A Model-Based Design approach for embedded system development on STM32 microcontrollers

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OBJECTIVES
A new software tool that supports Model Based Design (MBD) is presented. It is suitable for running Simulink® application models for STM32 MCUs. The first Simulink® blockset library for STM32 peripherals allows us to implement Processor In the Loop (PIL) configuration and automatic code generation. The second Simulink® blockset includes extensive Math and Motor control functions based on the STM32 Motor control library.

MODEL-BASED DESIGN WORKFLOW
MBD modifies traditional methods adopted in model development processes and introduces a better way to implement the following workflow:

- Executeable Specifications
- Design with Simulation
- Continuous Test and Verification
- Executable Specifications
- Automatic Code Generation

DEVELOPMENT PROCESS
MBD employs the V-model development process illustrated below in its various phases. The V-model allows:

- Generate off-line code
- Convert to on-line code for testing hardware
- Generate executable model for test simulation and testing
- Convert to prototype model for specified hardware

SYSTEM MODEL PARTITIONING
The key for building a successful MBD platform is partitioning the system model and the generated software code.

MBD TOOLS FOR STM32 MCUS AND FOC MOTOR CONTROL

An MBD system can be conceptually divided into two main models: one is for simulation, based on algorithm/math blocks and functional simulation peripherals; the second is based on the same algorithm blocks plus the target-oriented peripheral driver blocks to generate auto-code.

MBD FITS STM32 ECOSYSTEM FOR FOC CONTROL OF PMSM MOTORS

The STM32 Motor Control Workbench PC software tool reduces the design time and effort needed for STM32 PMSM FOC firmware configuration. The project file is generated through the GUI and then used to configure the whole Motor Drive system model.

STIM32 MC motor control firmware (X-CUBE-MCSDK) also includes the Permanent-magnet synchronous motor (PMSM) firmware library (FOC control) widely used in high-performance drives.

The Simulink® library provided by ST is based on C legacy code firmware to optimize runtime execution and memory footprint.

CONCLUSION
One single model for both simulation and auto-code generation is the novel approach in this work. Both Algorithms and Peripherals blocks generate an efficient C-code based on STM32 MC library and STM32 HAL libraries, respectively.

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