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Vector control of a parking brake for cars

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BRAKING SYSTEMS – Brake Actuators and
System Controls, Mechanical Brake System, Modelling and controlling an innovative brake, Microcontroller
implementation, PMSM

ABSTRACT

Research and /or Engineering Questions/Objective: *(max. 100 words)*

The DC motor limitations in electrical parking brake have brought the idea of electrical parking brake systems using (Permanent Magnet Synchronous Motor) PMSM for cars and light commercial vehicles. The brake will be clamped using a PMSM driven by a converter and a microcontroller. The main issue is the modelling of this system whose mechanical and electrical parameters are time varying. (57 words)

Methodology: *(max. 150 words)*

The first step is the modelling and the control of the PMSM with non-sinusoidal electromotive force. The vector control is used to obtain required torque control. This control requires an accurate knowledge of the motor’s parameters and accurate rotor position. The parameters are obtained by a reliable characterization. The control algorithms were designed and tested with three Hall-Effect position sensors and current sensors. A position observer is introduced to improve position low resolution. Robust algorithms able to drive the brake even with degraded measurement are developed. The calculation time had to be optimized. The second step concerns the complete electromechanical system. It has to be characterized and the brake control algorithms have to be developed and tested using similar methods as for the PMSM. (125 words)

Results: *(max. 150 words)*

An initial test bench was realized to characterize and control the PMSM with constant load. Different strategies were compared for the characterization and the control of the PMSM. Six step position control on one side, position and torque vector control on the other side were tested. The six step motor control doesn’t require accurate position sensors but it doesn’t allow smooth torque control. The vector control needs more accurate position sensors and allows correct torque, speed or position control. Those two brake control algorithms will be used for brake system integrated in the development car using CAN network. (100 words)

Limitations of this study: *(max. 100 words)*

They concern mechanical brake parameters whose variations are hard to estimate. Indeed the modelling of frictions in the mechanical transmission on one side and the modelling of brake pad’s stiffness on the other side are difficult. The non-sinusoidal electromotive force of the motor is also a difficulty for modelling and controlling the motor since the vector control is suitable for sinusoidal electromotive force motor. (65 words)

What does the paper offer that is new in the field in comparison to other works of the author: *(max. 100 words)*

This previous work concerned the control of an electrical parking brake using DC motor. The novelty in the presented work is the use of a permanent magnet synchronous motor for a brake. This motor has to be modelled and controlled. The algorithms must be integrated in the brake system using CAN network. (52 words)

Conclusion: *(max. 100 words)*

The beginning of this study allowed the design and the implementation of an advanced control algorithm. The aim is to integrate these algorithms in the embedded software environment of the car. The prototype of the brake has to be integrated in a first development car. The next steps concern the brake modelling and the clamping force estimation. New control laws, based on these modeling and estimation have to be designed. The further objective is to integrate time or temperature varying parameters into the control algorithm. (86 words)