The README file for gdrlib, GRAPE-DR interface/driver libraries

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(part of the codes were written by Drs. Kawai, Fukushige and Koike)

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Contents

1 Installation

Installation:
   The following is the minimal guide for installation.

1. Install the card and device driver. Here, I assume you have installed correct driver and you have the device files

    ```
    /dev/grape7eN (N=0,1,2,3)
    ```

    If not, consult to KFCR web page and install their driver software.

2. Get the archive from

    http://jun.artcompsci.org/softwares/gdrlib/gdrlibexport.tgz

3. extract it at some directory. by

    ```
    tar xvzf gdrlibexport.tgz
    ```

    Two directories are made (vpm-sim and gdrlib). Most of files are under gdrlib.

4. set environment variable GDRBASEDIR to gdrlib. For example, if you ran tar at directory /home/foo/src,

    ```
    setenv GDRBASEDIR /home/foo/src/gdrlib (csh)
    GDRBASEDIR=/home/foo/src/gdrlib ; export GDRBASEDIR (sh/bash etc)
    ```

    Some of the utility programs rely on this variable. So please add this to your .cshrc or .bashrc (or whatever you use) file.

5. run make by

    ```
    cd $GDRBASEDIR
    make all
    ```

    If you are very lucky, you'll see the message

    ```
    make succeeded
    ```

    In this case, you can go to the next step. If you see something like

    ```
    File foobar  missing
    make failed
    ```

    Well, good luck. Contact JM if all else failed.

6. if not done yet, update the firmware of your GRAPE-DR card, by

```
cd $GDRBASEDIR
make program_card
```

On the machine with GRAPE-DR card. This will first erase the firmware (FPGA programming data) of GDR, and then reprogram it with the data (gdrtb3/data/output.rpd).

It should finish with messages like:

```
    7.8 MB (96%) done
    7.2 MB (90%) done
  done.
    7.5 MB (93%) done
    7.8 MB (96%) done
  done.
```

When this reprogramming finished, you need to turn off the machine and restart, in order to force FPGA load new firmware (rebooting does not let FPGA reload the data).

BEWARE: Before turning off the machine, make absolutely sure that reprogramming processes are all finished (they might be running background). If you turn off the machine before reprogramming is finished, your GRAPE-DR card will never boot up.

After your machine is restarted, make sure that device files

```
/dev/grape7eN (N=0,1,2,3)
```

are all there. If not, well, you need to figure out what is wrong.

7. run the initialization script by

```
csh -f $GDRBASEDIR/gdrtb3/bin/singinit0.csh
```

If you are very lucky, you'll see the message

```
chip 0 : 4.000000e+00 4.000000e+00 4.000000e+00 4.000000e+00   error=0
chip 1 : 8.000000e+00 8.000000e+00 8.000000e+00 8.000000e+00   error=0
chip 2 : 1.600000e+01 1.600000e+01 1.600000e+01 1.600000e+01   error=0
chip 3 : 1.200000e+01 1.200000e+01 1.200000e+01 1.200000e+01   error=0
```

If you see something else, try the same command again. Example of message is:

```
DMAW timeout error for hib 0
hib 0 hibreg 0x18 =    b00f0       20 dma1 regs:
hib 0 hibreg 0x28 =     4000    23000 misc regs:
  [0]: 0x02bc3fff  [1]: 0x02bc3fff  [2]: 0x02bc3fff  [3]: 0x02bc3fff
  [4]: 0x00000fcf  [5]: 0x00000000  [6]: 0x891bcdef  [7]: 0x01234567
  [8]: 0x9abcdef0  [9]: 0x12345678  [a]: 0xabcdef01  [b]: 0x23456789
  [c]: 0xcdef0123  [d]: 0x456789ab  [e]: 0x00000008  [f]: 0x000001d0
 chip 0 : nan 4.000000e+00 4.000000e+00 1.508975e-315   error=1
```

If error persists after a number of trials (something like 10-20), try reboot-ing the machine. There is something not quire right in the reset logic of the current card firmware, which sometimes prevents the card from being correctly configured.

