Use Asymptotic Waveform Evaluation Methos on Transistor-Level Timing Analysis

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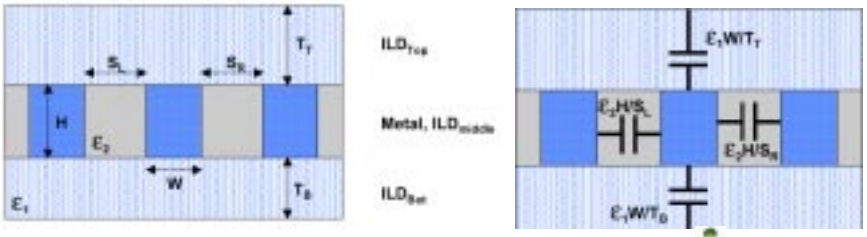
Outline

- *Motivation*
- Previous work
- Problems of Spice
- AWE(Asymptotic Waveform Evaluation
- Results

Importance of and Problem with Timing Analysis

- Importance: Determine how fast a circuit can run
  - Setup time, hold time of FF
  - Clock Frequency
- Problem
  - With shrinking Lambda, interconnect delay becomes the dominant factor rather than transistors
  - Parasitic and coupling effect(cross talk) kick in



Trend in Technology I

- Decreased Feature Size
- Decreased Voltage
- Al $\Longrightarrow$ Cu
- Increased Clock Frequency
- Improved Physical Structure

Trend in Technology II

Depend on whether scale voltage, there is full scaling(scale all by a factor of $S, S > 1$) and fixed-voltage scaling(only scale geometries but not voltage). There is

Table 1: Scaling Scenarios for Short-Channel Devices

Parameter	Full Scaling	Fixed-Voltage Scaling
W, L, t_{ox}	$1/S$	$1/S$
VDD, V_T	$1/k$	1
$Area$	$1/S^2$	$1/S^2$
$C_{[ox]}$	S	S
C_{gate}	$1/S$	$1/S$
k_n, k_p	S	S
$IntrinsicDelay$	$1/S$	$1/S$

Probelm of Spice in timing analysis

- Prohibitive Long Run Time
- Dynamic Timing Analysis: Need Test Pattern
- Accurate Spice of DSM technology
- We need an embedded timing analysis engine

Static and Dynamic Timing Analysis

- Static
  - No Test Pattern
  - Fix Critical Path
  - Pros: Fast.
  - Cons: Could be less accurate than Dynamic if models are not good.
- Dynamic
  - Require Test Pattern
  - Analysis Result Has Dependency on Tets Pattern used
  - Pros: Accurate; Can target specific test pattern
  - Cons: Need to generate enough test patterns and possibly large run time to get accurate result. Hard if there are a large number of inputs

Approach

- Model the whole circuit as a RC tree(an acyclic network)
- Extract circuit to blocks(gates) connected by interconnects.

$$Delay = F(input_slope, output_load)$$

Use AWE(Asymptotic Waveform Evaluation) Method

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Time Domain to Frequency Domain

- from Teveqnif Theory

Moment Matching

- Moment is defined as

Back to Time Domain

- Get the time domain waveform

MATLAB Simulation

- From MATLAB simulation results

Hurdles

- Extraction of DSM technology

Problem with AWE

- poles at right hand side

FEM method in layout extraction

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Data Flow

Data Flow