POWERTRAIN DEVELOPMENT, ANALYSIS AND TESTING

Optimizing real driving emissions, real world energy consumption and thermal management with CarMaker®, TruckMaker® and MotorcycleMaker®
Why Using CarMaker® for Powertrain Applications?

Realistic load duty cycles are the basis for the development, analysis and testing of powertrain systems. In many cases, speed and torque profiles from vehicle measurements or simplified longitudinal dynamics vehicle models are used in simulation and on test benches to evaluate the energy consumption, thermal behavior, durability and emissions of new powertrain concepts, components and systems. However, this approach offers very limited options to investigate system variations and calibration within a full vehicle under real driving conditions and has low flexibility concerning changes in vehicle configuration, driver behavior and operating strategy.

The CarMaker product family consisting of CarMaker, TruckMaker and MotorcycleMaker is a comprehensive and easy to use open integration and test platform with representative models of the vehicle, driver, road, traffic and environment. The provided model environment is used for closed-loop applications to generate realistic load duty cycles for powertrain system development and analysis in office simulation, HIL simulation and for testing on test benches. The closed-loop approach offers a high degree of flexibility, because realistic load duty cycles are not needed as an input for this type of maneuver-based closed-loop simulation and testing on test benches. Driving cycles defined by vehicle speed and real driving scenarios can easily be performed with virtual prototypes driven by a representative driver model. IPGDriver is capable to follow a predefined target speed as well as to choose the driving speed according to the course and the vehicle behavior. With the road data import functionality, open interfaces to third-party tools, its model integration capability and real time performance CarMaker offers an outstanding open integration and test platform for powertrain applications.

Virtual test driving with CarMaker allows for a seamless development, analysis and testing of powertrain systems taking into account all relevant interdependencies between the powertrain, chassis/suspension and brake system. Especially for the development and testing of hybrid electric vehicles, but also for all other current and future powertrain concepts, this approach is essential to evaluate real driving energy consumption, performance and emissions.
New Electric/Hybrid Powertrains in CarMaker – Model Architecture
Entire virtual vehicle – driving cycles – real driving scenarios

Main Application Areas
- Energy efficiency, emissions & performance investigation
- Powertrain concept and control analysis and testing
- Vehicle thermal management layout and optimization

Key Applications
- HEV/BEV and conventional powertrain concept studies
- Engine and transmission development and optimization
- X-in-the-Loop testing on engine, powertrain and roller dynamometer test benches
  - Real Driving Emissions (RDE) investigation
  - Real world energy consumption
  - Virtual electrification/hybridization
  - Durability testing
  - Powertrain/Engine ECU calibration and testing
  - Operating strategy and driver behavior investigations
  - Electronic horizon: predictive energy management using road property sensors or the ADASIS-v2-Standard

Features
- Closed-Loop approach taking into account vehicle, driver, road and environment
- Realtime simulation environment for setup of virtual vehicle prototypes with conventional, hybrid and full electric powertrains
- Easy to use full vehicle models including data set generator for all vehicle classes
- Comprehensive and tunable driver model with artificial intelligence (IPGDriver)
- Representative road, traffic and environment models
- Road data import (GPS- and map-based)
- Model integration from different sources like AVL CRUISE, Dymola, GT-SUITE, LMS Amesim, MapleSim, Ricardo WAVE, SimulationX, Simulink, ...
- Functional Mock-up Interface (FMI)
- Open interfaces to third-party tools like navigation systems, DoE tools and PLM systems
SOLUTIONS FOR VIRTUAL TEST DRIVING

As an innovation driver for virtual test driving, the company is a leading global provider of software and hardware products for the automotive and supplier industry. With the areas Simulation Software, Real-time Hardware, Test Systems and Engineering Services, IPG Automotive supports its customers in creating innovations and improving their development process efficiently. The simulation solutions CarMaker, TruckMaker, and MotorcycleMaker, as open integration and test platforms, facilitate great savings in time and cost for customers, in a continuous development process of Model-, Software- and Hardware-in-the-Loop, all the way to the Vehicle-in-the-Loop method. The application ranges from the general vehicle dynamics simulation, developing and testing of chassis control systems, as well as interconnected systems such as chassis, powertrain, and steering in full electric and hybrid vehicles. Another strength of IPG Automotive is the development of future-oriented solutions for the integration and testing of advanced driver assistance systems.