Tutorial: NanoSim Timing and Power Simulation

NanoSim Simulation

This tutorial demonstrates a basic NanoSim simulation using UNIX batch mode and a 4-bit adder.

Files Needed for the Basic Simulation

The following table lists the files needed for this tutorial. These files are located in the [nanosim_installation_directory]/*doc*/*ns*/*tutorials*/*nanosim*/*Timing_Power* directory.

File Name	Description
cfg	Batch-run configuration file
setup.spi	SPICE netlist for adder circuit
adder.vcd	Verilog description file
adder.vec	Vector file
run	Run script for this tutorial
cmos35t.mod	A BSIM3 v3 SPICE model

Procedure for Running the Basic Simulation Tutorial

Use the following procedure to run the basic tutorial.

1 Use the UNIX **cat** command to display the contents of the run script.

```
cat run
```

This script contains the following line:

```
nanosim -nspi setup.spi -nvec adder.vec -C cfg
```

The run script specifies the SPICE netlist, `setup.spi` and the command file for processing the netlist, `adder.vec`. It also specifies the cfg configuration file. Since no technology file is given, the simulator uses the *cmos35t.mod* BSIM3 model file instead of using a technology file.

For more information on command-line options, see the *NanoSim Command Reference*.

2 Use the UNIX cat command to display the contents of the configuration file.

```
cat cfg
```

This file contains the following configuration commands:

```
set_print_format for=fsdb

print_node_logic *

print_node_voltage *

report_node_powr gnd vdd

tv_node_setup s* - clk rise 0.5n window=3n

set_print_iwindow 10n 800n

report_block_powr x1 track_src=1 track_gnd=1
track_wasted=1 track_power=1 x1.*

report_block_powr x2 track_src=1 track_gnd=1
track_wasted=1 track_power=1 x2.*

report_block_powr x3 track_src=1 track_gnd=1
track_wasted=1 track_power=1 x3.*

report_block_powr x4 track_src=1 track_gnd=1
track_wasted=1 track_power=1 x4.*

print_probe_i avg x1* x2* x3* x4*
```

For more information on these commands, see the *NanoSim Command Reference*.

3 Use the UNIX **source** command to source the relevant CSHRC file to set up the path to run NanoSim.

```
source [nanosim_installation_directory]/CSHRC
```

4 Run the simulation with the *run* script. Check the file permissions to make sure the run script is set to be executable.

5 When the simulation is finished, list the directory contents. The following files are created:

nanosim.err
nanosim.fcap
nanosim.hist
nanosim.ignore
nanosim.log
nanosim.nodealias
nanosim.out
nanosim.stat

When the simulation ends, the following message appears:

```
Total number of errors reported in the .err file
(ADDER.err): 2
Please use the viewerror utility to view the
detailed error messages
Summary of Errors
=================

T_CODE(2):

    D_CODE (1): 2
```

6 Use the **viewerror** utility to translate the error file as follows:

```
viewerror -i nanosim.err -o errors
```

The error file *nanosim.err* is an encoded file that needs to be translated to plain English so the errors can be understood.

The translated file is called *errors.* and contains the following information.

```
SUMMARY:   There are total of 2 error messages, with:
           2 Timing Errors
#1    Timing Error: setup time violation at 324.18 ns clk rising
     at 324.18 and s[3] changing at 323.82 ns
     Diff 0.36 ns. Setup Time 0.50 ns required
     Specified by cfg.

#2    Timing Error: setup time violation at 624.18 ns
     clk rising at 624.18 and s[3] changing at 623.82 ns
     Diff 0.36 ns. Setup Time 0.50 ns required
     Specified by cfg.

These errors are the setup time errors from the setup timing
check.
```

7 View the *nanosim.log* file and inspect the power reports at the end of the file. You will see separate reports for each block that was specified in the four **report_block_powr** commands. (A sample of typical output follows.)

The first power report is the output from the **report_node_powr** command. This is a sample report. The actual numbers may be different in reports that you generate.

```
Current information calculated over the intervals:

     1.00000e+01 -  8.00000e+02 ns

Node: gnd
    Average current     :  1.91645e+03 uA
    RMS current         :  3.44505e+03 uA

    Current peak #1     :  4.46610e+04 uA  at   6.50100e+02 ns
    Current peak #2     :  3.85330e+04 uA  at   3.30100e+02 ns
    Current peak #3     :  3.21120e+04 uA  at   4.90100e+02 ns
    Current peak #4     :  3.20460e+04 uA  at   1.70100e+02 ns
    Current peak #5     :  2.59890e+04 uA  at   2.50100e+02 ns

Node: vdd
    Average current     : -1.94542e+03 uA
    RMS current         :  3.48094e+03 uA

    Current peak #1     : -4.46610e+04 uA  at   6.50100e+02 ns
    Current peak #2     : -3.85330e+04 uA  at   3.30100e+02 ns
    Current peak #3     : -3.21120e+04 uA  at   4.90100e+02 ns
    Current peak #4     : -3.20460e+04 uA  at   1.70100e+02 ns
    Current peak #5     : -2.59890e+04 uA  at   2.50100e+02 ns
```

