locked up wheel generates are reduced braking force, smaller than the peak value of the available adhesion between entries and road A locked-up wheel will also lose its capability.

To sustaining lateral force This may resulting the loss of vehicle stability. Applying maximum braking force on both sides will result in a yaw moment that will tend to pull the vehicle to the high friction side and contribute to vehicle instability, and forces the operator to make excessive steering corrections to counteract the yaw moment

2.2 Steer-ability

Good peak frictional force control is necessary in order to achieve satisfactory lateral forces and, therefore, satisfactory steer-ability. Tire characteristics play an important role in the braking and steering response of a vehicle. For ABS-equipped vehicles the tire performance is of critical significance. All braking and steering forces must be generated within the small tire contact patch between the vehicle and the road.[4].

2.3Wheel-Speed Sensors

Electro-magnetic or Hall-effect pulse pickups with toothed wheels mounted directly on the rotating components of the drive train or wheel hubs. As the wheel turns the toothed wheel (pulse ring) generates an AC voltage at the wheel-speed sensor. The voltage frequency is directly proportional to the wheel's rotational speed.[1].

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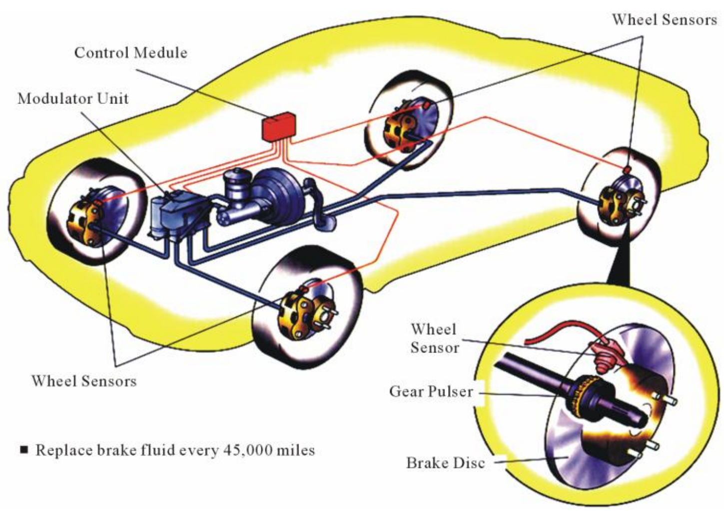

Figure 2.2 Typical ABS components [5].

3. ABS CONTROL SYSTEM

A ABS control system is a closed loop control system in which a sensor monitors the output (slip ratio) and feeds data to the controller which adjusts the control (brake pressure modulator) as necessary to maintain the desired system output (match the wheel slip ratio to the reference value of slip ratio).[7]ABS brake controllers pose unique challenges to the de-signer: a) For optimal performance, the controller must operate at an unstable equilibrium point, b) Depending on road conditions, the maximum braking torque may vary over a wide range, c) The tire slippage measurement signal, crucial for controller performance, is both highly uncertain and noisy, d) On rough roads, the tire slip ratio varies widely and rapidly due to tire bouncing, e) brake pad coefficient of friction changes, and f) The braking system contains transportation delays which limit the control system bandwidth [8].

