SILVACO

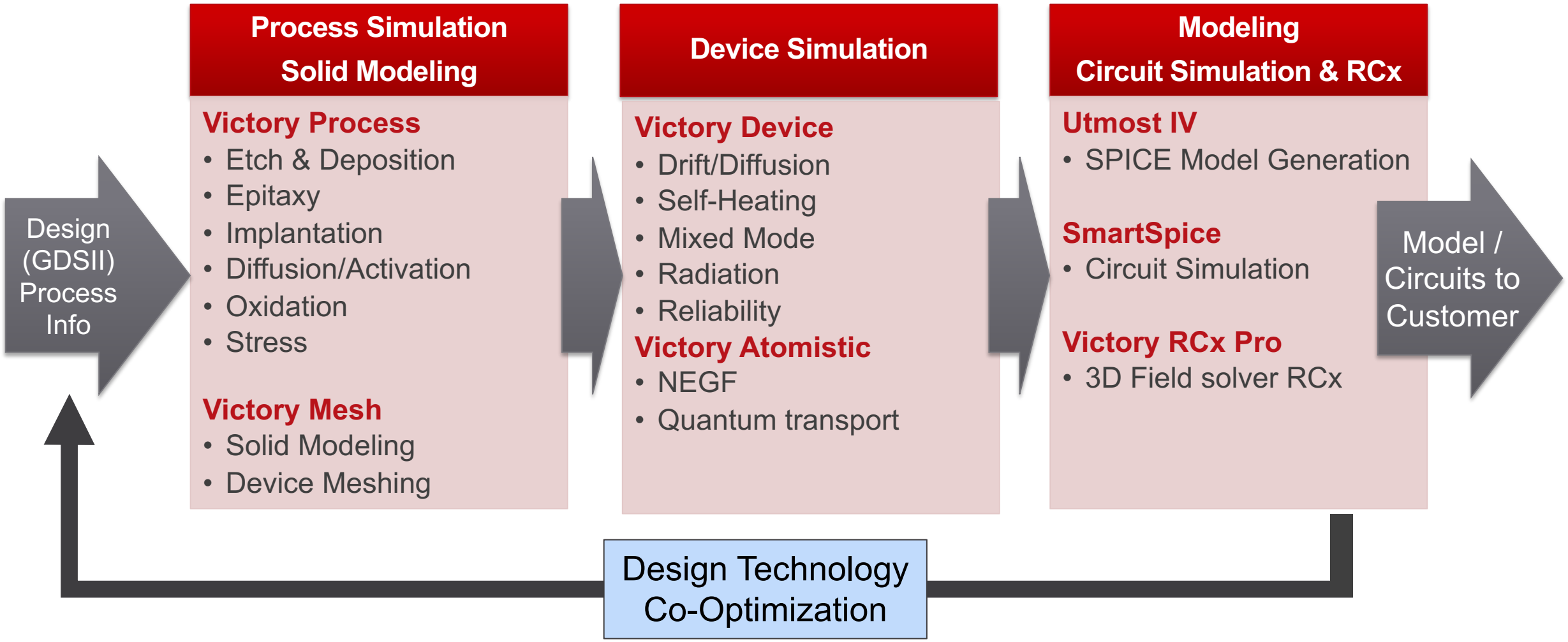
DTCO Integrated Tool Flow

Single Run Time Environment

Contents

Introduction

DTCO: Connecting Semiconductor Physics to Circuit Design

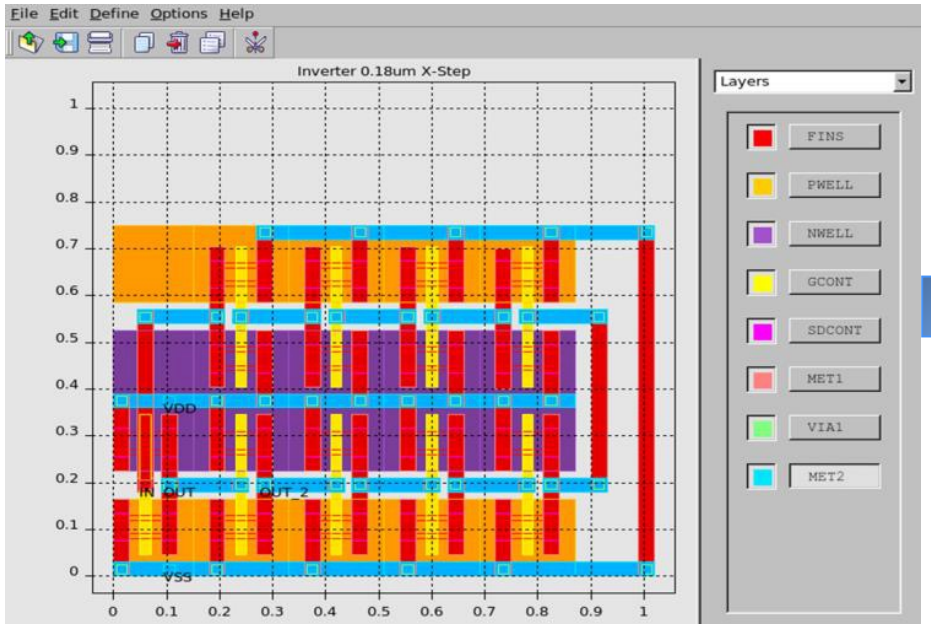


Introduction

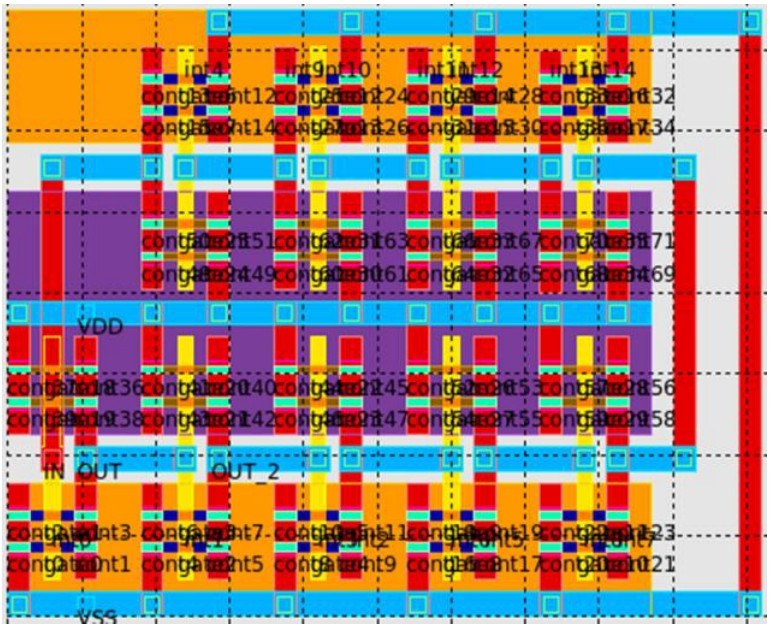
- Design Technology Co Optimization (DTCO) improves designs across multiple domains.
- 3D active device and BEOL parasitic extraction builders are now integrated and share the same:
  - Layout tool
  - Structure builder
  - Structure mesh generator
  - Rule file
  - Simulation interface
  - Syntax
- A single input file can now run a full TCAD to SPICE flow, enabling a powerful integrated DTCO environment

Select Cell and Annotate using Rule File

- Supplied layout with basic labels (Vss , Vdd , In,
- Layout automatically annotated using the rule file



