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Control of a Brushless DC Motor for the Actuation of a Four-wheel Drive Transfer Case

Master's Thesis

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Abstract

In a standard four-wheel drive vehicle, a so-called transfer case is used in order to enable the driver to send the engine torque to the rear wheels of the vehicle, or to all four wheels. This transfer case is usually actuated by a motor. Controlling the position of the motor ensures the car to be driven at the required driving modes. In current mass production applications, brush-type DC motors are used for this purpose. The present work investigates the possibility of using a brushless DC motor instead of a brush-type DC motor. The control of DC motor is done digitally with the use of a microcontroller along with other associated power electronics. This thesis works with the modified power electronics needed for the brushless motor and uses the existing software structure of a production program of Siemens VDO. Control of a brushless motor is more complex than that of a DC motor. Brushless motor involves two different tasks simultaneously – keeping the motor rotating and controlling the physical parameters like position, speed etc. In order to keep a brushless motor rotating, the stator field is energized in a sequence that the rotor field tries to catch up with the stator field. This commutation sequence is implemented with the use of a complex programmable logic device (CPLD). The CPLD needs to know the rotor position in order to create such commutation sequence. Hall sensors are used to give the CPLD this information. The advantage of the use of a CPLD is twofold – it reduces the complexity of the software and it is much faster than the software and hence less error prone to such time critical application. The microcontroller deals with, among a lot of other things, controlling the motor (speed, position, current). A PID algorithm is used for the control purpose.