Simulation Tools to Model and Optimize Electric Systems

OVERVIEW
The MSC.EASY5 Ricardo Electric Systems Library V1.0, developed by Ricardo Inc., a leading expert in powertrain research and development, helps you solve more of your electric systems design problems through modeling and simulation than any other software on the market. The Electric Systems Library provides tools to develop concepts into designs. For experts in electric machines, as well as application-oriented users from other disciplines, complete systems can be modeled, analyzed, and simulated quickly and flexibly.

The Electric Systems Library was designed for engineers by engineers. It focuses on the kinds of results you want to achieve in modeling the complex dynamics of electric systems. While the underlying components utilize fundamental electrical, magnetic, mechanical and control system principles, they are designed for straightforward use at the system level. Tools are supplied to model AC and DC machines, power electronics, control systems, electrical energy storage, and networks at multiple levels of complexity. High-level models are built and exercised quickly, with a user-friendly migration path to more detailed models of higher fidelity.

ELECTRIC SYSTEMS SOLUTIONS
Electric System components are easily connected to facilitate the flow of electrical energy into rotational mechanical energy and vice versa. The scope of the component models is focused on localized systems, such as in automotive and industrial applications, as opposed to distributed utility systems connected with a large power grid. Motor-generator components and the power electronic infrastructure to support them are available. This expedites the modeling of hybrid vehicle systems.

CAPABILITIES
• Easily incorporates electric systems into powertrain models
• Includes flexible control strategies for all machines
• Parameterizes components according to electromagnetic characteristics or mechanical performance specs
• Incorporates simple, user-friendly electric component interconnection
• Simulates with efficient high-frequency switch-mode electronics or continuous emulation
• Utilizes short-term simulations that can examine details like pulsation effects, while faster long-term simulation elucidates overall performance
• Incorporates your own Fortran or C code into the model
• Develops complete virtual prototypes by interfacing MSC.EASY5™ models to mechanisms modeled in MSC.ADAMS™ and DADS®, and control systems in SIMULINK®

BENEFITS
• Model complex electric systems without having to write code or derive equations
• Build complete virtual prototypes of Hybrid Electric Vehicles by combining components from the Electric Systems, Powertrain and Fuel Cell libraries
• Achieve fast simulations using efficient integration methods optimized for highly nonlinear and discontinuous events
• Further integrate your subsystems through the modular machine/controller/electronic combinations
• Collaborate better by sizing machines before final design details are available
SAMPLE APPLICATION

A basic goal of this library is to represent a level of complexity sufficient for the overall system without burdening the user with unnecessary detail. When designing HEV systems, you may need a machine to deliver motoring torque in some circumstances and brake acting as a generator in others. Knowing only the stall torque, rated speed or power, and an estimate of the maximum current, a brushless permanent magnet machine can easily be incorporated. Integrating the machine, inverter and controller can easily be accomplished, as shown below.

The simulation results pictured below show full four-quadrant operation. Rated (stall) torque is available at low speed in either direction and constant power is available at higher speed in either direction.

ELECTRIC SYSTEMS COMPONENTS

The Electric Systems Library contains over 40 pre-configured components sorted by groups:

- Three-Phase AC Machines
- Commutated DC Machines
- Machines – Special Purpose
- Power Electronics
- Passive Networks
- Sources and Loads

After establishing the basic results, features can be systematically added, such as a more detailed electric supply network and switch-mode power electronics already built into the inverter. It is in this way that ideas can evolve from the concept stage into final design.

MODEL PARAMETRIZATION

Flexibility has also been designed into the parameterization of many of the components in the Electric System Library. A machine, for example, is characterized by a list of data in terms familiar to an electrical engineer, such as resistance and inductance. The same machine is also available in the library in a form requiring data more familiar to a powertrain engineer, such as speed and torque, rather than detailed electrical parameters.

REQUIREMENTS

MSC.EASY5™ runs on Unix® platforms and Pentium®-based PCs. The following MSC.EASY5 products are required:

- Simulation and Analysis Toolkit (Product ID 10169)
- Ricardo Electric Systems Library (Product ID 10185)

For more information about the Ricardo Electric Systems Library and other MSC.EASY5 products, visit us at www.adams.com/easy5.

You may also contact us directly at 1.800.426.1443, or send e-mail to easy5.sales@mscsoftware.com.

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