

How to add HiSIM_HV into SPICE3f5

Remarks-1: The "c" source code from U.C.Berkley has been ported to Linux. The port "spice3f5sfix" is available from "ibiblio"(see the following URL).

<http://www.ibiblio.org/pub/Linux/apps/circuits/spice3f5sfix.tar.gz>

This update procedure is premised to install HiSIM_HV into "spice3f5sfix" on the RedHat Enterprise LINUX Version 3, and cannot be applied to the SUN OS and others.

Remarks-2: The implementation into SPICE3 basically followed BSIM-SOI. However, modifications and improvements are done by the Ultra-Small Device Laboratory at Hiroshima University, which are notified by USDL-HU.

Remarks-3: The HiSIM_HV model is level 62 in SPICE3f5.

- (1) make "hisimhv" directory in ./src/lib/dev
- (2) copy HiSIM_HV sources to ./src/lib/dev/hisimhv directory
- (3) update the following to "./conf/defaults"

```
@@ -262,7 +262,12 @@
#          vcvs:      voltage-controlled voltage source
#          vsrc:      voltage source

-DEVICES   = asrc bjt bsim1 bsim2 bsim3 cap cccs ccvs csw dio ind isrc ¥
+DEVICES   = hisimhv ¥
+          asrc bjt bsim1 bsim2 bsim3 cap cccs ccvs csw dio ind isrc ¥
+          jfet ltra mes mos1 mos2 mos3 mos6 res sw tra urc ¥
+          vccs vcvs vsrc
```

- (4) update the following to "./conf/linux"

```
@@ -14,7 +14,9 @@

CC_OPT= -O2 -s

-SPICE_DIR   = /usr/local/spice
+SPICE_DIR   = /usr/local/spice-hisim      /* Installation directory for binary */
SPICE_LIB_DIR= $(SPICE_DIR)/lib
SPICE_EXEC_DIR= $(SPICE_DIR)/bin
```

- (5) update the following to "./src/bin/bconf.c"

```
@@ -106,6 +106,9 @@
#ifdef DEV_bsim3
#include "bsim3itf.h"
#endif
+#ifdef DEV_hisimhv /*added by USDL-HU*/
+#include "hsmhv.itf.h" /*added by USDL-HU*/
+#endif /*added by USDL-HU*/
#include "mos2itf.h"
#include "mos3itf.h"
#include "jfetitf.h"
@@ -138,6 +141,9 @@
#ifdef DEV_bsim3
#include "bsim3/bsim3itf.h"
#endif
```

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```
+#ifdef DEV_hisimhv          /*added by USDL-HU*/
+#include "hisimhv/hsmhvitf.h" /*added by USDL-HU*/
+#endif                      /*added by USDL-HU*/
  #include "mos2/mos2itf.h"
  #include "mos3/mos3itf.h"
  #include "jfet/jfetitf.h"
@@ -221,6 +227,9 @@
  #ifdef DEV_bsim3
    &B3info,
  #endif
+#ifdef DEV_hisimhv /*added by USDL-HU*/
+  &HSMHVinfo, /*added by USDL-HU*/
+#endif /*added by USDL-HU*/
  #ifdef DEV_cap
    &CAPinfo,
  #endif
```

(6) update the following to “./src/bin/cconf.c”

```
@@ -121,6 +121,9 @@
  #ifdef DEV_bsim3
  #include "bsim3itf.h"
  #endif
+#ifdef DEV_hisimhv          /*added by USDL-HU*/
+#include "hsmhvitf.h"      /*added by USDL-HU*/
+#endif                      /*added by USDL-HU*/
  #include "mos2itf.h"
  #include "mos3itf.h"
  #include "jfetitf.h"
@@ -153,6 +156,9 @@
  #ifdef DEV_bsim3
  #include "bsim3/bsim3itf.h"
  #endif
+#ifdef DEV_hisimhv          /*added by USDL-HU*/
+#include "hisimhv/hsmhvitf.h" /*added by USDL-HU*/
+#endif /*added by USDL-HU*/
  #include "mos2/mos2itf.h"
  #include "mos3/mos3itf.h"
  #include "jfet/jfetitf.h"
@@ -236,6 +242,9 @@
  #ifdef DEV_bsim3
    &B3info,
  #endif
+#ifdef DEV_hisimhv /*added by USDL-HU*/
+  &HSMHVinfo, /*added by USDL-HU*/
+#endif /*added by USDL-HU*/
  #ifdef DEV_cap
    &CAPinfo,
  #endif
```

(7) update the following to ./src/bin/config.c

