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# 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

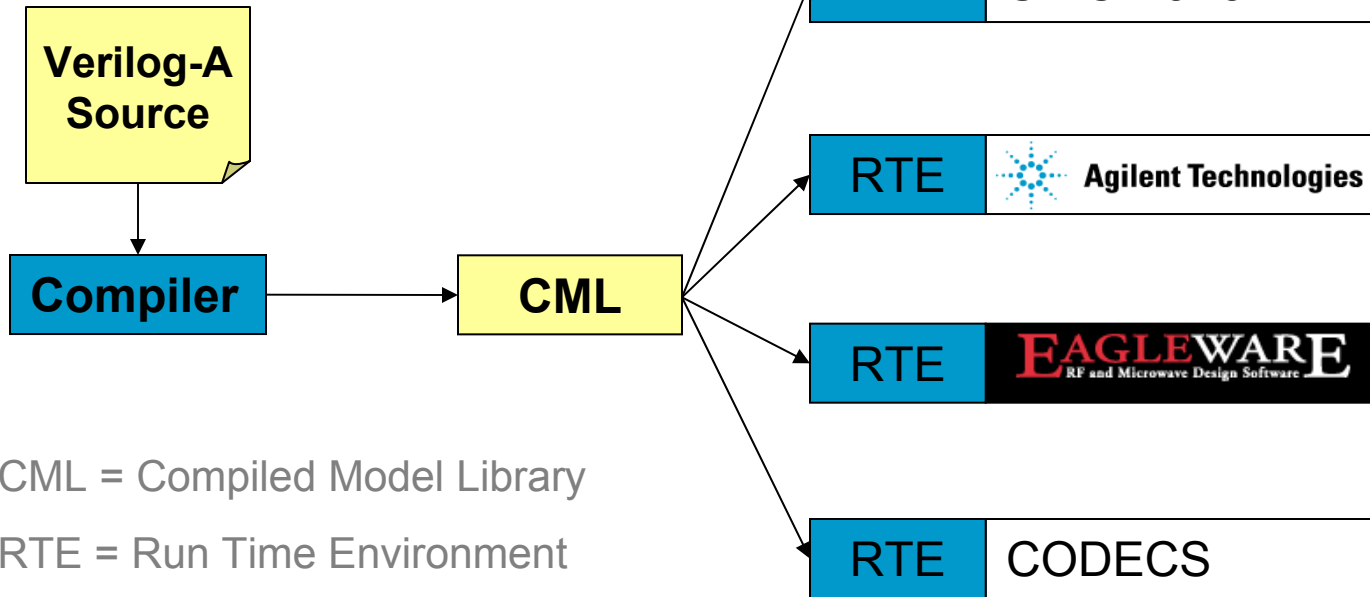
\*\*Stanford University, Stanford, CA

# 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

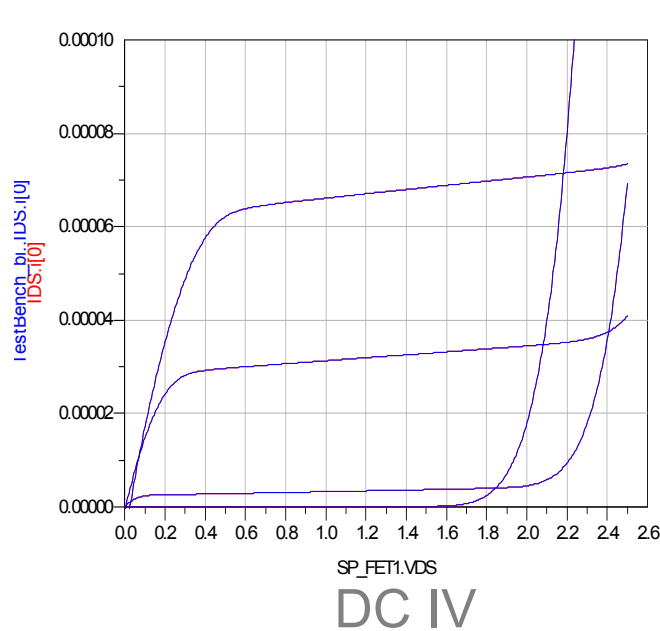
RTE = Run Time Environment

...which can be shared by multiple simulator types

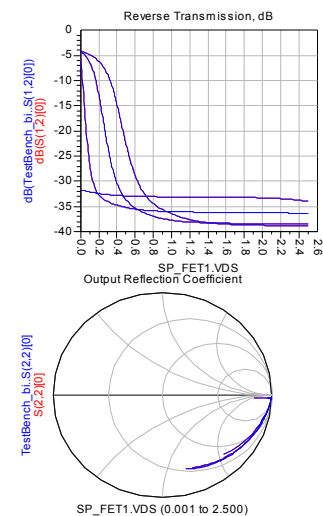
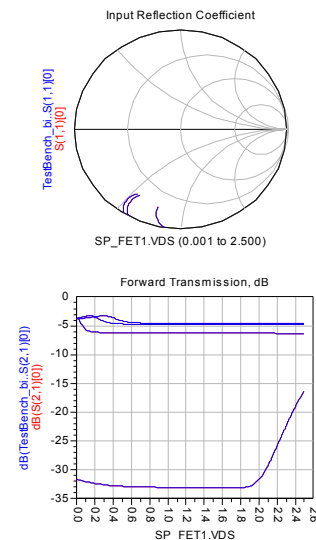
# Compact Models in Verilog-A