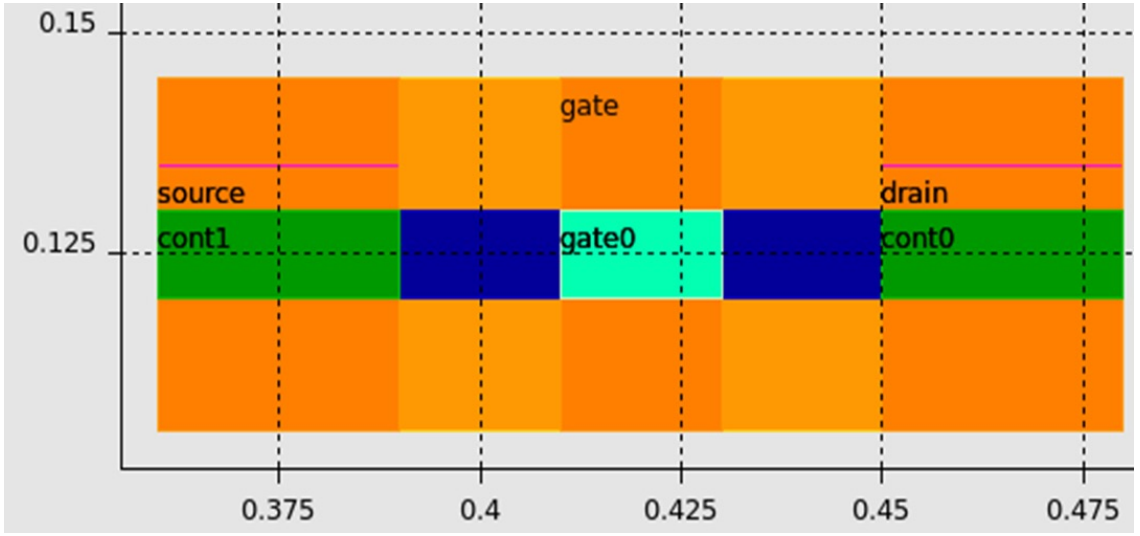

```
; Locate N and P Devices
AND PWELL FINS NFET
AND NWELL FINS PFET

; Define Gate Contacts
AND NFET GCONT NGATE
AND PFET GCONT PGATE

; Define Source-Drain Regions
AND NFET !NGATE NSD
AND PFET !PGATE PSD

; Define Source-Drain Contacts
AND NSD SDCONT NCONT
AND PSD SDCONT PCONT

; Define Well Contacts
AND NGATE PWELL NSUB
AND PGATE NWELL PSUB

; Mask required for process simulation
OR MET1 GCONT SAC_POLY

Export NGATE
Export PGATE
Export NSD
Export PSD
Export NCONT
Export PCONT
Export NSUB
Export PSUB
Export SAC_POLY
```



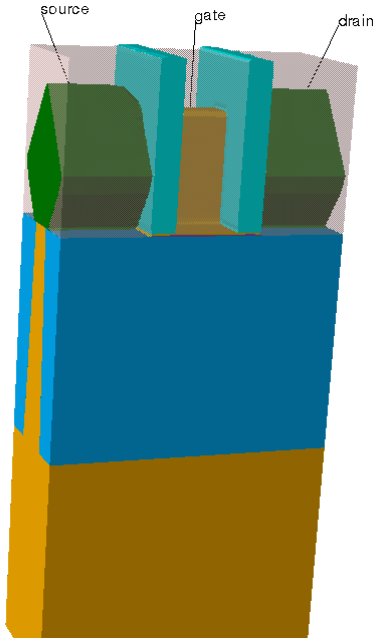
Example using a ring oscillator circuit

Clip Layout to Build Active Devices

- From same layout, clip areas to build active devices
- Full Victory Process simulation capability available



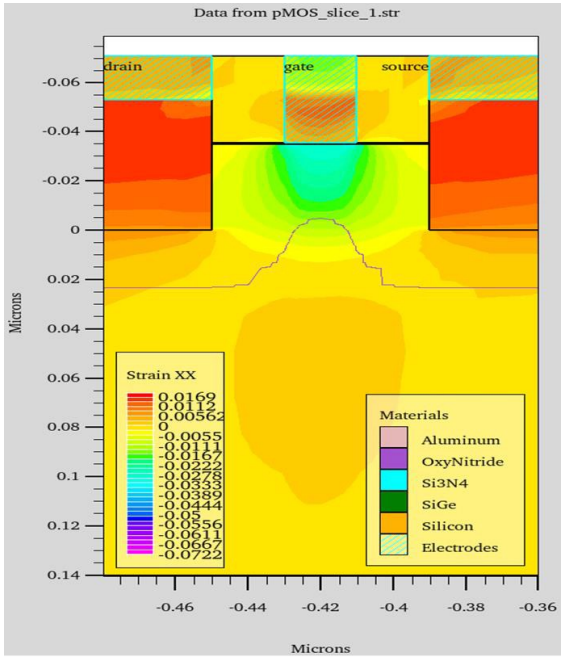
- Variables are used to automatically mesh the active structures

