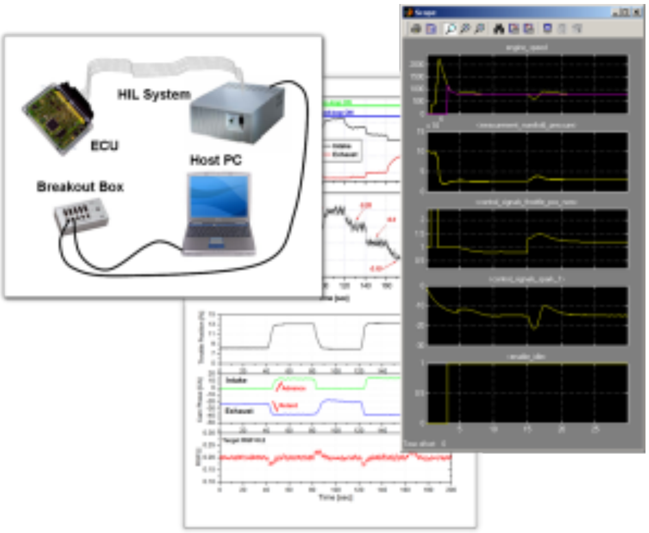
Enginuity Application Examples

Fully exploit virtual controller design using Enginuity and the Mathworks platform. Enginuity is a powerful engine plant model tool package that supports most varieties of production engine applications. Our customers value Enginuity models as a cost effective solution for many of their engine control development tasks. Enginuity helps them to significantly shorten the engine control development cycle and to alleviate the need for expensive experimental test infrastructure. See below for numerous examples of Enginuity applications.

Rapid Control Strategy Prototyping



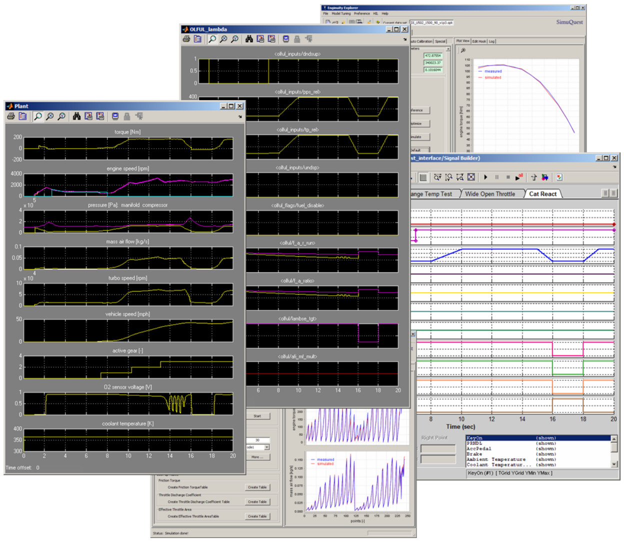
This automotive OEM outsources the entire engine control system (ECU hardware and software) for all its engine programs but simultaneously has a need to implement custom controls for selected or new engine features (such as variable cam-phasing, variable valve lift, etc.).

The deployment of such custom control features within the production hardware and software framework is cumbersome, involves costly intermediate system upgrades or requires the purchase of expensive licensing rights.

In order to expedite the in-house evaluation and development of custom control strategies the company uses Enginuity along with a model-based framework for rapid controller prototyping and HIL testing.

In addition to serving as an efficient way to prototype and evaluate new control features this practice allows this company to commit more resources to the development of in-house IP

Production Control Strategy Development and Validation



This automotive OEM develops the engine controls in-house as an intrinsic part of each engine development program.

In an effort to assess and leverage the benefits of a model-based development practice this OEM has decided to implement the entire production open-loop fuel control strategy in Matlab Simulink. For this purpose a base framework consisting of Enginuity and UniPhi along with a library of proprietary model-based control features is used.

Within this framework, the production code for open-loop fuel control is ported into StateFlow models and, within the UniPhi data management and controller architecture tool, combined with Enginuity's base engine control features to form a fully operational, stand-alone engine control strategy.

The framework is then leveraged for all further control development and calibration work. Along with a high-fidelity Enginuity engine model, the framework affords rapid and interactive feature development and testing.

After-market Control Strategy Development and Validation

This after-market supplier provides special purpose controller tuning kits for existing engine applications.

