Developing servo drive and simulation software using Simulink code generation
Introduction

Adoption of automatic code generation at ANCA Motion

Engineering education initiative:
- Servo drive and motor simulator with a web based interface
- Synchronous motor Hardware in the Loop (HIL)
ANCA Motion designs and manufacture flexible control systems, specialising in high precision solutions for CNC machines.
Introduction – Typical CNC Machine
Introduction—Servo Drive

Servo drives enable position, velocity and torque control of permanent magnet synchronous motors.

Various current ratings

Usually multiple drives are used in an individual CNC machine.

AMD5x Servo Drives

AMD2000 Servo Drives
Evolving requirements – Servo Drive

Faster and more accurate motor control

Increasing variety of applications each with different needs

How to keep up with increased demands and have robust code?

How to handle the increasing number of test scenarios?
Before code generation

Translation step is an extra source of error
Using Code Generation

- Encourages development of more accurate models
- More testing in simulation
- Shorten test-develop-debug cycle
- Automates translation step

Flowchart:

1. Develop plant model
2. Develop Controller
3. Automatic translation to C
4. Test
   - Pass
   - Fail
5. Prototype
   - Pass
   - Fail
6. Deploy

Is the model accurate enough?

Y: Continue
N: Repeat steps 3 to 6
Software in the Loop (SIL)

Detailed plant model and code generation have allowed us to create an automated Software in the Loop (SIL) test system.

Integrated with our Continuous Integration (CI) server and run nightly.
ANCA Motion - Code generation advantages

Automates translation step, reducing development time and a potential source of errors

Easier to achieve code consistency between developers

SIL testing has reduced the need for physical hardware.

With SIL, errors can be detected earlier in the development cycle
Create a servo drive and synchronous motor simulator with a web interface.
Web based servo sim – Simulink & ASP

![Diagram showing the components of a web-based servo simulation using Simulink and ASP.NET MVC. The diagram includes blocks for Simulink Coder, Plant Model, DLL, Controller, View, and Model. The flow of data is indicated by arrows.]
Web based servo sim
Create a synchronous motor simulator that can replace physical motors when testing servo drive hardware.

The simulator will run on a Texas Instruments (TI) C2000 based microcontroller.
Motor HIL System overview

- **PWM**
- **Position**
- **Current**

**C2000**

- **Switch Model**
  - Voltage
  - **Motor Model**

- **Encoder Model**
  - Position

- ** DAC**
  - Current

- **Rotor Dynamics**

- **Winding Dynamics**
The custom motor simulator was written entirely in Simulink.

Embedded coder was used to generate C code from Simulink and call the TI toolchain to compile and deploy onto the target.

TI target support package used to configure and control hardware.
Motor HIL System - Results

Encoder signals CW and CCW rotation 5 rad/s

Duty cycle measurement

Source: Li, D., Li, W., Wei, Y., Zhang, L. (2016). Servo Drive Hardware in the Loop Test System
Conclusion

Automatic code generation automates translation step removing potential source of errors.

SIL allows errors to be captured earlier.

Enables greater focus on algorithms as opposed to implementation concerns.