

# **SPICE Test Case Database Creation**

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# Outline

Motivation

Data Extraction for Database

Circuit Type Recognition

Conclusion

# Motivation

- Huge number of cases (20000~)
- Hard to locate particular case by case feature
- Establish the database to facilitate case searching by specified instance/model/feature/..., etc
- Work Schedule

Date	Tasks
Jul.15th—Jul.22th, 2014	Understand project goal and related specific scope
Jul.23th—Aug.10th, 2014	Write/refine script Collect technology, model, analysis info
Aug.11th—Aug.25th, 2014	Run script, build database
Aug.26th—Sep.15th, 2014	Circuit Type analyzing, write report

# Data Extraction for Database

## *Expected Database Format*

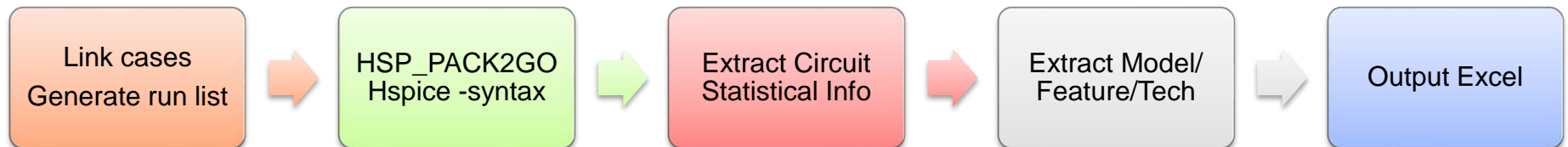
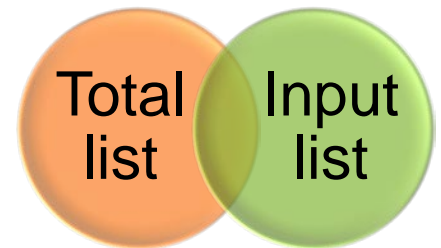
Case	Circuit Statistical Information				Model Level			Misc			Simulation Feature		
	# Node	# Elem	# Res	...	MOS Level	MOS Version	...	SRC	TECH	TYPE	SN	HB	...
top.sp	1229	2619	516	...	54	4.6	...	AMD	180nm	Amp	1	0	...
adc.sp	3704	8350	4951	...	9	NA	...	TI	NA	ADC	1	1	...
test.sp	10	6	0	...	NA	NA	...	NA	10nm	NA	1	0	...
1k.sp	3	1000	0	...	101	4.2	...	TSMC	EXIST	Mean Less	0	1	...

Note: The script doesn't include SRC and TYPE extraction, and these two info is analyzed manually for now.

# Data Extraction for Database

## *Script functionality*

- Input: <case list>
  - Total case list used in HSPICE daily/weekly regression
  - Only the orange part will be performed to easily enlarge database (default)
- Output: wiki\_stat\_list.xls list.right list.wrong
- General procedure ( `./wiki_case_stat_list.pl <case list>` ):



- Option:
  1. -l: Include <case list>, only cases in the list will be performed.
  2. -nhsp: disable HSPICE to speed up but circuit statistical info will be omitted.

# Data Extraction for Database

## *Circuit statistical information*

- .lis generated by 'hspice -syntax'
- Append option in netlist
  - lis\_new=0
  - nomod=0
- Two types of formats
- Both lead by
  - ‘\*\*\* Circuit Statistics \*\*\*’
- Uncertain element format in RF
  - JFET/U/B/S/N/Vector
- Circuit statistical error (9000787422)
  - B/S/W/Vector

- HSPICE Engine

```
***** Circuit Statistics *****
# nodes      =      847 # elements =    1421
# resistors  =      576 # capacitors =    627 # inductors  =      0
# mutual_inds =      0 # vccs      =      0 # vcvs      =      0
# cccs       =      0 # ccvs      =      0 # volt_srcs =    10
# curr_srcs  =      0 # diodes   =      0 # bjts      =      0
# jfets      =      0 # mosfets  =    208 # U elements =      0
# T elements =      0 # W elements =      0 # B elements =      0
# S elements =      0 # P elements =      0 # va device  =      0
# vector_srcs =      0 # N elements =      0
```

- RF Engine

```
***** Circuit Statistics *****
Resistors      :      84
Capacitors(total) :      17
Coupling Capacitors :      0
Voltage Sources :      10
Current Sources :      25
MOSFETs       :      82
Total # of Nodes :      448
Total # of Elements :      218
```

# Data Extraction for Database

## *Model level & Simulation feature*

- Model level

- Speed up by dot '.' in start of line
- .sp generated by HSP\_Pack2Go
- Regular expression for scientific notation of model level & version
- Multiline separated by '\'

```
.model nchpd_sr.2 \  
NMOS LEVEL = 54 LMIN = 0.027e-06
```

- Simulation feature

- Speed up by dot '.' in start of line
- .sp generated by HSP\_Pack2Go
- Check original .sp file
- Simulation feature missing in HSP\_Pack2Go result (9000787421)
  - .snosc
  - .hb
  - not limited to the features above
- Well organized to expand new feature in the script

