Cadence Tutorial (Part Two)

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Version: 10/24/05

(based on 6.776 setup by Mike Perrott)

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Introduction

In this second tutorial we will build on what we learned in the first tutorial. We will learn more sophisticated modeling techniques and more powerful simulation skills. We will use them to answer the question, "For a given load capacitor and a maximum required rise and fall time what is the minimum power required to meet these specs?"

For this we will find useful models that automatically include the increase in source and drain depletion capacitance with increases in the device size. So we will use a parameterized subcircuit around the mos1 model that we created in the first tutorial.

In order to find the rise time, the fall time and the power per cycle we will run a transient simulation.

In order to answer the optimization question, we will use a parametric simulation as an insightful way to pursue the answer.

Upgrade the Device Models

We remember from the first tutorial that we didn't include the variation of lambda with length in the device model. Also the variation of the source and drain impedance is controlled by setting it per instance in the schematic. This is tedious. We will change the models.

We will add two new techniques to our modeling repertoire which we have seen in netlists previously. The first is that we will create our entire model within a subckt statement the same as our inverter was when we looked at the netlist. Secondly, we will use parameter statements to re-calculate the source and drain values for each instantiated mos device. Again we used this technique to vary the input DC source in the first tutorial.

We will also use one piece of spectre magic, called the inline statement. The inline statement precedes the word subckt and it makes the instantiated element within the subckt with the same name look like the entire subckt for the purposes of probing. All this means is that when we are plotting data, the subckt containing a pmos looks like a pmos model directly for the purposes of plotting.

Edit your mos6012.scs file and add the following. You can leave the models from the first tutorial intact because we are changing the model name from nmos6012 to nmos6012p for parameterized.

```
//   Created by: Kerwin Johnson Sept 2005.


simulator lang=spectre insensitive=yes


inline subckt nmos6012p (d g s b)
 parameters w=3e-6 l=1.5e-6 as=1.35e-11
 + ad=1.35e-11 ps=1.2e-5 pd=1.2e-5
 + nrs=1.5 nrd=1.5 lds=4.5e-6 ldd=4.5e-6


 model nmos6012i mos1
 + type = n
 + l = l
 + w = w
 + vto  = 0.75
 + kp   = 100e-6
 + lambda = 7e-2 * (1.5e-6 / l)
 + phi = 0.7
 + gamma=0.6
 + tox  = 1.5e-8
 + cj = 1e-4
 + cjsw = 5e-10
 + pb = 0.9
```