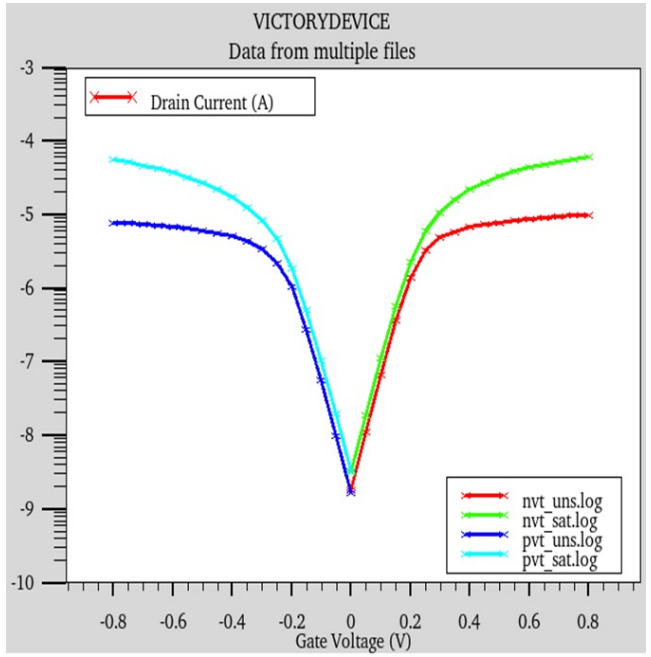


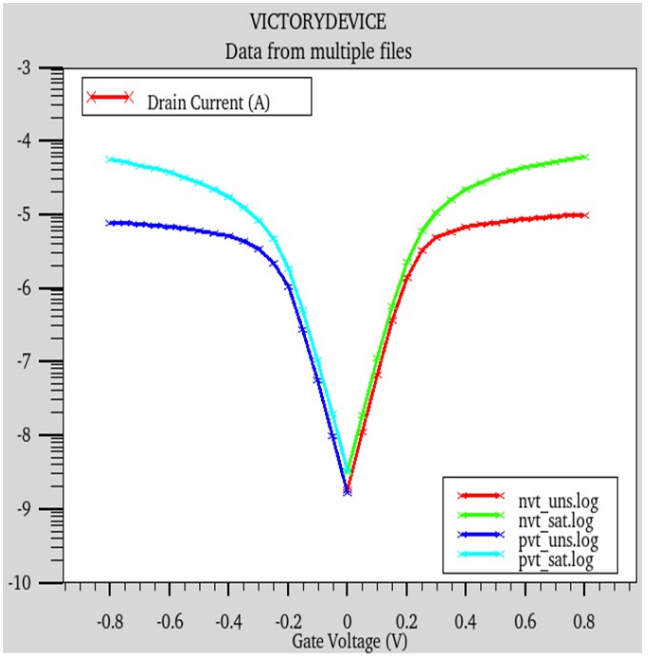
Example of stained SiGe extensions for pMOS

