More on Initial Delay Issues

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Agenda

- Last presentation revisit
- Dive into IBIS simulation implementation
- Situations and solutions
- Conclusions
Last presentation revisit

Driver Model: Transistor-level Spice model vs. IBIS model

- Perfect matching results on Rising and Falling between all three simulators

This is a good IBIS model

Good for only Rising or Falling stage

VT curves reached stable zone

Ramp rate: 0.8v/115ps
This is an ISI issue, not only timing.
Last presentation revisit

With cut off 1ns delay VT waveforms
- Stimulus patterns “01010100110011001100111000”

IBIS Simulator-1
- Spice vs. with_VT vs. no_VT

Cut out extra delay or not use VT curves does not solve the issue
Dive into IBIS simulation implementation

General IBIS Output Equation

\[-I_{out}(t) = K_u(t)I_{pu}(V) + K_d(t)I_{pd}(V) + I_{pc}(V) + I_{gc}(V)\]

Important \(K_u(t)\) and \(K_d(t)\)
Dive into IBIS simulation implementation

- Simulators care starting time not ending time
- Always assume both $K_u$ and $K_d$ will reach stable state (full state transition period)

Current IBIS implementation is not good for incomplete transition cases
Situations and solutions

- How to avoid this problem
  - Let assumptions to be true

\[ T(r/f)s - (\text{Rise/Fall}) \text{ Safe transition period} \]

Rising and falling Ts may be different

Use it only when stimulus state transition time (minimum bit width) is greater than 2 x Ts
Can simulation equation be enhanced?

One possibility:

$$-I_{out}(t) = K_{us}(t)I_{pu}(V) + K_{ds}(t)I_{pd}(V) + I_{pc}(V) + I_{gc}(V)$$

where

$$K_{us}(t) = Ku(t) \times f(state\_transit)$$

$$K_{ds}(t) = Kd(t) \times f(state\_transit)$$

$$f(state\_transit): \text{transition factor}$$
Conclusions

- Current IBIS implementation is not good enough for ISI analysis
  - Cut off initial delay or not use VT curves does not solve the problems
- Your IBIS model may be not good enough for high speed digital signals
  - You will have more reasonable Error Rate analysis results if your minimum bit width is greater than 2*Ts (safe transition period)
- Can IBIS output equation be enhanced?
  - One possibility is to add signal transition factor
The Hope starts here!

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