Engine Simulation Software for ECU Development
Lowers CO\textsubscript{2} Emissions and Costs

Ford is developing a new fuel-efficient three-cylinder engine to combat tough new fuel-economy and emissions regulations. The high efficiency of this new engine type can be reached through the promising technique of downsizing combined with direct fuel injection and turbocharging. To fulfill the requirements of a narrow timeframe together with financial restrictions and sophisticated engine technology, Ford implemented the simulation model enDYNA Themos test ECU control functions during the ongoing development.

The Challenge
- Analyze and test ECU functions for the new engine on a HIL test bench to avoid expensive tests in the vehicle.
- Use highest model accuracy with thermodynamic processes for obtaining accurate values such as the pressure after turbocharger and exhaust temperatures as well as the common rail pressure to close the loop for the ECU controllers.
- Rely on Ford in-house resources for model adaptation and parameterization with available measurement data.

The Decision for TESIS
As TESIS is known as a provider of reliable and progressive real-time engine models with straightforward support, en-DYNA\textsuperscript{®} Themos\textsuperscript{®} was chosen as the right engine model for the HIL.

The Solution
- Ford adapted the ready to use thermodynamic model of a 4-cylinder engine to a 3-cylinder model without special engineering services.
- To solve specific questions concerning the model adjustment and parameterization, Ford got advice from the TESIS support team.
- By connecting the necessary signals from the prepared interface, the analysis of engine controller functions could immediately begin.

The Benefits
- **Rapid start with a high precision model**
  - Ready to use libraries and preconfigured models allow reducing the HIL preparation time.
  - Comprehensive tools to get the suitable model parameters out of available engine data.
  - Documentation for each part of the model as well as tutorials are included.
- **Acceleration of work process**
  - enDYNA Themos guarantees a stable and reliable test environment for application engineers.
  - Ready-to-use scripts and standard driving cycles for automated tests can be modified by the user.
- **Flexible and cost-efficient testing**
  - To test the ECU behavior in critical situations, each operating point of the engine can be adjusted in a test bench mode.
  - Testing of the ECU's failure detection ability is possible on the HIL.
  - The solution is easily extendible to support additional HIL simulators and further engine control unit development.

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