Report: OOMMF on GPU

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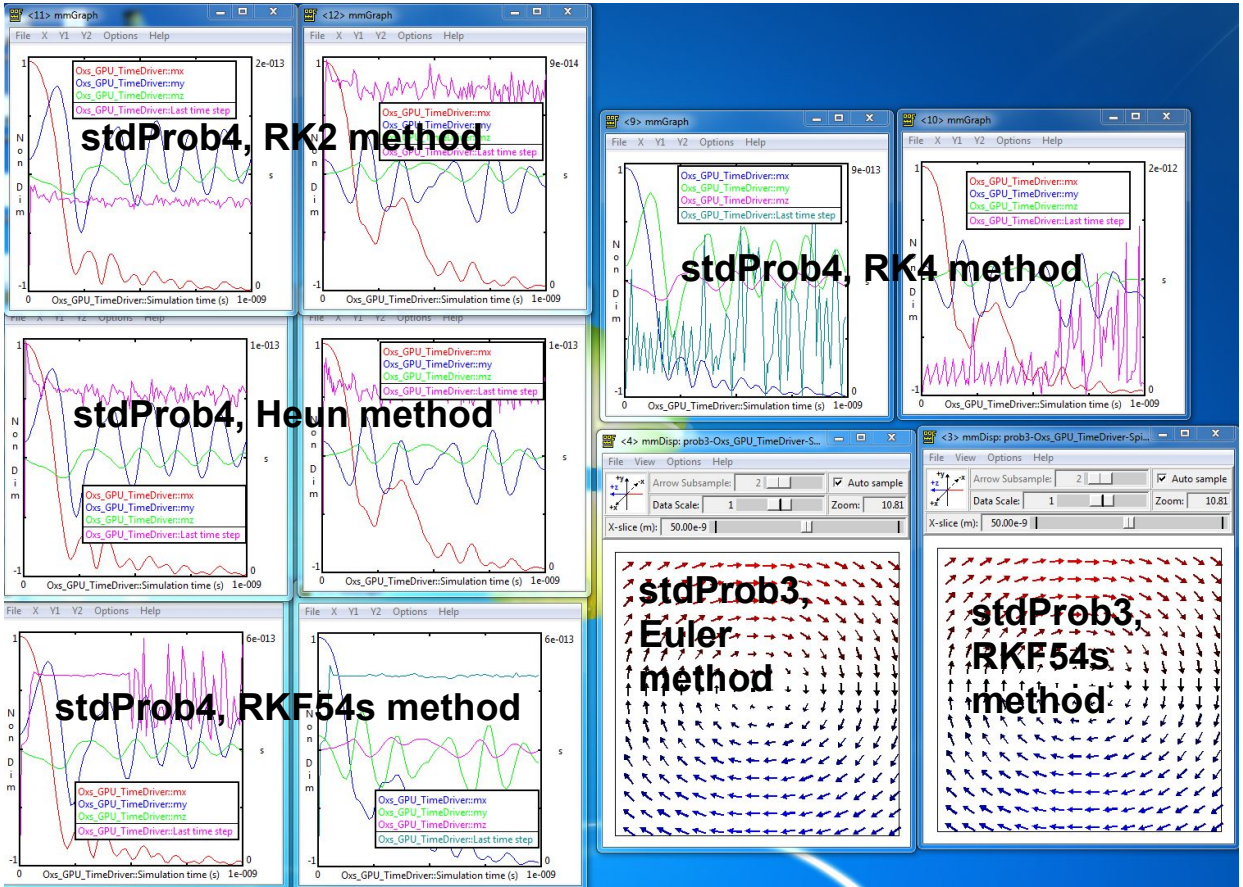
Outline