# Data Extraction for Database

## Technology (Minimum Gate Length)

- Major consideration

1. Scientific notation & Unit

```
.model PENHMP_DL780_L100_302 PMOS LMIN = 96.5N
```

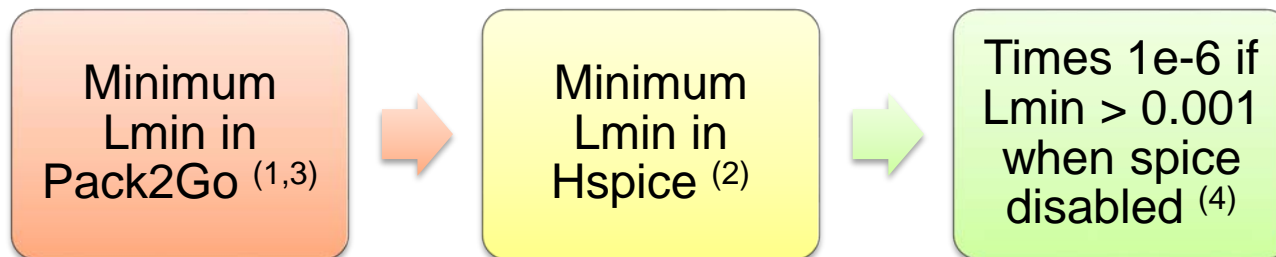
2. Equation-based

```
lmax = lmax_dg1 lmin = lmin_dg1 ln = 3.8e-007
```

3. Hspice result only contains the minimum employed size

4. Scale missing (nominal value: 1e-6) in Pack2Go

- Extraction Procedure





# Data Extraction for Database

## Script Performance

- Statistical Results

- Total # of cases: 20586
- Success cases: 19643 (95.42%)
- Fail cases: 943 (4.58%)
- Time consumption: Nearly 4 days

- Fail Reason

- Dummy case
- RF engine
- Design\_exploration (9000782954)

CASENAME	NODE	ELEMENT	RESISTOR	CAPACITC	INDUCTOR	MUTUAL_VCCS	VCVS	CCCS	CCVS	VOLT_SRC	CURR_SRC	DIODE	BIT	JFET	MOSFET	U
1 accuracy/amd/amd_nvds6.sp	84	103	32	1	0	0	0	0	0	0	13	0	0	24	0	33
2 accuracy/amd/amd_pld3.sp	47	19	0	0	0	0	0	0	0	0	1	0	0	0	0	18
3 accuracy/amd/amd1.sp	33	20	0	0	0	0	0	0	0	0	8	0	0	0	0	12
4 accuracy/amd/amd10.sp	12	20	0	0	0	0	0	0	0	0	11	0	0	0	0	9
5 accuracy/amd/amd11.sp	4	6	0	0	0	0	0	0	0	0	0	3	1	0	0	2
6 accuracy/amd/amd2.sp	33	20	0	0	0	0	0	0	0	0	8	0	0	0	0	12
7 accuracy/amd/amd3.sp	33	20	0	0	0	0	0	0	0	0	8	0	0	0	0	12
8 accuracy/amd/amd7.sp	24	16	0	0	0	0	0	0	0	0	9	0	0	0	0	7
9 accuracy/amd/amd9.sp	12	20	0	0	0	0	0	0	0	0	11	0	0	0	0	9
10 accuracy/amd/pdv.sp	12	20	0	0	0	0	0	0	0	0	11	0	0	0	0	9
11 accuracy/applctr/afll55_bdf.sp	18	33	13	4	0	0	4	0	0	0	5	1	4	2	0	0
12 accuracy/applctr/alm107.sp	18	33	13	4	0	0	4	0	0	0	5	1	4	2	0	0
13 accuracy/applctr/alter2.sp	4	4	0	0	0	0	0	0	0	0	2	0	0	0	0	2
14 accuracy/applctr/dlsto.sp	32	31	5	0	0	0	0	0	0	0	21	0	0	0	0	5
15 accuracy/applctr/h5853.sp	171	167	39	8	1	0	0	0	0	0	6	2	0	26	0	85
16 accuracy/applctr/tunnelk.sp	3	3	1	0	0	0	1	0	0	0	1	0	0	0	0	0
17 accuracy/bogdant/test_sweep.sp	6	6	0	0	0	0	0	0	0	0	5	0	0	0	0	1
18 accuracy/bypass/pil.sp	106	66	19	1	0	0	0	0	0	0	12	0	0	0	0	34
19 accuracy/clean/h7990.sp	4139	7997	782	3161	0	0	0	0	0	0	208	0	1711	0	0	2135
20 accuracy/clean/tqtl.sp	46	106	3	18	0	0	0	0	0	0	4	0	0	0	0	72
21 accuracy/dcoq/bj3.sp	659	739	65	9	0	0	0	0	0	0	5	2	417	145	96	0
22 accuracy/dcoq/corv.sp	2	3	0	1	0	0	0	0	0	0	0	1	1	0	0	0
23 accuracy/dcoq/h6355.sp	295	2926	0	1756	0	0	0	0	0	0	2	0	584	0	0	584
24 accuracy/dcoq/h6582.sp	870	765	8	341	6	0	0	0	0	0	53	0	0	0	0	348
25 accuracy/dcoq/hang.sp	58	82	18	8	1	0	11	9	3	0	14	2	14	0	2	0
26 accuracy/dcoq/opamp.sp	649	288	102	18	0	0	0	0	0	0	6	0	0	0	162	0
27 accuracy/result/change.sp	17	24	6	3	0	0	4	8	0	0	3	0	0	0	0	0
28 accuracy/155/h9867n.sp	8	12	0	0	0	0	0	0	0	0	7	0	0	0	0	5
29 accuracy/155/h9867p.sp	8	12	0	0	0	0	0	0	0	0	7	0	0	0	0	5
30 accuracy/155/utov1.sp	16	8	3	1	0	0	0	0	0	0	3	0	0	0	0	0
31 accuracy/155/utov3.sp	90	12	5	3	0	0	0	0	0	0	3	0	0	0	0	0

