ISSN: 2278-0181
ETEDM - 2019 Conference Proceedings

Electronic Stability Traction Control System in Vehicle

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***Abstract*:- The benefits of Vehicle Electronic Stability Control (ESC) are well understood with regard to assisting drivers to maintain vehicle control during extreme handling maneuvers or when extreme road conditions are encountered. The goal of this project is to study and develop an Electronic Stability Control (ESC) system model by utilizing the functionality to validate the developed ESC model. A certain vehicle dynamics model was developed with two way braking system. One is normal mode in which it acts as a normal brake when driver applies it. Another one is smart mode this gets work when vehicle is get slipped in mud, snow, etc.**

In smart mode the principle of working is hybrid method where the acceleration and brake work simultaneously to lift the vehicle from trash road condition.

1. INTRODUCTION

Vehicle traction control can greatly improve the performance of vehicle motion and stability by providing anti-skid braking and anti-spin acceleration. Vehicle traction control is especially important for automated highway systems as related to longitudinal and lateral control.
In the prediction stage, the control logic of such a system uses information from the wheel angular velocity and/or acceleration to estimate the wheel slip. Wheel slip is a nonlinear function of wheel angular velocity and vehicle velocity and is described in more detail. The control command is based on the estimated slip and wheel acceleration. The wheel slip/acceleration phase plane is divided into different sectors. Each sector has a corresponding control action (e.g. APPLY, HOLD, RELEASE).

Another method to estimate the vehicle velocity would be to use an accelerometer. Accelerometers measure acceleration which can be integrated to calculate velocity. To avoid accumulation of integration error, the initial velocity should be updated (from wheel angular velocity) every few seconds before acceleration or braking starts. At the initiation of acceleration or braking, the last initial condition should be used for the integration process. Additional hardware may also be required to reduce the accumulation of the error due to the slope of the road.

The throttle and the brakes ultimately control the longitudinal tractive force. Controlling the longitudinal traction can achieve various control objectives while assuring ride quality and passenger comfort. A few of these are:

(1) Maintain the fastest stable acceleration and deceleration.

(2) Obtain anti-skid braking and anti-spin acceleration.

(3) Maintain steer-ability during lateral maneuvers.

(4) Make vehicles move longitudinally in a platoon following the vehicles in front in an automated highway system.

(5) Make a platoon of vehicles follow a desired lateral and longitudinal path simultaneously in an automated highway system.

2. PROBLEM FORMULATION

Current research on safety algorithms for electric vehicles has not addressed the issues of modeling digitally-controlled electric drives. Specifically the issues of analytical modeling of timing of digital control events are absent in existing studies. To reliably evaluate electric anti-lock braking and stability systems by simulation it is necessary to use a model that corresponds to the control dynamics of the considered electric drive.

Torque control dynamics are influenced by motor parameters, but also by drive control algorithm and its digital implementation. Digital control events may be precisely modeled by hybrid continuous- discrete systems; however, the drive model used for validating vehicle traction control systems should be unified and given analytically to allow more comprehensive analysis and easy implementation.

This work proposes a simple solution for traction control using two way brakes one is normal and another is smart while in slippery condition.

3. METHODOLOGY

To design a good control method, a representative mathematical model of the system is needed. In this section, a mathematical model for vehicle traction control is described for analysis of the system, design of control laws and prototype. Although, the model considered here is relatively simple, it retains the essential dynamic elements of the system. Understanding of stability is essential for design of a good control system. The stability of the system, described in this section, is analyzed by linearizing the system around the equilibrium point.

3.1 *System Dynamics*

A vehicle model, which is appropriate for both normal mode and smart mode, is described in this sub-section. The model identifies wheel speed and vehicle speed as state variables and wheel torque as the input variable. The two state variables in this model are associated with one-wheel rotational dynamics and linear vehicle dynamics. The wheel dynamics and vehicle dynamics are derived by applying Newton's law.

3.1.1 *Wheel Dynamics*

The dynamic equation for the angular motion of the wheel is

$$\dot{\omega}_w = [T_e - T_b - R_w F_t - R_w F_w]/J_w \qquad (1)$$

where J_w, is the moment of inertia of the wheel, o, is the angular velocity of the wheel, the over dot indicates differentiation with respect to time, brake torque and the torque components due to the tire tractive force and the wheel viscous friction.

R_w	Radius of the wheel
N_v	Normal reaction force from the ground
T_e	Shaft torque from the engine
T_b	Brake torque
F_t	Tractive force
F_w	Wheel viscous friction

Table 1 Wheel Parameters

The tractive force developed on the tire-road contact surface is dependent on the wheel slip, the difference between the vehicle speed and the wheel speed, normal by the vehicle speed for braking and the wheel speed for acceleration. The engine torque and the effective moment of inertia of the driving wheel depend on the transmission gear shifts.

