Simulation in Real Time

Abstract:

The development of a new car includes years of testing witch is very expensive. Therefore simulation has become a way to study different concepts in the beginning of the development process to make it less time consuming. The last years of improvements on simulation software and models makes it possible to work with simulation in all phases of the development process to gain even more time.

In today's cars there are many ECUs to control different subsystems such as: engine control, climat control, brake control, autogearbox control, etc. The development of software and hardware for these ECUs includes three ways of working with simulation:

- Off-line simulations.
- Rapid Control Prototyping.
- Hardware in the Loop Simulation.

Briefly the way of working is like this: After you have decided what autogearbox (for example) to use in a new car you start to think about the controller system for it. This is best done in off-line simulations where you have a model of the autogearbox as well as of the control system. When you have a control strategy that seams to work in the simulation environment, you generate C-code from the control model and download it on a real time computer that is installed in the car to act like a real ECU. Then you can drive some tests in reality with your control strategy to see how it acts. This is called Rapid Control Prototyping. When you have reached the state when your system configuration is ready, i.e. you have decided what microprocessor, sensors, actuators and control software to use, you can make simulations with this hardware connected to a simulation model of the car. This is called Hardware in the Loop Simulation. I will talk about these simulation techniques and a couple mathematical problems that occured in a Hardware in the Loop Simulation project that I work with.

Per Olsson, Volvo Technology Development