```
@@ -68,6 +68,9 @@
  #ifdef DEV_bsim3
  #include "bsim3itf.h"
  #endif
+#ifdef DEV_hisimhv          /*added by USDL-HU*/
+#include "hsmhvitf.h"      /*added by USDL-HU*/
+#endif /*added by USDL-HU*/
  #include "mos2itf.h"
  #include "mos3itf.h"
```

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```

#include "jfetif.h"
@@ -100,6 +103,9 @@
#include DEV_bsim3
#include "bsim3/bsim3itf.h"
#endif
+#ifdef DEV_hisimhv          /*added by USDL-HU*/
+#include "hisimhv/hsmhvif.h" /*added by USDL-HU*/
+#endif                    /*added by USDL-HU*/
#include "mos2/mos2itf.h"
#include "mos3/mos3itf.h"
#include "jfet/jfetif.h"
@@ -183,6 +189,9 @@
#include DEV_bsim3
        &BSIM3info,
#endif
+#ifdef DEV_hisimhv        /*added by USDL-HU*/
+        &HSMHVinfo,      /*added by USDL-HU*/
+#endif                    /*added by USDL-HU*/
#include DEV_cap
        &CAPinfo,
#endif

```

(8) update the following to “./src/lib/inp/inp2m.c”

```

@@ -32,10 +32,12 @@
char *nname2; /* the second node's name */
char *nname3; /* the third node's name */
char *nname4; /* the fourth node's name */
+char *nname5; /* the fifth node's name added by USDL-HU */
GENERIC *node1; /* the first node's node pointer */
GENERIC *node2; /* the second node's node pointer */
GENERIC *node3; /* the third node's node pointer */
GENERIC *node4; /* the fourth node's node pointer */
+GENERIC *node5; /* the fifth node's node pointer added by USDL-HU */
int error; /* error code temporary */
GENERIC *fast; /* pointer to the actual instance */
int waslead; /* flag to indicate that funny unlabeled number was found */
@@ -44,6 +46,7 @@
INPmodel *thismodel; /* pointer to model description for user's model */
GENERIC *mdfast; /* pointer to the actual model */
IFuid uid; /* uid for default model */
+int flg_node5 = 0 ; /*added by USDL-HU*/

        line = current->line;
        INPgetTok(&line,&name,1);
@@ -57,6 +60,12 @@
        INPgetTok(&line,&nname4,1);
        INPtermInsert(ckt,&nname4,tab,&node4);
        INPgetTok(&line,&model,1);
+        if ( INPlookMod(model) == 0 ) { /*added by USDL-HU*/
+                nname5 = model; /*added by USDL-HU*/
+                INPtermInsert(ckt,&nname5,tab,&node5); /*added by USDL-HU*/
+                INPgetTok(&line,&model,1); /*added by USDL-HU*/
+                flg_node5 = 1 ; /*added by USDL-HU*/
+        } /*added by USDL-HU*/
        INPinsert(&model,tab);
        thismodel = (INPmodel *)NULL;
        current->error = INPgetMod(ckt,model,&thismodel,tab);
@@ -70,6 +80,8 @@
                && thismodel->INPmodType != INPtypelook("BSIM1")
                && thismodel->INPmodType != INPtypelook("BSIM2")

```

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```

+         && thismodel->INPmodType != INPtypelook("BSIM3")
+         && thismodel->INPmodType != INPtypelook("HiSIMHV") /*added by USDL-HU*/
+     )
+
+     {
+         LITERR("incorrect model type")

```

(9) update the following to “./src/lib/inp/inpdomod.c”

```

@@ -108,16 +108,57 @@
+     }
+     break;
-     default: /* placeholder; use level 9 for the next model */
+     case 62: /*added by USDL-HU*/
+         type = INPtypelook("HiSIMHV");
+         if(type < 0) {
+             err = INPmkTemp(
+                 "Device type HiSIMHV not available in this binary¥n");
+         }
+         break;
+     default: /* Use level 8 or higher levels for the other models */
+         err = INPmkTemp(
+             "Only MOS device levels 1-8 are supported in this binary¥n");
+         "Only MOS device levels 1-8, 62 are supported in this binary¥n");
+         break;
+     }
+     INPmakeMod(modname,type,image);

```

(10) update the following to “./src/lib/inp/inpfindl.c “

```

@@ -1,12 +1,13 @@
- /* INPfindLev(line)
-  * find the 'level' parameter on the given line and return its
-  * value (1,2,or 3 for now, 1 default)
-  */
+/* INPfindLev(line)
+ * Find the 'level' parameter value on the model file
+ * The HiSIM_HV model is level 62 in SPICE3.
+ */

#include "spice.h"
#include "misc.h"
@@ -20,62 +21,105 @@
INPfindLev(line,level)
char *line;
int *level;
- {
- char *where;

+ {
+ char *where;
+ char LevArray[3]; /* save individual level numerals */
+ char *LevNumString; /* points to the level string */
+ int i_array = 0;
+ where = line;