- Validation
- Benchmark
- Installation Instructions
- ChangeList
- Future Work

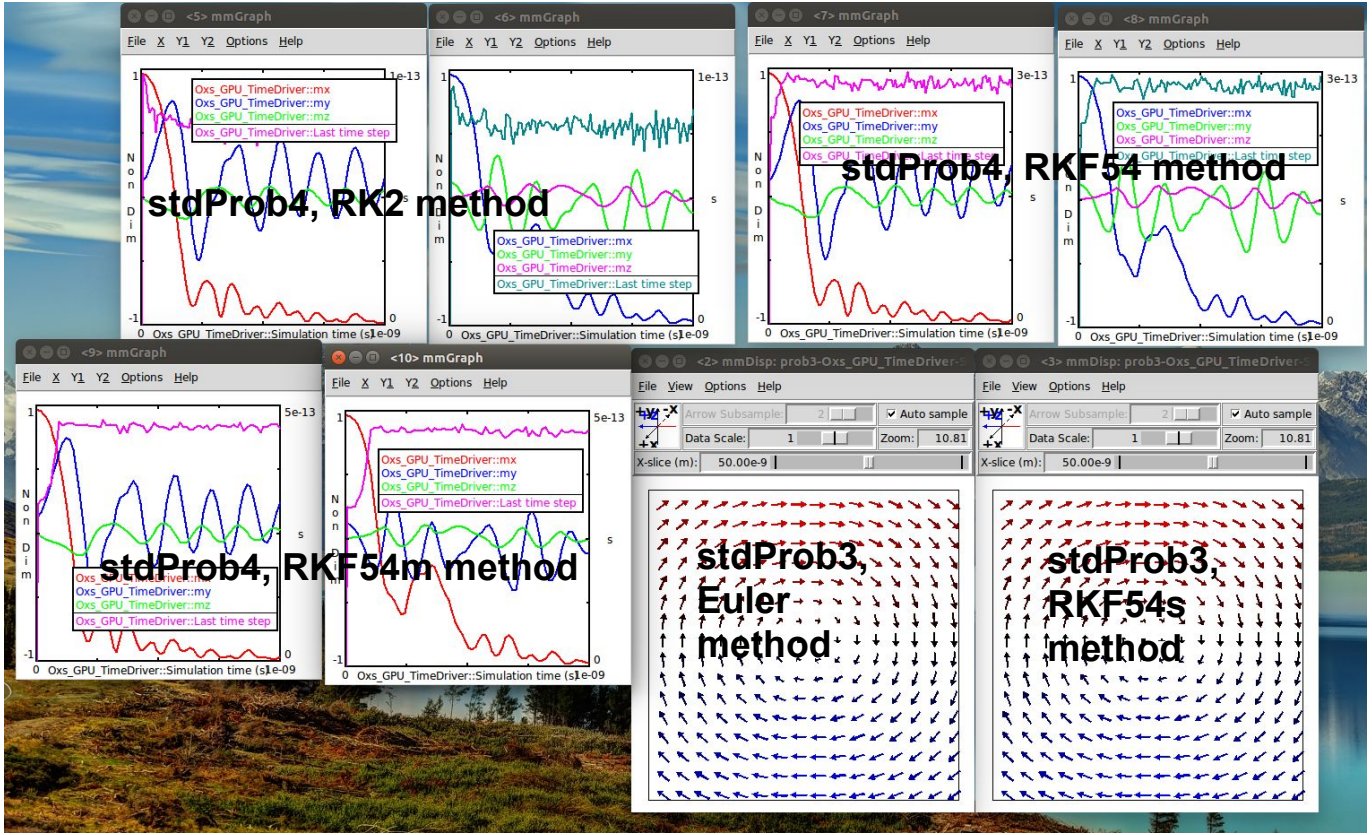
Validation on Windows

- Consistent <M>
- Noticeable difference in the time-step sizes.



Validation on Linux (Ubuntu14.04)

- Consistent <M>
- Noticeable difference in the time-step sizes.



Benchmark (modified stdProb3, Euler method)

Windows (64 bit), Nvidia GTX690 (2GB memory), Intel Xeon E5-1650@3.2Hz

CPU Wall Time/Field Evaluation in [ms]

CPU_Wall_Time/FE [ms] (SpeedUp)	GPU (single prec.)	GPU (double prec.)	CPU-1 thread (double prec.)	CPU-6 thread (double prec.)
4K (16^3)	0.91 (1.8x)	1.18 (1.4x)	1.65	0.71 (2.3x)
32K (32^3)	1.59 (8.8x)	2.99 (4.7x)	14.00	5.49 (2.5x)
256K (64^3)	5.64 (25.0x)	17.58 (8.0x)	140.7	51.56 (2.7x)
2M (128^3)	42.75 (29.1x)	148.1 (8.4x)	1242.9	470.1 (2.6x)
4M (128x128x256)	102.2 (34.8x)	N/A	3556.4	993.4 (3.6x)

Benchmark (modified stdProb3, RKF54s method)

Windows (64 bit), Nvidia GTX690 (2GB memory), Intel Xeon E5-1650@3.2Hz

CPU Wall Time/Field Evaluation in [ms]

CPU_Wall_Time/FE [ms] (SpeedUp)	GPU (single prec.)	GPU (double prec.)	CPU-1 thread (double prec.)	CPU-6 thread (double prec.)
4K (16^3)	0.84(2.7x)	0.84(2.7x)	2.24	0.51(4.4x)
32K (32^3)	0.94 (19.4x)	2.36(7.8x)	18.29	3.90(4.7x)
256K (64^3)	5.23 (34.3x)	17.35(10.4x)	179.54	39.29(4.6x)
2M (128^3)	46.63 (31.1x)	153.20(9.5x)	1450.9	324.9(4.5x)
4M (128x128x256)	94.58 (31.1x)	N/A	3040.9	680.3(4.5x)

Installation Instructions

Windows (Windows 7, 64 bit)

1. Control Panel -> System and Security -> System -> Advanced System Settings -> Advanced -> Environment Variables, add CUDA_HOME = % CUDA_PATH%
2. tclsh oommf.tcl pimake clean + tclsh oommf.tcl pimake