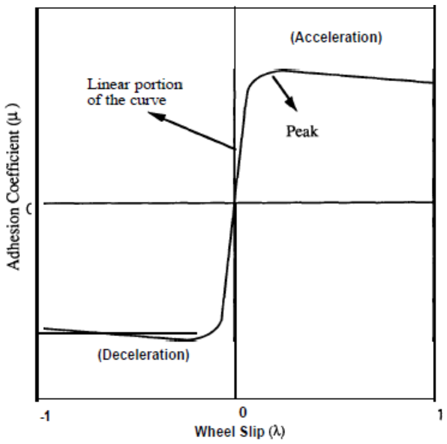


Figure 1 A typical μ–λ Curve

Mathematically, wheel slip is defined as

$$\lambda = (\omega_w - \omega_v)/\omega, \ \omega \neq 0 \qquad (2)$$

where, is vehicle angular velocity defined as

$$\omega_v = \frac{V}{R_w} \qquad (3)$$

Which is equal to the linear vehicle velocity, V, divided by the radius of the wheel. The variable o is defined as

$$\omega = \max(\omega_w, \omega_v) = \begin{cases} \omega_w \text{ for } \omega_w \geq \omega_v \\ \omega_v \text{ for } \omega_w < \omega_v \end{cases} \qquad (4)$$

which is the maximum of vehicle angular velocity and wheel angular velocity.

For various road conditions, the curves have different peak values and slopes, as shown in Figure 2. The adhesion coefficient-slip characteristics are influenced by operational parameters like speed and vertical load. The average peak values for various road surface conditions are shown in Table 2.

Surface	Average Peak Value
Asphalt and concrete (dry)	0.8-0.9
Asphalt (wet)	0.5-0.6
Concrete (wet)	0.8
Earth road (dry)	0.68
Earth road (wet)	0.55
Gravel	0.6
Ice	0.1
Snow (hard packed)	0.2

Table 2 Average Peak Values for Adhesion Coefficient

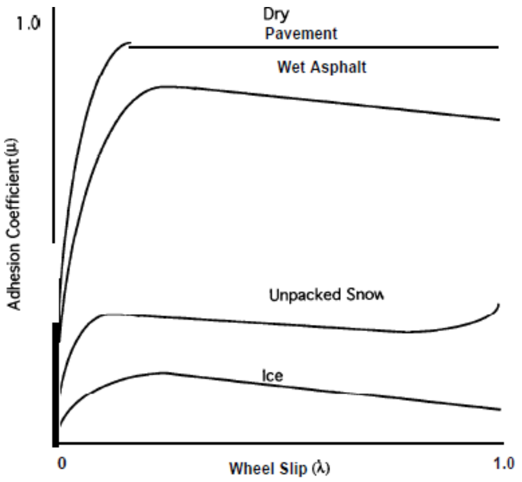


Figure 2 μ–λ Curves for Different Road Conditions

The model for wheel dynamics is shown in Figure 3. The parameters in this figure are defined in Table 1. The figure shows the acceleration case for which the tractive force and wheel viscous friction force are directed toward the motion. The wheel is rotating in the clockwise motion and slipping against the ground, i.e. $\omega_W > \omega_V$ The slipping produces the n- active force towards right causing the vehicle to accelerate towards right. In the case of deceleration, the wheel still rotates in the clockwise motion but skids against the ground, i.e. $\omega_W < \omega_V$. The skidding produces the tractive force towards left causing the vehicle to decelerate.

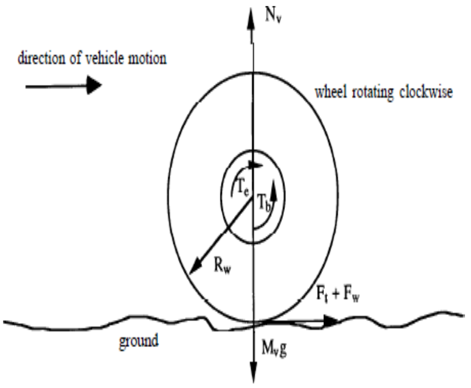
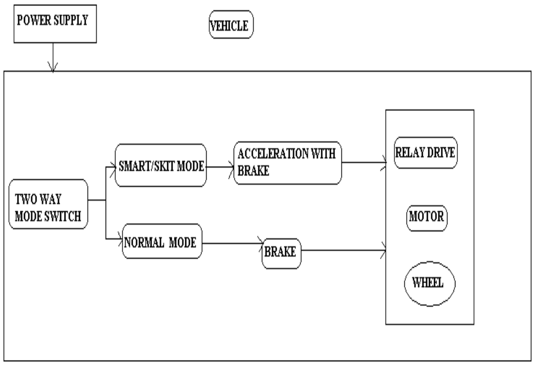


