Addressing Automotive System Electrification Challenges with Physical Modeling & Simulation

Saber Solutions

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Agenda

Overview – Physical Modeling & Simulation
Customer Successes
The Challenge...

Electrification
Electrifying Automotive Systems
Driving the Need for Physical Modeling & Simulation

System design includes integration of multiple physical domains – interactions cannot be ignored

Increasing SW / HW interdependencies – earlier development requires platforms for mechatronic design

Product quality & reliability remain critical – just more difficult to predict and manage

Supply chain collaboration is a key to success – increased dependence on CAE tools & methods
Saber Product Line

Physical Modeling & Simulation for Multi-Domain Systems

Saber is...

A Proven Platform for Modeling & Simulating Physical Systems

Circuit & System Design
Modeling & Characterization
Simulation & Test
Analysis & Reporting

Saber helps to...

Accelerate Electrification of Physical Systems
Increase HW Quality & Reduce Prototyping Iterations
Connect the Physical System to the rest of Electronics Design
Physical Modeling & Simulation

What is it?
• Lumped-element, conserved energy descriptions of multi-domain behaviors interacting as part of a system
  – e.g. an Electric Machine: electrical + magnetic + mechanical + thermal interactions within a single "component"

How is it used?
• Proven approach for predicting and optimizing the behavior of complex dynamic systems, without decoupling physical domains

Why is it important?
• Increasing demands on content, integration, efficiency, reliability, cost, time to market…physical prototyping alone is becoming intractable
Saber Tackles System Complexity
Unmatched Power Electronic & Electromechanical Simulation

Use standard languages & extensive behavioral libraries for modeling power electronics, electric machines, batteries and more...

Test, integrate, & optimize the complete multi-domain system – the path to higher reliability and robustness

Verify & calibrate embedded SW through integrations to C-code, Synopsys Virtual Prototypes and Simulink

History of success in design, integration and model exchange for electro-* systems
Electrified Vehicle Power Systems

Complex power electronics

Power converters (DC/DC), inverters (DC/AC, rectifiers, AC/DC)

Complex, SW-controlled mechatronics

Electric motors, generators, alternators

Energy storage – Batteries, fuel cells, …
Saber Technology Overview

Integrated Modeling, Simulation & Analysis

- Circuit & System Design
- Modeling & Characterization
- Simulation & Test
- Analysis & Reporting

Saber
Supporting the Design of Real Systems

**Saber Differentiation**

### Modeling
- **Base Set:**
  - Behavioral Language(s)
  - Multi-Domain Modeling
  - Generic Model Libraries
  - Modeling Assistants
- **+ Saber:**
  - Component Libraries
  - Input Format Compatibility
  - Component Characterization
  - FE / Field Solver Extraction

### Simulation / Analysis
- **Base Set:**
  - Time-Domain Performance
  - Freq-Domain Performance
  - Scripting / Automation
  - Embedded SW Connections
- **+ Saber:**
  - Design Optimization
  - Design for Robustness
  - Design for Reliability
  - Grid / Parallel Computing

### Environment / Usability
- **Base Set:**
  - Windows-based IDE
  - Documentation & Examples
  - Support & Community
  - Industry Standards
- **+ Saber:**
  - Linux, Unix Support
  - Leading Performance
  - Leading Robustness
  - Supply Chain Success
Saber Strengths
Connecting Electronic Design with Physical Systems

**Model Inputs**
- MAST
- VHDL-AMS
- SPICE
- C/C++
- Simulink
- IBIS
- S-parameters

**Circuit & System Design**
- Saber

**Modeling & Characterization**
- EM & Multiphysics
  - CST
  - Infolytica
  - others...
- Analysis & Reporting

**Simulation & Test**
- Distributed Computing
  - EST
  - ChiasTek
  - others...

**Embedded SW / Algorithm**
- Embedded SW / Algorithm
  - Synopsys
  - Mathworks
  - others...

**Wire Harness**
- PCB
  - Zuken
  - Mentor
  - others...

**Digital Verification**
- Digital Verification
  - Synopsys
  - Mentor
  - others...

**HW Integration & Test**
- HW Integration & Test
  - NI
  - others...

**TCAD**
- TCAD
  - Synopsys

**EM & Multiphysics**
- EM & Multiphysics
  - CST
  - Infolytica
  - others...

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Enabling Success in the Supply Chain

Model Exchange with Saber

Saber is required for model exchange throughout the automotive supply chain

Used successfully by OEMs and Tier 1s to verify requirements before physical delivery

Supported by industry consortiums and standards bodies (e.g. VDA, SAE, FlexRay)
“Saber from Synopsys supports us in supplying our customers with high quality transceiver models which have become mandatory for the development & verification of modern In-Vehicle networks. The support of languages like MAST and VHDL-AMS and the functionalities to automate the entire verification process are very helpful for reducing the testing effort.”

**Thomas Suermann**, Senior Engineer
NXP Semiconductors
Saber Customer Success

Robust Design of Motor Drive Electronics

Verification-Based Robust Design of BLDC Drive Electronic Control
L. Berger, K. Schoenherr, M. Roeder, A. Jennert
IEEE Industrial Electronics Conference, 2009

Parallel design & verification flow with integrated Saber / Zuken PCB environment

Costly design changes reduced

System quality and cost optimized
Saber Summary

Proven solution for Physical Modeling & Simulation—addressing complexities of electrification & multi-domain integration

Broad coverage in linking electronic design to the physical system

Committed to customer partnership to advance power components through systems

Try for yourself! Free Demo/Student-Edition

http://www.synopsys.com/saber
Thank You