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Vehicle Powernet Design

Synopsys' Saber® provides a complete design and verification solution for vehicle power networks

Overview

Energy demand in modern automobiles increases with each model year. The electronic content in today's vehicles accounts for 35% of total vehicle cost and continues to climb. Comfort and infotainment accessories proliferate and drive-by-wire controls are replacing traditionally mechanical functions. The increased energy demand compels carmakers to improve power network (powernet) performance and efficiency to enhance system reliability.

Improving powernet reliability requires a systematic development approach that ensures reliability issues are addressed as an integral part of the design process. Design teams use robust design methodologies to manage complex energy generation and distribution problems, such as designing an alternator charging system, taking into account system and environmental variations that affect performance.

Robust Design For Vehicle Power Networks

- Size system components to match energy generation with consumption
- Verify power network loading and distribution
- Verify energy management algorithms with hardware/software co-simulation
- Simulate complete vehicle power networks using models from a proven power component library
- Model and characterize power networks using industry standard MAST and VHDL-AMS languages
- Verify power network performance and ensure reliability with advanced sensitivity, statistical, and fault analyses
- Choose from dozens of performance measurements to quickly analyze power network simulation results
- Automate power network design and analysis using simulation and post-processing experiments
- Increase analysis throughput with distributed simulations across multiple CPUs

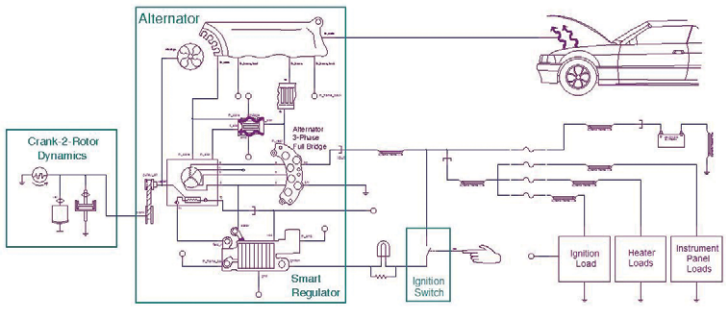
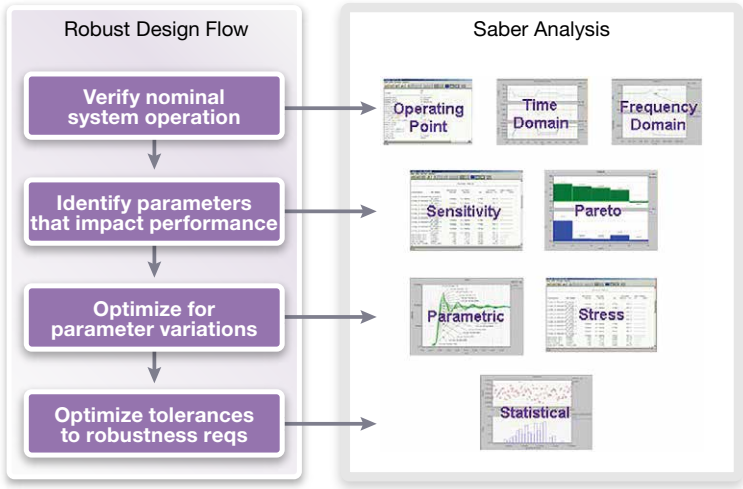


Figure 1: Alternator charging system

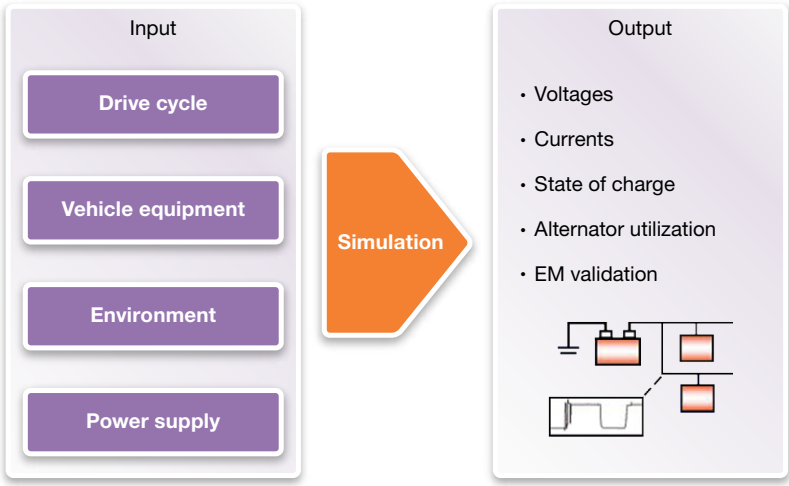
Robust Design

Robust design is a proven development methodology that immunizes power network performance against variations in system parameters and environmental conditions. The objective is to determine the most cost-effective design solution that meets performance and reliability specifications. Adopting a robust design methodology requires that design teams verify system performance across a broad range of conditions. A comprehensive simulation solution is required to effectively analyze complex power networks.