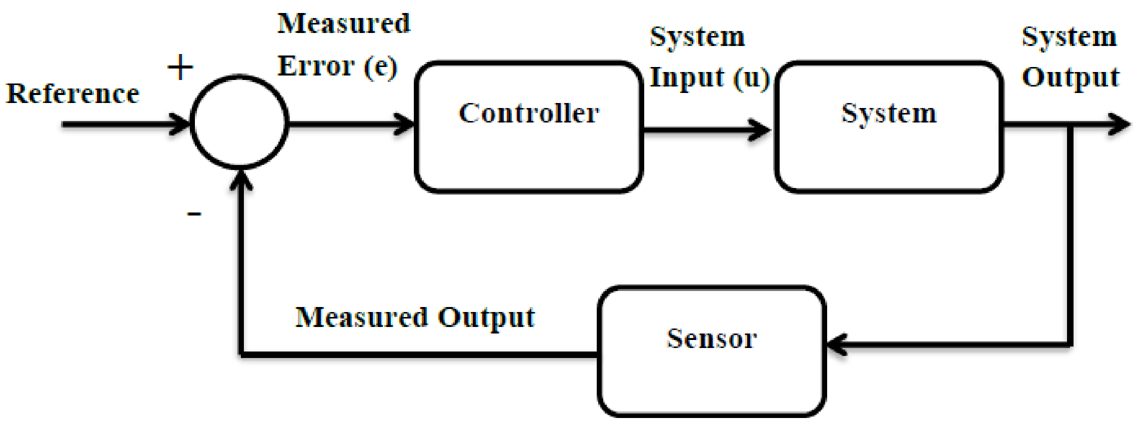

Fig 2.3 Block Diagram of ABS Control System [1].

3.1Nonlinear Control Based on Back stepping Control Design

The complex nature of ABS requiring feedback control to obtain a desired system behavior also gives rise to dynamical systems. Wang, *et al.* [9] compared the design process of back stepping approach ABS via multiple model adaptive control (MMAC) controllers. The high adhesion fixed model, medium adhesion fixed model, low adhesion fixed model and adaptive model were four models used in MMAC. Approaches. It is concluded that the use of grey system theory, which has certain prediction capabilities, can be a viable alternative approach when the conventional con-troll methods cannot meet the desired performance specifications.

3.2 Robust Control Based on Sliding Mode Control Method

Sliding mode control is an important robust control approach. For the class of systems to which it applies, slid-in mode controller design provides a systematic approach to the problem of maintaining stability and con-sestet performance in the face of modeling imprecision[10].On the other hand, by allowing the tradeoffs between modeling and performance to be quantified in a simple fashion, it can illuminate the whole design process

3.3 Hydraulic control modulator

It receives operating signals from the ECU to apply or release the brakes under ABS conditions It executes the commands using three solenoid valves connected in series with the Mastery lender and the brake circuit some valve for each front wheel hydraulic circuit.

3.4 Adaptive Control Based on Gain Scheduling Control Method

Ting and Lin [11] presented an approach to incorporate the wheel slip constraint as a priori into control design so that the skidding can be avoided. A control structure of wheel torque and wheel steering is proposed to transform the original problem to that of state regulation with input constraint. For the transformed problem, a low-and-high gain technique is applied to construct the constrained controller and to enhance the utilization of the wheel slip under constraint. Simulation shows that the proposed control scheme, during tracking on a snow road, is capable of limiting the wheel slip, and has a satisfactory co-ordination between wheel torque and wheel steering.

3.5 Intelligent Control Based on Fuzzy Logic

FC has been proposed to tackle the problem of ABS for the unknown environmental parameters [12]. How-ever, the large amount of the fuzzy rules makes the analysis complex. Stan, *et al.* [13] performed a critical analysis of five fuzzy control solutions dedicated to ABS systems. The detailed mathematical model of controlled plant is de-rived and simplified for control design with focus on tire slip control. A new fuzzy control solution based on a class of Takagi-Surgeon fuzzy controllers is proposed. This class of fuzzy controllers combines separately de-signed PI and PID controllers corresponding to a set of simplified models of controlled plant linearized in the vicinity of important operating points. Simulation results validate the suggested fuzzy control solution in control-ling the relative slip of a single wheel.

4. CONCLUSIONS

In this review paper we briefly describe thatABS control is highly nonlinear control problem due to the complicated relationship between its components and parameters. Many different control methods for ABS have been developed and research on improved control methods is continuing. It is inferred that ABS improves the braking performance.The stopping distance after using ABS system has considerably reduced. As far as automotive industry is concerned ABS technology is most recent development in enhancing passenger safety and accident avoidance.

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