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

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



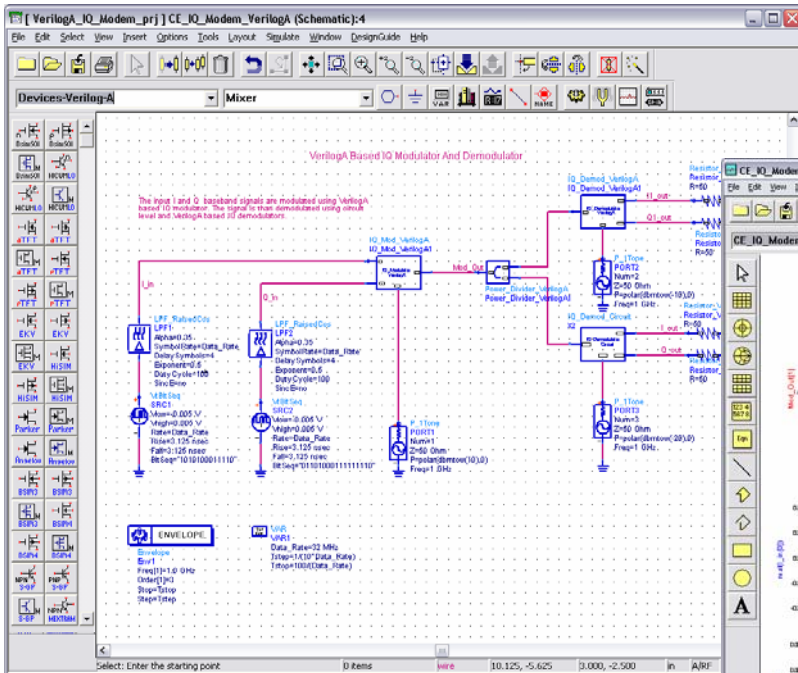
DC IV



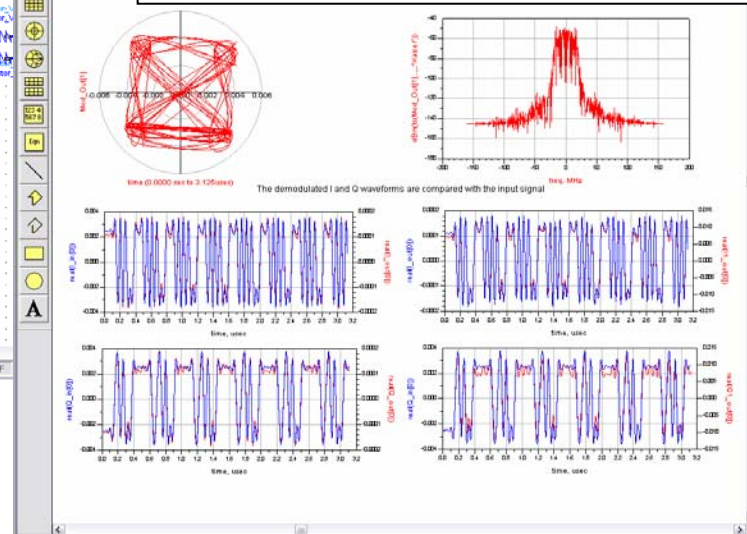
S-parameters @ 10GHz vs. bias

# Complex Circuit Behavior

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