# Data Extraction for Database

## *Reported STARs*

- 5 reported STARs

STAR ID	Description	Example
9000781561	Hspice path error	hspice -i <b>temp</b> /test1.p -o temp/test1.lis
9000782953	Pack2Go path error	HSP_Pack2Go -i input.sp -d <b>/remote/hspbuild4/lpsang/slow2/temp/</b>
9000782954	Unable to handle design exploration in Pack2Go	misc/exploration/mos.sp
9000787421	Missing simulation feature in Pack2Go	.snosc / .hb
9000787422	Circuit Statistical Error in Hspice	B / S / W / Vector

# Circuit Type Recognition

## Methodology

- File name

customers/NEC/ADC10bit/10bitadc.sp	3502	8609	0	0	0	7807	adc
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- Subckt name and node name

```
SubCkt: bgact_30_alib_2a_amp act_vp biasref cactbgdis cactbgen gate trim[2] trim[1] trim[0] vbgr vcc_de
```

- Same number of node and number

bench/analog/altera_pll/altera_pll.sp	7224	3008	0	9	0	2902	pll
bench/analog/altera_pll/altera_pll_bdf.sp	7224	3008	0	9	0	2902	pll
bench/analog/altera_pll/altera_pll_Ultrashort.sp	7224	3008	0	9	0	2902	pll

- Meaningless case

- Node/Element Ratio

model/capacitor/frmc/frmc10k.sp	3	10002	0	0	0	0	meaningless
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- Factitious setting number of elements

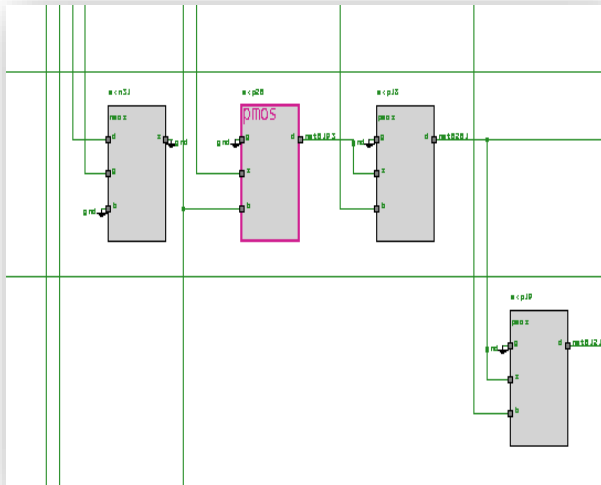
cmi_model/tmi/star9000487906/case/mac.sp	300005	100004	0	0	0	100000	meaningless
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# Circuit Type Recognition

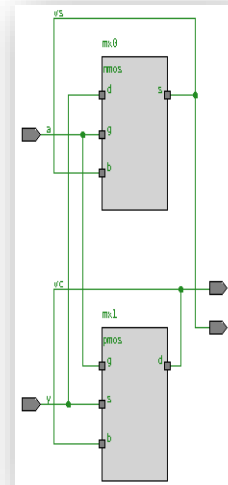
## *Results & Difficulties*

- Results: 647 / 997 / 1398 (Recognized / Checked / Total)
- Schematic Viewer: Cdesigner & CX
  - Low recognition rate
  - Cdesigner can't open most of the cases
  - The schematic drawn by CX is poor for circuit recognition

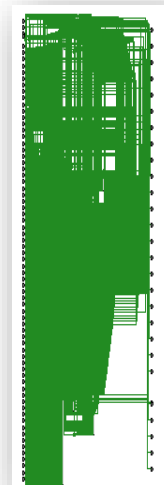
**Device Wrapper**



**Messy Routing**



**Congestion**



# Conclusion

- Script for basic data extraction has been completed and well organized for future maintenance.
- 95.42% of the total 20586 cases has been extracted.
- Report 5 STARs about Hspice and HSP\_Pack2Go.
- Circuit Recognition need more automatic method to solve, and a standard format for new cases may help.

# Thank You

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