Device Simulation and SPICE Model Extraction

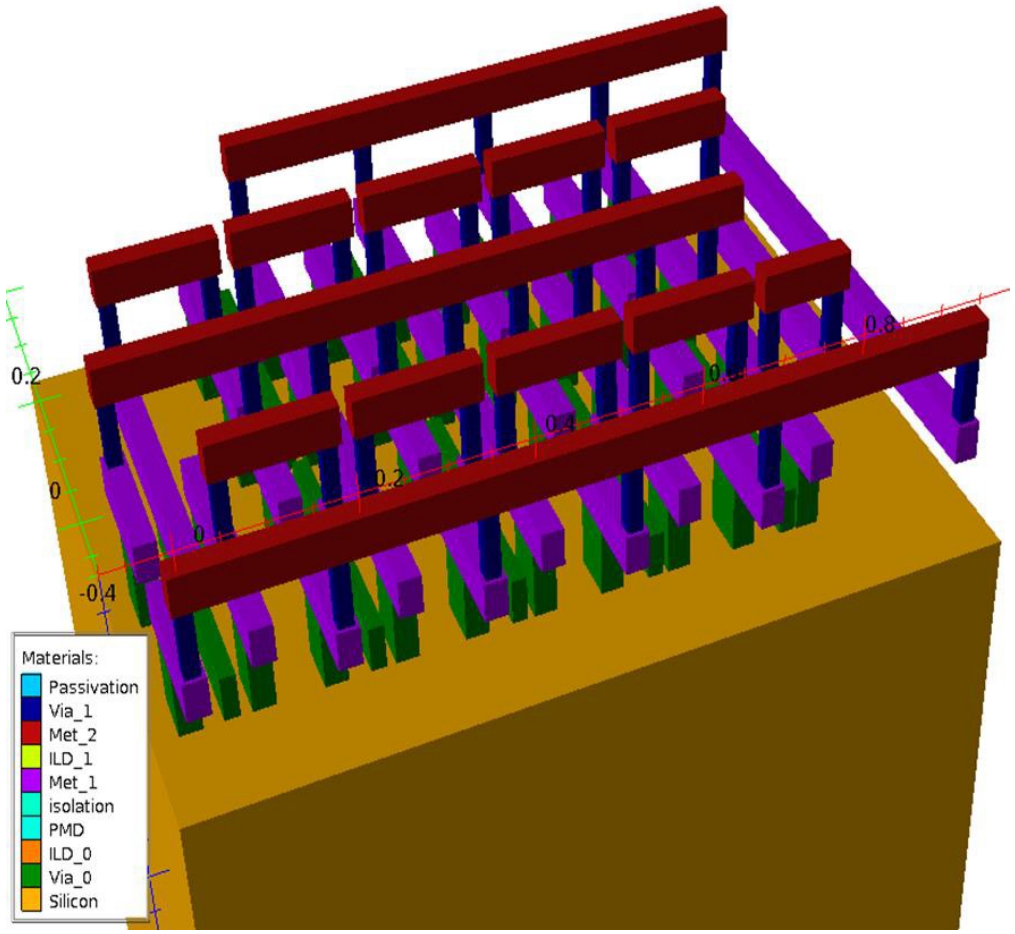
- Simulate active device I V and capacitance curves
- Automated multi gate SPICE model extraction