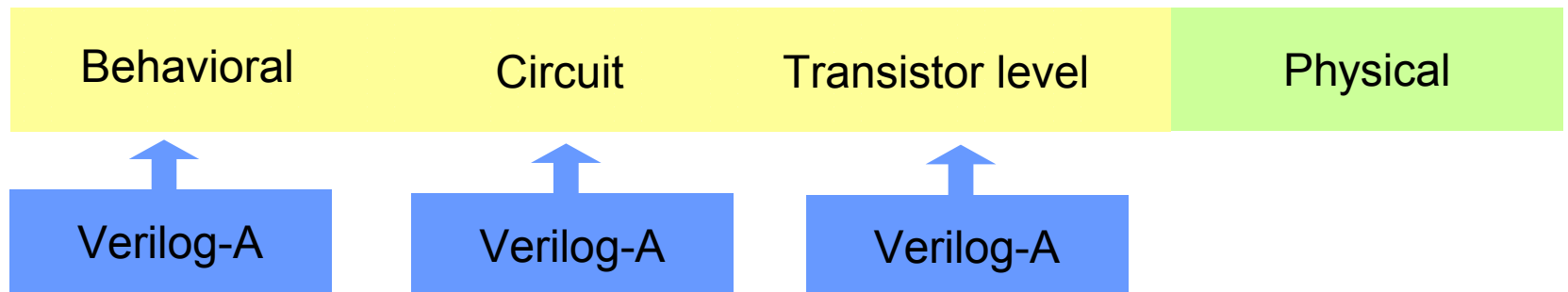
ADS Circuit Envelope simulation using Verilog-A implementation of models





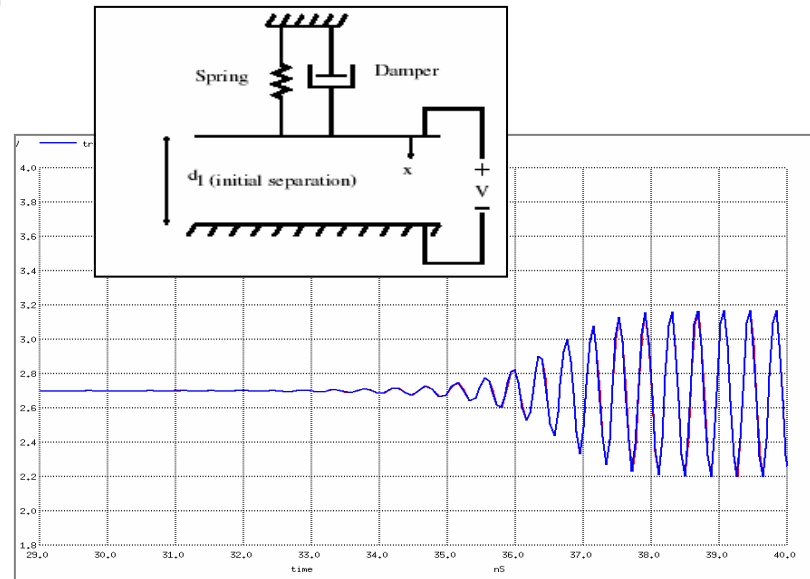
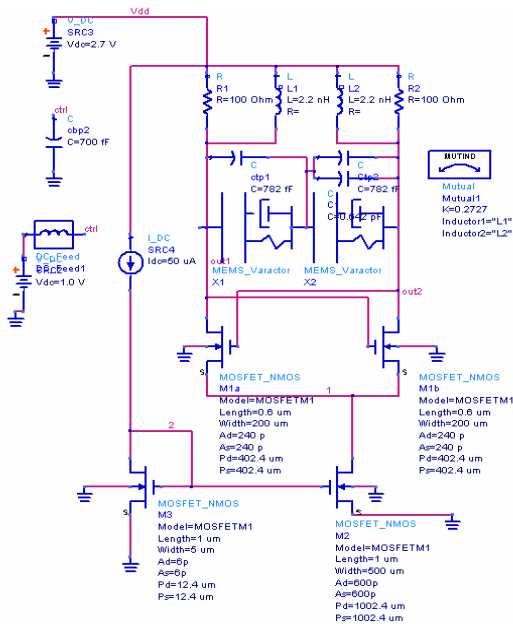
# Abstraction

- 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