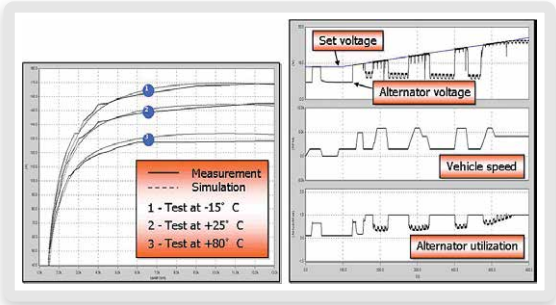
Comprehensive Analysis

Beyond assessing the nominal performance of powernet systems, ensuring reliability requires a broad range of standard and advanced analyses in the time and frequency domains including sensitivity, statistical, stress, and fault. Saber's simulation algorithms are specifically tuned for analyzing numerically stiff systems, a common and challenging characteristic of vehicle power networks. Saber has a long and successful history of addressing these types of complex systems.



Model Accuracy Requirements

Powernet simulation requires accurate multi-domain (electrical, mechanical, magnetic, etc.) models for all system components including the alternator, battery, wires, fuses, and loads. Written in the industry-standard modeling languages MAST and VHDL-AMS, Saber's library of physics-based powernet models includes behavioral and characterized components at multiple levels of design abstraction. The Saber solution also supports a suite of modeling tools for creating and characterizing behavioral models using measured device data, creating standalone models directly from equations, and translating SPICE netlists into Saber simulator equivalents.



Flexible Data Analysis

The Saber simulator's comprehensive waveform analyzer displays, measures, and transforms simulation data to provide a complete picture of power network performance. Powernet performance measurements are easily applied to simulation results and displayed directly on the waveform. Design teams use these measurements to quickly verify network operation against the network loading and distribution specification.

Energy Management

Embedded software control is required for efficient powernet energy management. Though traditionally separate activities, hardware and software design must now be integrated from the beginning of powernet development to avoid complications during system implementation. The Saber/Simulink co-simulation interface integrates hardware design with power management algorithm development, while providing access to Saber's comprehensive capabilities for robust design.

Automating Simulation and Analysis

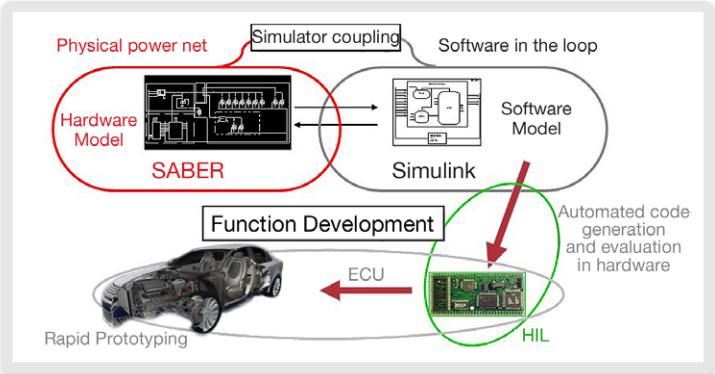
Robust design methodologies require repetitive simulation steps, many of which are time consuming to setup. The Saber suite of tools helps design teams define, execute and save simulation configurations and results as a series of experiments. The saved experiments can be loaded and customized for design processes that need to be repeated. For example, design teams can automate multiple Monte Carlo simulations and result generation.

Boosting Simulation Throughput

Robust design methodologies require advanced sensitivity and statistical analyses to verify the reliability of complex power networks. These analyses are recursive simulations requiring hundreds or thousands of runs which is impractical to support on a single CPU. The Saber environment solves this problem by distributing iterated simulations across a compute grid allowing multiple CPUs to perform the analyses in much less time. When a simulation is complete, results are gathered into a single data file for easy processing.

Conclusion

The rapid increase of automotive electronics has led to daunting power network challenges as power consumption grows. Saber tools are widely used by many automotive OEMs and suppliers to design and verify power networks under a variety of conditions. The Saber simulator's popularity in power distribution and management has led to the availability of essential power models by device manufacturers. These models are complimented by a comprehensive library of simulation models backed by 20 years of industry experience. Advanced modeling, simulation, and postprocessing capabilities have established the Saber simulator as the standard robust design and analysis tool for power network design.



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