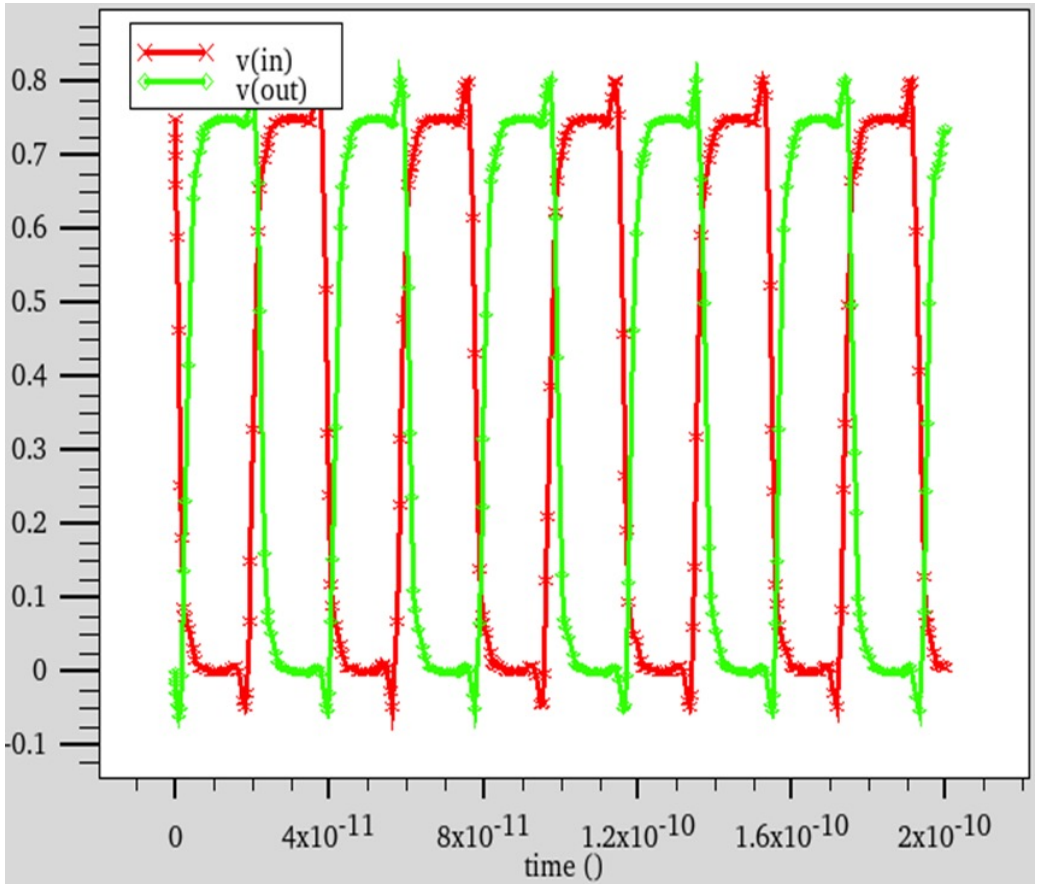


3D BEOL Structure for RCX Field Solver



- A Full 3D structure is created for BEOL field solver
- Active device netlist automatically extracted, then
- RC parasitics extracted and automatically back annotated
- Same structure builder/syntax as used for active devices