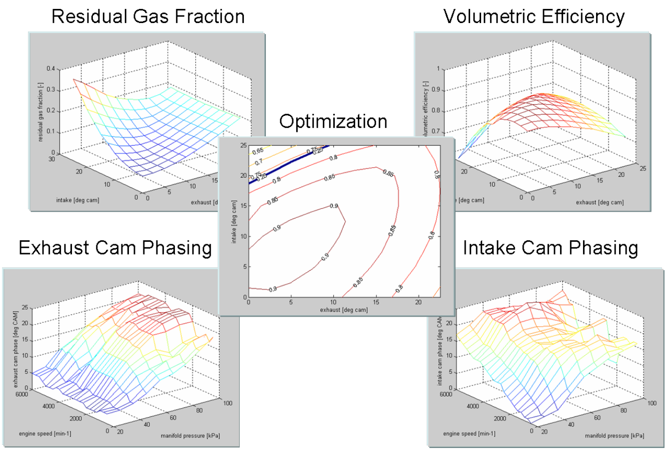
The company uses Enginuity as a model-based vehicle to develop and validate engine control strategies for various after-market targets (racing, car-enthusiasts, etc.). For this purpose, the entire control strategy is implemented in the form of a Simulink model using the base control strategy contained in Enginuity demo models as a controller model template.

Controller development and validation evolves interactively within the modeling environment. Embedded software for the target hardware is generated automatically using target specific driver blocksets and automated code generation tools.

Cam Phasing Control Calibration

This automotive OEM uses Enginuity to expedite the calibration of the cam-phasing tables for a 4-cylinder engine program.

Enginuity engine models are first tuned to match the performance characteristics of the target engine. The fully tuned models are then used to procure raw mapping data (volumetric efficiency, residual gas fraction, etc.) across the entire engine operating envelope (varying engine speed, manifold pressure, and intake and exhaust cam phaser positions in all possible permutations). The mapping data is then processed to create optimized cam-phaser look-up tables.



The entire data acquisition and optimization process takes less than half a day. The procured look-up tables reflect optimized calibration values which are close to the targeted production standard. They are validated and fine-tuned in a final empirical calibration step using an engine test cell.

The collection of engine mapping data within a virtual setting and the automated data processing leads to enormous time savings compared with a traditional, fully empirical process or a process involving CFD-based engine models.

Engine Test Cell Set-Point Controller Development and Validation

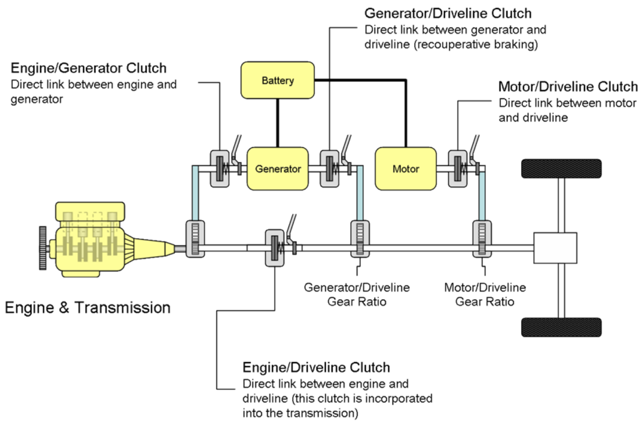
This automotive OEM uses Enginuity to develop and validate set-point controllers for engine test cells.

The set-point control software and hardware must typically be developed before the target engine becomes available.

Enginuity is used as a substitute for the target engine during the controller prototyping and development stage. The controls are developed in the form of models in Matlab Simulink and tested using an Enginuity simulation model. The software for the controller target is created using an automated code generation approach.

The complete control system is tested and validated using a HIL set-up with a real-time Enginuity model.

Hybrid Vehicle Control Development



This electronics OEM uses a hybrid vehicle control strategy and a model-based software development process to demonstrate the prowess and the capabilities of various of its micro-processor families for automotive control applications.

The hybrid control strategy is developed and tested using a model-based software development approach. The approach involves an Enginuity-based hybrid vehicle model, a set of models for the microprocessors, models for the controls residing on various individual ECUs (i.e., ECUs for engine, transmission, battery, and supervisory control), and driver block-sets for the target processors.

The individual requirements associated with each of the different control entities as well as the fact that each of the control entities must be coordinated in an appropriate manner all impose a set of intriguing challenges regarding the computational and communicational capabilities of the ECU hardware.

The application is meant to highlight the computational capabilities of the target processors as well as the benefits of model-based chip support tools.

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