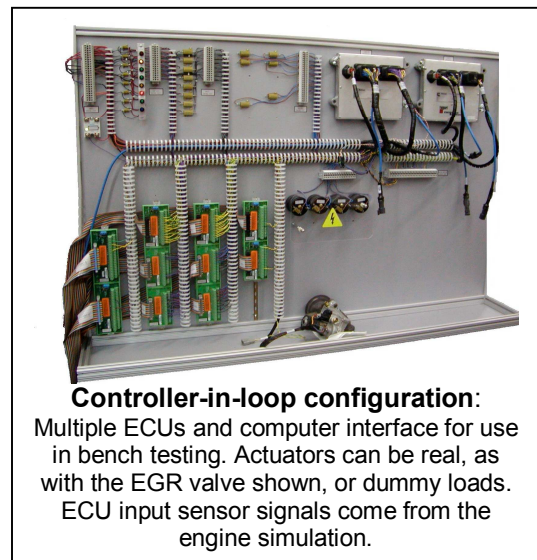


Model-Based Simulation Optimizes Product Testing Processes

With engines and electronic engine controllers becoming more complex by the year, Cummins Inc., a leading world-wide manufacturer of engines and related products, needed to develop new techniques to test and validate the control strategies over a wide range of real world operating scenarios. The outcome was CyberApps, or virtual applications, a simulation system for modeling various engine applications and executing them in pure simulation or hardware-in-the-loop simulation (HILS).

Cummins integrated the CyberApps hardware-in-the-loop simulation system with CyFlex™, a high performance and flexible test and measurement system from CyberMetrix, Inc. This gave Cummins the best of both worlds – an integrated test and simulation system that can be used over the complete product development lifecycle. Cummins has used this flexible combination to test engines and components in creative ways.

In the controller-in-loop configuration show here, the engine controller is tested against models of the engine and application, Cummins performs a wide range of feature and regression testing on the controller code, as well as controls tuning. By simulating various fault conditions, Cummins tests and validates the diagnostic features of the On-Board Diagnostics (OBD). A broad array of vehicles, routes, environments, and operator characteristics can be easily simulated. Cherian Olikara, Director of Engine Systems Analysis at Cummins and one of the developers of CyberApps, comments, “It is expensive in money and time to perform vehicle tests at, for example, 30 C and 3000 meter ambient conditions. With CyberApps, we can simulate an entire transit of the Death Valley and the Sierras at any ambient conditions.”



Controller-in-loop configuration:
Multiple ECUs and computer interface for use in bench testing. Actuators can be real, as with the EGR valve shown, or dummy loads. ECU input sensor signals come from the engine simulation.

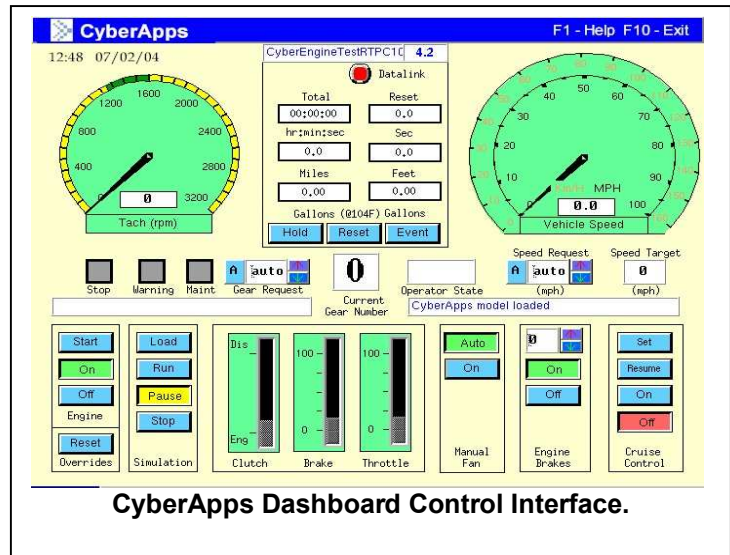
Engine-in-loop simulation is achieved using CyberApps in high-performance engine test cells. These simulations are used for fuel economy tests, engine controls development, and application specific studies. This avoids the time and cost associated with vehicle installations and allows a single setup to be automatically applied to several virtual vehicles in back-to-back tests. There is the added benefit of being able to use special instrumentation for high-performance monitoring that would be difficult to use in vehicles on the road. Cummins also uses engine-in-loop simulation technology for emission development of engines for light duty applications by simulating a vehicle on a chassis dynamometer.

CyberApps is used in the Cummins’ Machine Integration Lab to verify the correct communication between their engine controllers with other vehicle electronics such as transmission controllers, anti-lock braking systems, and electronic dashboards. Communication issues are found and solved early in the development process.

The power of the CyberApps capability in part derives from the use of standard commercially available technologies including Simulink®, a simulation development toolkit from The Mathworks, and CyFlex, a flexible test, measurement, and control system offered by CyberMetrix. Leveraging the integrated test and simulation capability allows Cummins the benefits of a feature-rich component and powertrain test system that supports a wide range of industry standards. The CyFlex system also offers many built-in features such as support for a range of data

acquisition and control IO equipment, flexible and capable test automation, high performance data logging, communications with electronic control units, support for auxiliary instruments and environmental control devices, as well as automation of post-test analysis using a variety of third-party analysis packages.

The CyberMetrix CyFlex platform leverages Concurrent Computer Corporation's RedHawk real-time Linux® operating system running on Concurrent's iHawk computing platform. The availability of the iHawk™ platform in ranging from one to eight CPUs allows CyFlex to respond to a wide range of needs, including extremely high-performance test and simulation requirements. CyberMetrix and Concurrent offer CyFlex-based integrated test and simulation solutions on a world-wide basis.



CyberApps Dashboard Control Interface.

According to Mr. Olikara, "The use of CyberApps and CyFlex for high-fidelity real-time simulation and test has allowed us to effectively address the ever-increasing complexity of engine and controller development. We have produced significantly more and higher-quality test-driven decisions at a lower cost than would be possible using vehicle-based testing in the field alone."

*For more information on CyFlex technology please contact:
CyberMetrix Inc., 4400 Ray Boll Blvd, Columbus, IN 47203,
www.cybermetrix.com, 1-800-713-1203 or 812-378-5903,
info@cybermetrix.com.*

For more information on Concurrent Computer Corporation's iHawk powered by RedHawk Linux please contact: Concurrent's Integrated Solutions Division, 2881 Gateway Drive, Pompano Beach, Florida 33069, www.ccur.com/isd, 1-800-666-4544 or 954-974-1700, isd.info@ccur.com.

7/29/04