The following report is a block power report for block x1. It is the output from the **report_block_powr** command. This is a sample report. The actual numbers may be different in reports that you generate.

```
Block: x1
    Number of nodes in block            :  17
    Number of elements in block         :  41
    Number of block supply nodes        :  1
    Number of block ground nodes        :  1
    Number of block biput nodes         :  1
    Number of block input nodes         :  2
    Number of block output nodes        :  1
    Number of block stages              :  10
    Number of block partial stages      :  1

    Average supply current              : -91.667342 uA
    RMS supply current                  :  495.562140 uA

    Average ground current              :  92.949747 uA
    RMS ground current                  :  488.153132 uA

    Average input current               :  0.000000 uA
    RMS input current                   :  0.000000 uA

    Average output current              :  0.406962 uA
    RMS output current                  :  48.157018 uA

    Average biput current               : -1.687595 uA
    RMS biput current                   :  54.301521 uA

    Average capacitive current          : -64.319114 uA
    RMS capacitive current              :  410.756931 uA

    Average wasted current              : -32.936076 uA
    RMS wasted current                  :  133.657216 uA

    Wasted current percentage           :  33.865623%

    Average block power                 :  461.861828 uW
    RMS block power                     :  2468.131632 uW
```

8 Use nWave to instantaneously view the waveforms of the power consumption. At the command prompt, type

```
nWave &
```

These waveforms were specified using the **print_probe_i** command in the cfg file.

9 From the nWave main window, select **File > Open** to open the *adder.out* file.

10 Use the **Signal** pull-down menu to select the signals that you want to view (see Figure 1).

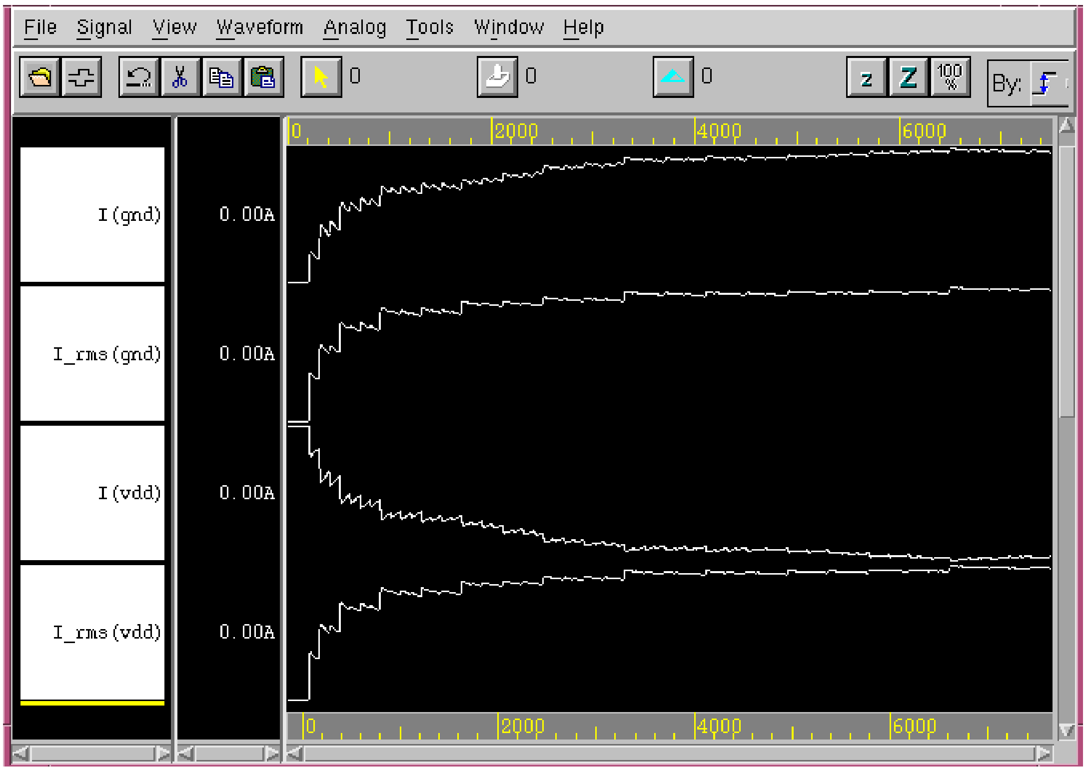

Figure 1 Waveform of basic adder circuit (selected signals)

11 When you have finished viewing the waveforms, select **File > Exit** to exit the program.