The ruby script singinit.rb calls singinit0.csh for many times and if it failed for 10 times let the machine reboot. So you can add this script to your /etc/rc.d/rc.local file, so that GRAPE-DR is automatically correctly configured at the boot time.

8. run simple test program by

```
cd $GDRBASEDIR/gdrtb3/s*4/g5work
testsimplegravity
```

Last several lines of output should look like:

```
test result i=124, x, y, z, pot=   2.2241655e-02  -3.5558756e-02   4.0199178e-0
test result i=125, x, y, z, pot=   2.0320930e-01   4.3498625e-01   6.8560934e-0
test result i=126, x, y, z, pot=  -9.9551894e-02   2.9829155e-01  -4.8519510e-0
test result i=127, x, y, z, pot=   2.8926574e-01  -2.0044886e-01   1.6011464e-0
Max err = 9.09026e-08 7.47371e-08
elapsed time 3.732610e-02 [sec] jtrans 9.536743e-07 [sec] itrans 2.503395e-05 [
```

If you see very different numbers (in particular for Max err), something might be wrong.

9. Test the GRAPE-5 compatibility library by

```
cd $GDRBASEDIR/gdrtb3/s*4/g5work
grape-g5 < testin8k
```

Last several lines of output should look like:

```
T=       5.000  E =    -0.234403117
DE=-5.18459339e-05  V.R. =   0.478515
T=       5.000  E =    -0.234403117
```

```
             DE=-5.18459339e-05  V.R. =    0.478515
             CM :-4.00130e-17  6.76881e-17  7.18707e-17
             CMV: 5.33292e-18  1.93124e-17  2.50586e-17
             AM : 7.38522e-03 -1.07756e-02  4.48527e-03
             Exit  diag:CPU sec.=         3.62
             JP= 1.821004e+06 161 IP= 7.261850e+04 10304 RUN = 9.207827e+05 10304
```

10. Test the GRAPE-6 compatibility library by

    ```
    cd $GDRBASEDIR/gdrtb3/s*4/hermite
    testgrape6
    ```

    Last several lines of output should look like:

    ```
    i:   98 acc: 1.543805e-01  9.378150e-01  1.686263e+00
             jerk 2.547531e+00  -5.586068e-02  -8.773696e-01
     pot, flag: -1.610577e+00 0
    i:   99 acc: -1.339726e+00  8.797277e-01  2.482934e-01
             jerk -2.699727e-01  -6.660465e-01  -6.509609e-01
     pot, flag: -1.403734e+00 0
    ```

11. Test the GRAPE-6 compatibility library by

    ```
    cd $GDRBASEDIR/gdrtb3/s*4/pit
    pit_gdrg6_lx -i test1024
    ```

    Last several lines of output should look like:

    ```
    Time= 10 N= 1024
    Energies(KE,PE,ETOT)=  0.237124709340127804  -0.497582668163563113  -0.2604579
    CMPOS= -9.40491643944144431e-09  -1.22107975606940491e-08  -2.8332864914919252
    CMV = 6.61856012460241769e-10  2.73682332628836719e-10  -5.24483237916706369e-
    steps = 2391918 Bsteps = 35867 CPU time 6.85389590263366699
    speed = 21.4416159256919983 Gflops
    JP= 1.273452e+03 IP= 1.205301e+05 RUN = 1.385896e+05
    ```

2 Linking

2.1 Common stuff

All libraries and header files are in $GDRBASEDIR/gdrtb3/lib (I have not created "include" directory...). So you need option

   `-I$GDRBASEDIR/gdrtb3/lib [In Makefile, -I$(GDRBASEDIR)/gdrtb3/lib]`

for compiling and

   `-L$GDRBASEDIR/gdrtb3/lib [In Makefile, -L$(GDRBASEDIR)/gdrtb3/lib]`

for linking.

2.2 GRAPE-5

Use

```
#include "g5sim-gdr.h"
```

for header file, and

```
-L$GDRBASEDIR/gdrtb3/lib  -lgdrgrav -lsing -lhib
```

for linking.

2.3 GRAPE-6

Use

```
#include "grape6.h"
```

for header file, and

```
-L$GDRBASEDIR/gdrtb3/lib  -lgdrg6 -lsing -lhib
```

for linking.