- while(1) {
-     where = index(where,'l');
-     if(where == 0) { /* no 'l' in the line => no 'level' => default */
-         *level = 1;
-         return((char *)NULL);
-     }

```

----- Abbreviation-----

```

-     case '9':
-         *level=9;
-         return((char *)NULL);
-     default:
-         *level=1;
-         return(INPmkTemp(
-             " illegal argument to level parameter - level=1 assumed"));
-     }
+ while(1)
+ { where = index(where,'l');
+   if(where == 0) /* no 'l' in the line => no 'level' => default */
+     { *level = 1; /* the default model is level=1 */
+       return((char *)NULL);
+     }
+   if(strncmp(where,"level",5)!=0)
+     { /* this l isn't in the word 'level', try again */
+       where++; /* make sure we don't match same char again */
+       continue;
+     }
+   /* The word level found, lets look at the rest of the line */
+   where += 5;
+   while((*where == ' ') || (*where == '\t') || (*where == '=') ||
+         (*where == ',') || (*where == '(') || (*where == ')') ||
+         (*where == '+'))
+     { where++;
+     }
+   LevNumString = LevArray;
+   while(!((*where == ' ') || (*where == '\t') || (*where == '=') ||
+         (*where == ',') || (*where == '(') || (*where == ')') ||
+         (*where == '+')))
+     { LevArray[i_array] = *where;
+       i_array++;
+       where++;
+     }
+   LevArray[i_array] = '\0';
+
+   if (strcmp(LevNumString, "1") == 0)
+     { *level=1;
+       return((char *)NULL);
+     }
+   else if (strcmp(LevNumString, "2") == 0)
+     { *level=2;
+       return((char *)NULL);
+     }
+   else if (strcmp(LevNumString, "3") == 0)
+     { *level=3;
+       return((char *)NULL);
+     }
+   else if (strcmp(LevNumString, "4") == 0)
+     { *level=4;
+       return((char *)NULL);
+     }
+   else if (strcmp(LevNumString, "5") == 0)
+     { *level=5;
+       return((char *)NULL);
+     }
+   else if (strcmp(LevNumString, "6") == 0)

```

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```

+     { *level=6;
+       return((char *)NULL);
+     }
+     else if (strcmp(LevNumString, "7") == 0)
+     { *level=7;
+       return((char *)NULL);
+     }
+     else if (strcmp(LevNumString, "8") == 0)
+     { *level=8;
+       return((char *)NULL);
+     }
+     else if (strcmp(LevNumString, "9") == 0)
+     { *level=9;
+       return((char *)NULL);
+     }
+     else if (strcmp(LevNumString, "62") == 0)           /*added by USDL-HU*/
+     { *level=62;
+       return((char *)NULL);
+     }
+     else
+     { *level=1;
+       printf("illegal argument to 'level' – level=1 assumed\n");
+       return(INPmkTemp("illegal argument to 'level' – level=1 assumed"));
+     }
+   }
+ }

```

(11) update the following to “./src/lib/ckt/noisean.c”

```

@@ -109,6 +111,14 @@
         ckt->CKTdcMaxIter);

        if (error) return(error);

+
+       /*added by USDL-HU*/
+       /* Noise should call CKTload with MODINITSMSIG, as is done by AC: */
+       ckt->CKTmode = (ckt->CKTmode & MODEUIC) | MODEDCOP | MODEINITSMSIG;
+       error = CKTload(ckt);
+       if(error) return(error);
+
        data = (Ndata*)MALLOC(sizeof(Ndata));
        step = 0;
        data->freq = job->NstartFreq;
@@ -261,6 +271,7 @@
        error = CKTnoise(ckt,N_DENS,N_CLOSE,data);
        if (error) return(error);

+#ifdef INT_NOISE
        data->numPlots = 0;
        data->outNumber = 0;

@@ -280,6 +291,7 @@
        error = CKTnoise(ckt,INT_NOIZ,N_CLOSE,data);
        if (error) return(error);
    }
+#endif

```

(12) update the following to “./util/skeleton/make_def.bd”

```

@@ -114,7 +114,12 @@

```

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DEV_SUBDIRS = \$(DEVICES)

-ALL_DEVICES = asrc bjt bsim1 bsim2 bsim3 cap cccs ccvs csw dio ind isrc ¥
+ALL_DEVICES = hisimhv ¥
+ asrc bjt bsim1 bsim2 bsim3 cap cccs ccvs csw dio ind isrc ¥
jfet ltra mes mos1 mos2 mos3 mos6 res sw tra urc ¥
vccs vcvs vsrc

(13) Let's try to compile and install

- > ./util/build clean /* If you need to clean the object modules */
- > ./util/build linux /* Compilation */
- > ./util/build linux install /* Installation Spice3 modules to SPICE_DIR */