Installation Instructions

Linux (Ubuntu, 64 bit)

1. export OOMMF_TCL_INCLUDE_DIR=/usr/include/tcl8.6
2. export OOMMF_TK_INCLUDE_DIR=/usr/include/tcl8.6
3. export OOMMF_TK_CONFIG=/usr/lib/x86_64-linux-gnu/tk8.6/tkConfig.sh
4. export OOMMF_TCL_CONFIG=/usr/lib/x86_64-linux-gnu/tcl8.6/tclConfig.sh
5. export CUDA_HOME=<PATH_TO_CUDA_DIR>
6. tclsh oommf.tcl pimake clean + tclsh oommf.tcl pimake

Installation Instructions

Optional user configuration (works for both platforms)

1. [Optional] use double precision on GPU by replacing “#define CHOOSESINGLE” by “#define CHOOSEDOUBLE” at <oommf_dir>/app/oxs/base/GPU_devstruct.h
2. [Optional] choose a GPU other than GPU0 by replacing “#define DEV_NUM 0” by “#define DEV_NUM <TheIndexYouNeed>” at <oommf_dir>/app/oxs/base/GPU_devstruct.h. [Note] this will work only if multiple GPUs are available
3. tclsh oommf.tcl pimake

ChangeList

Changed Files

These files are slightly changed to accept the inherited GPU modules

1. <oommf_dir>/app/oxs/base/driver.h : a new constructor declared
2. <oommf_dir>/app/oxs/base/driver.cc : a new constructor defined
3. <oommf_dir>/app/oxs/ext/timeevolver.h: two new constructors defined

These files are slightly changed for compilation purpose

1. <oommf_dir>/config/options.tcl
2. <oommf_dir>/pkg/oc/procs.tcl
3. <oommf_dir>/app/pimake/csourcefile.tcl
4. <oommf_dir>/app/pimake/platform.tcl

ChangeList

Added Files

1. <oommf_dir>/app/oxs/base/GPU_devstruct.h
2. <oommf_dir>/app/oxs/base/GPU_chunkenergy.h
3. <oommf_dir>/app/oxs/base/GPU_energy.h
4. <oommf_dir>/app/oxs/ext/GPU_timedriver.h
5. <oommf_dir>/app/oxs/ext/GPU_timeevolver.h
6. <oommf_dir>/app/oxs/local/GPU_devstruct.cu
7. <oommf_dir>/app/oxs/local/GPU_helper.h
8. <oommf_dir>/app/oxs/local/GPU_helper.cu
9. <oommf_dir>/app/oxs/local/GPU_timedriver.cc
10. <oommf_dir>/app/oxs/local/GPU_timeevolver.cc

ChangeList

Added Files

1. <oommf_dir>/app/oxs/local/GPU_chunkenergy.cc
2. <oommf_dir>/app/oxs/local/GPU_energy.cc
3. <oommf_dir>/app/oxs/local/GPU_eulerevolve.h
4. <oommf_dir>/app/oxs/local/GPU_eulerevolve.cc
5. <oommf_dir>/app/oxs/local/GPU_rungekuttaevolve.h
6. <oommf_dir>/app/oxs/local/GPU_rungekuttaevolve.cc
7. <oommf_dir>/app/oxs/local/GPU_evolver_kernel.h
8. <oommf_dir>/app/oxs/local/GPU_evolver_kernel.cu
9. <oommf_dir>/app/oxs/local/GPU_Demag.h
10. <oommf_dir>/app/oxs/local/GPU_Demag.cc

ChangeList

Added Files

1. <oommf_dir>/app/oxs/local/GPU_Demag_kernel.h
2. <oommf_dir>/app/oxs/local/GPU_Demag_kernel.cu
3. <oommf_dir>/app/oxs/local/GPU_ExchUniform_new.h
4. <oommf_dir>/app/oxs/local/GPU_ExchUniform_new.cc
5. <oommf_dir>/app/oxs/local/GPU_ExchUniform_new_kernel.h
6. <oommf_dir>/app/oxs/local/GPU_ExchUniform_new_kernel.cu
7. <oommf_dir>/app/oxs/local/GPU_uniaxialanisotropy_new.h
8. <oommf_dir>/app/oxs/local/GPU_uniaxialanisotropy_new.cc
9. <oommf_dir>/app/oxs/local/GPU_anisotropy_new_kernel.h
10. <oommf_dir>/app/oxs/local/GPU_anisotropy_new_kernel.cu

ChangeList

Added Files

1. <oommf_dir>/app/oxs/local/GPU_fixedzeeman.h
2. <oommf_dir>/app/oxs/local/GPU_fixedzeeman.cc
3. <oommf_dir>/app/oxs/local/GPU_zeeman_kernel.h
4. <oommf_dir>/app/oxs/local/GPU_zeeman_kernel.cu

Future Work

- STT module on GPU
- CG evolver on GPU
- DMI on GPU
- Problem size: 8M problem on 2GB GPU memory

Thanks!

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