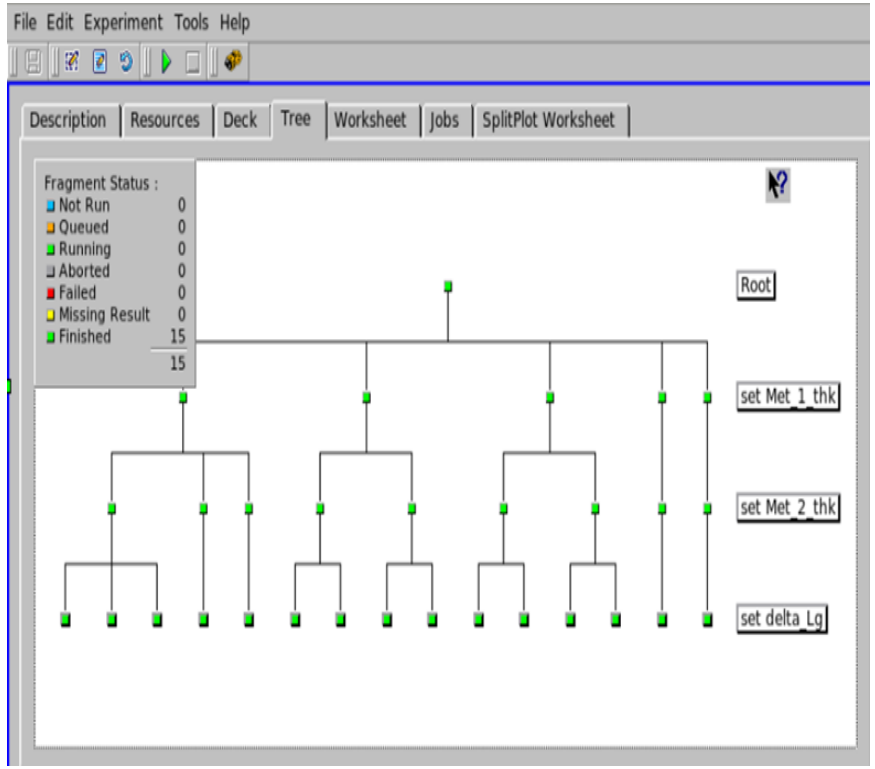
SPICE Simulation within Same Input File

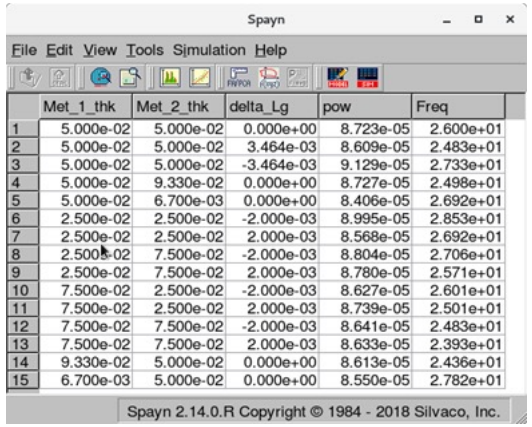


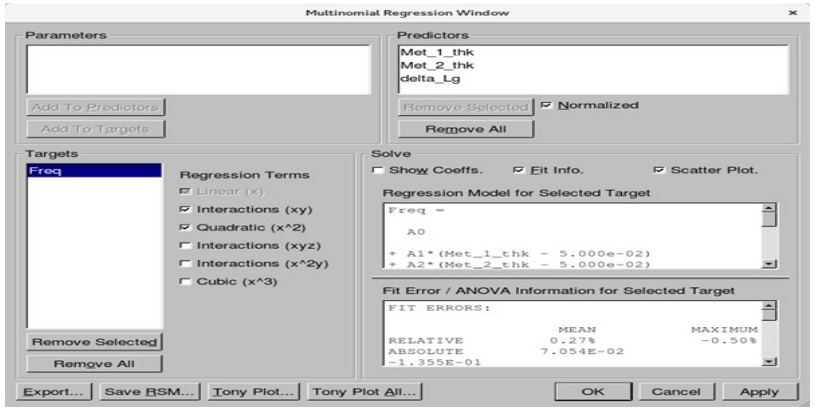
- Use ".INCLUDE" statement in SPICE to import created netlist
- SPICE simulations run and key performance parameters extracted for full flow optimization
- All run using the same interface and script

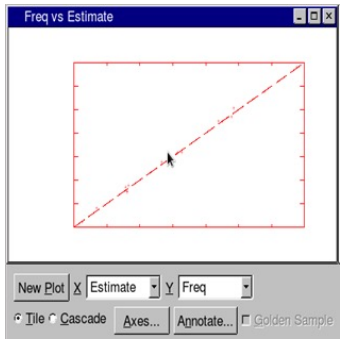
DTCO Statistical Analysis Environment

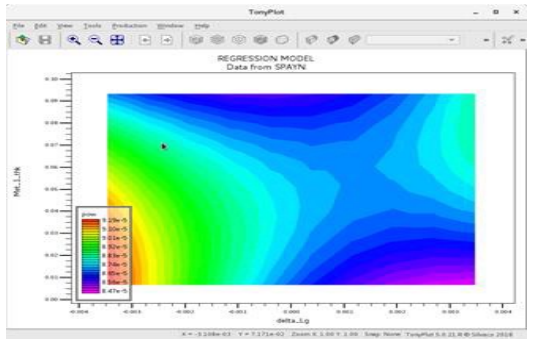
- Design of Experiments and analysis environment
- Statistical analysis of layout/process/circuit dependencies

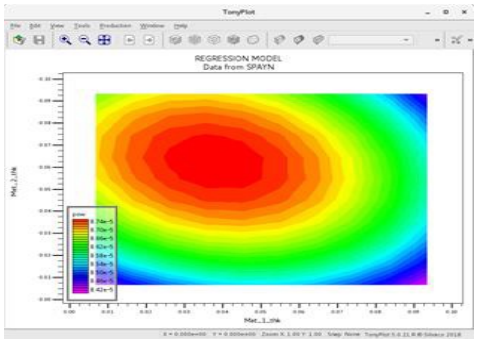












Summary

- Single fully integrated run time environment
- Anything can be a variable Layout, Process, BEOL
- Clear actionable results for Design Optimization
- Complete and full TCAD to SPICE simulation capability
- Parameterization models linking all design variables
- Powerful extract statements for parameter extraction
- All tools developed in house for smooth integration
- Worldwide support for your success