Hardware-in-the-Loop Testing of Control Algorithms for Brushless DC Motor

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Abstract. The aim of this article is to inform readers about new trends in the development of control algorithms. One of the trends currently gaining popularity is a Model Based Design (MBD) approach. MBD consists of a sequence of several steps, is the sequence being defined by the V-cycle [1] [2]. This new development method plays a role not only in science and research, but also increasingly often in the commercial development of industry applications.

The following article deals with the hardware-in-the-loop (HIL) development phase, where the control algorithms for brushless DC (BLDC) motors are tested and tuned on the dSPACE simulator.

1 Introduction

The development of the V-cycle is shown in Fig. 1. This new development life cycle enables verification, validation and testing during each phase of development. Detection and correction of errors is possible at the beginning of the development cycle. This is much cheaper and more effective than redesign of a device as usually happens during traditional development procedures during the prototyping phase. The other advantages that model based design allows are: reduction of development time and cost, easier certification, faster and easier testing, support with accompanying documents, reduction of failures, etc.

A further important aspect is higher safety during testing. It is not necessary to test the control algorithms on the real system, which is often dangerous. First, the new code is tested on the HIL simulator and then, if no hazardous state occurs, it can be applied in the target system.

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2 Model Based Design – MBD

The first step of the MBD, the principles of which are shown in Fig. 2, involves the device specification and the requirements of each part. Development continues with analysis of the incoming parameters and specification of the future hardware and software. It is important to choose a suitable software environment for model based design.

Complex software environment, which allows MBD technology, is i.e. MATLAB & Simulink. Simulink enables composition of the real system according to its mathematical and physical description. For such a model of the controlled system it is possible to design and realize any control algorithm and simulate it.

Fig. 1. Diagram of the V-cycle

Fig. 2. Diagram of the Model Based Design principles