New Capabilities for Verilog-A Implementations of Compact Device Models

Marek Mierzwinski, Patrick O’Halloran, Boris Troyanovsky, Karti Mayaram,* Robert Dutton**

Tiburon Design Automation, Santa Rosa, CA
*Oregon State University, Corvallis, OR
**Stanford University, Stanford, CA
Overview

• Verilog-A has promised a simple, efficient language of describing analog behavior in simulators
  
  – End users will only accept Verilog-A if models look and feel like “built-in” devices with support of all analyses and comparable performance

• This work demonstrates complex compact device models implemented in Verilog-A working in research and commercial simulators
Architecture

The compiler produces a independent, portable model object file…

CML = Compiled Model Library
RTE = Run Time Environment

…which can be shared by multiple simulator types
Compact Models in Verilog-A

- Verilog-A devices must perform identically to “built-in” components

Verilog-A and built-in versions of UC Berkeley BSIM4 MOSFET

DC IV S-parameters @ 10GHz vs. bias
Complex Circuit Behavior

- Verilog-A devices must be supported in all analysis types, just like built-in devices

ADS Circuit Envelope simulation using Verilog-A implementation of models
Multiple Simulators Sharing One Model

- Compiled Verilog-A devices can be shared among diverse simulators
- Same compiled object file linked to each simulator
- Develop in one simulator, same results in all simulators
Abstraction

- Verilog-A provides a convenient language to control the level of abstraction in a model
- CODECS provides numerical (physical) description of device, c-code, macro model, and Verilog-A behavioral modeling
CODECS: Mixed device / circuit level simulation

Verilog-A model of MEMS varactor and BSIM3 MOSFET compared to numerical model of MOSFET

Oscillator start up transient using Verilog-A MEMS and BSIM3 compared to numerical/physical description of FET

Verilog-A allows some models to be abstracted to a higher level to improve simulation performance and to allow models to be ported to other simulators.
Summary

• Verilog-A has been shown to be an ideal language for describing analog behavior, including implementation of compact device models

• Verilog-A provides a way to distribute identical model content in a variety of commercial and research simulators