**An Antilock-Braking Systems(ABS) Control**

Ayman Aly , El-Shafei Zeidan, Ahmed Hamed, Farhan Salem. "Intelligent Control and Automation." An Antilock-Braking Systems(ABS) Control, vol 2, pp. 186-195, 2011.

The issue is basically about the braking system that was adopted in the vehicles at early age and the problems that constituted with that kind of braking system and the measures taken to overcome those problems by implementing new braking systems thereby reducing the problem faced. Here we get to know about a kind of braking system called "Antilock-Brake System". Previously vehicles were installed with basic braking system which would lock the wheels of the vehicle which led to locking of wheels thereby causing the vehicle to slip on the ground and the car would spin out of control. Antilock-Brake System helped to stabilize the vehicle by applying the brakes such that the wheel would not stop rotating and thereby producing maximum friction between the tires and ground. This is important as this reduced the accidents, added more safety featured and increased the stability of the vehicle which produced high performance.

The basic principle of this braking system is to reduce the stopping distance, increases the stability of vehicle, reduces the wheel slip and applies braking based on the type of road. The main problem that was solved b the Antilock-Brake system is that it deleted the wheel locking which was very dangerous. It applied braking to all the wheels equally there by giving the vehicle stability, direction control, reduced wheel slip on the ground. These are gained by the kind of sensors implemented in the braking system. Hydraulics, sensors and control electronics work together. Based on the wheel angular velocity(w), wheel rolling radius(R) and vehicle forward velocity(V) the wheel slip will be regulated. Wheel slip (s)= (V-wR)/V. The vehicle velocity sensor, Wheel velocity sensor, Tire road interaction work together and send the values to the control algorithm which will tell how much brake has to be applied. This is sent to brae actuator valve and then to Brake Actuator.

There are various Control Method which were used to improve the performance of ABS.

1) classical control

2)optimal control

3)non linear control

4) robust control

5)adaptive control

6)intelligent control

Classical control:

The braking and steering performance of vehicle is evaluated and acted accordingly at various driving conditions even at J-turns. But the limitation is that it does not pose enough robustness. By using NPID stopping distance and better velocity performance was achieved than the conventional PID.

Optimal Control:

In this no friction estimator is required. This design is performed via Lyapunov methods in which the change in road conditions will be analyzed by controller parameter. To avoid thus adaptive control approach is used.

Nonlinear Control:

Here individual controller is designed to each subsystem like suspension and wheel and algorithm is written. As a result the integration of anti-lock braking and active suspension system improves the performance of the system. This controlled wheel slip ratio accurately, higher robustness and improves ABS performance.

Robust Control Based on Sliding Mode Control Method:

It maintains stability and consistent performance. Kayacan proposed Grey sliding mode controller which regulated the wheel slip based on wheel forward velocity. This anticipates the upcoming values of wheel slip and takes necessary action to avoid the slip.

Adaptive control based on Gain Scheduling Control Method:

Here Ting and Lin gave importance to wheel slip constraints than to control design. In this the wheel slip was limited due to coordination between wheel torque and wheel steering.

Intelligent control based on Fuzzy Logic:

The controller identifies the current road condition and generates a command braking pressure signal, based on current and past readings of the slip ratio and brake pressure. The controller detects wheel blockage immediately and avoids excessive slipping. The ABS system performance is examined on a quarter vehicle model with nonlinear elastic suspension. The parallelism of the fuzzy logic evaluation process ensures rapid computation of the controller output signal, requiring less time and fewer computation steps than controllers with adaptive identification. The robustness of the braking system is investigated on rough roads and in the presence of large measurement noise. This paper describes design criteria, and the decision and rule structure of the control system. The simulation results present the system's performance on various road types and under rapidly changing road conditions.