Figure 3 Wheel Dynamics

4. BLOCK DIAGRAM



The main power supply will be given to the step down transformer. The 230 volt AC supply will be Step down to 12v by using step down transformer this 12V AC supply will be converted in DC by using bridge rectifier and it will be regulate up to 12V by using 7812 regulator for working of SYSTEM. Capacitor filters are used to remove any ripples present in the DC voltage.

The slide switch is used to choose the mode of operation as normal or smart. In case of normal if we apply brake the acceleration gets stop and drum brake attached in wheel stops the vehicle. In case of smart mode the when we apply smart brake the vehicles acceleration and brake runs simultaneously while skid in mud or snow to release the vehicle without any manual support. The relay acts to switch the mode operation as per condition

5. IC VOLTAGE REGULATORS

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts

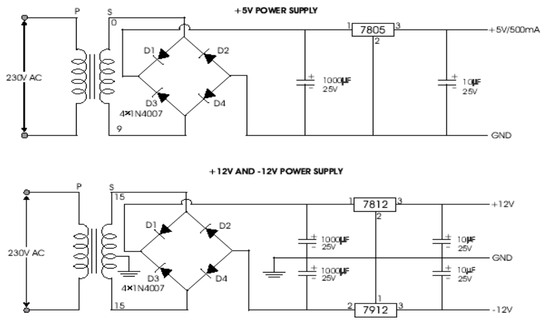


FIG: Circuit diagram (Power supply)

6. RELAY DRIVER CIRCUIT

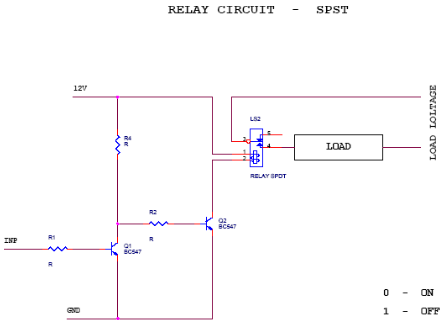


FIG: Relay driver circuit

7. APPLICATON

It is used in road cars to make a safety drive in icy or slippery conditions
Aggressive gripping in wheels

Prevent over steering and under steering Traction control starts automatically when the engine is ignited
Driver safety is maintained

8. CONCLUSIONS

It was shown that traction control is important for safety and highway automation of vehicles. A robust control strategy was designed for slip control, which in turn controls the traction. It was shown how traction control can be used to satisfy different objectives of vehicle control. The importance of traction control was further emphasized by comparing its performance to passive control in a PROTOTYPE MODEL in which an impulse like STUCK IN MUD OR SNOW. This study showed that the system under traction control is stable in the presence of external disturbances, whereas the system under passive control may become unstable in the presence of external disturbances. Traction control can be used to enhance the performance of a single independent vehicle with a complete set of sensors and controller integrated in a single system, or a platoon of vehicles, where the sensors and the controllers are distributed within the vehicles and the roadway, It can be used to accelerate or decelerate a single vehicle in the minimum time, or it can be used to enhance the maneuvering ability of a vehicle, especially during severe steering actions. Traction control also improves the performance of platoon of vehicles in terms of stability and achieving a tighter control. Traction control makes the system robust to external disturbances and provides a better control especially during significant lateral maneuvers.

9. FUTURE ENHANCEMENT:

Further study of traction control is in progress including evaluation of traction control as a part of integrated longitudinal and lateral control strategy.

10. REFERENCES:

[1] J. A. Cabrera. J. J. Castillo. E. Carabias. and A. Ortiz. Evolutionary Optimization of a Motorcycle Traction Control System Based on Fuzzy Logic, IEEE Transactions on Fuzzy Systems, vol. 23, no. 5, pp. 1594-1607, Oct. 2015.

[2] H. Ha, J. Kim, and J. Lee, Cornering stability enhancement algorithm for in-wheel electric vehicle, in Proc. 2014 IEEE International Conference on Industrial Technology (ICIT), 2014, pp. 806-809.

[3] V. Ivanov, D. Savitski, and B. Shyrokau, A Survey of Traction Control and Anti-lock Braking Systems of Full Electric Vehicles with Individually- Controlled Electric Motors, IEEE Transactions on Vehicular Technology, vol. 64, issue: 9, pp. 3878- 3896,2015.