HEAT-2D performance on K40c with PPCG and PGI OpenACC

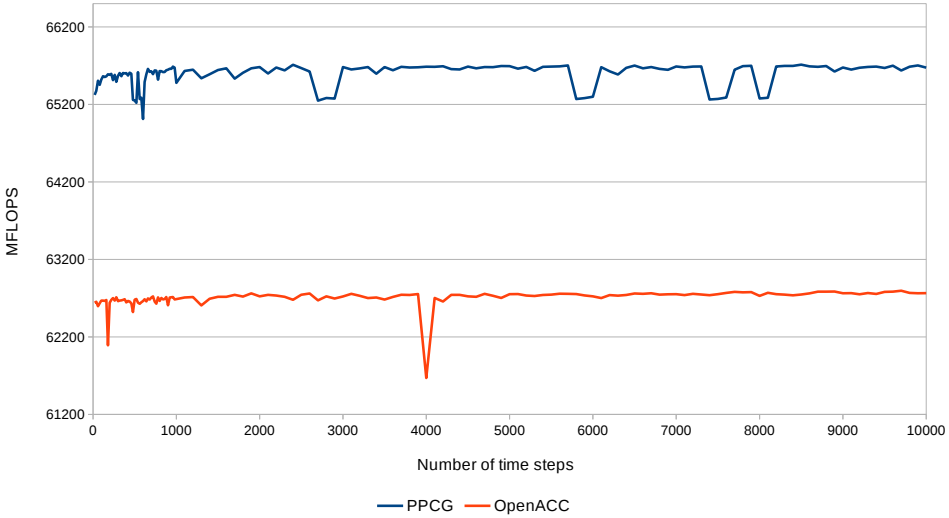
Olaf Schenk, Dmitry Mikushin

October 13, 2015

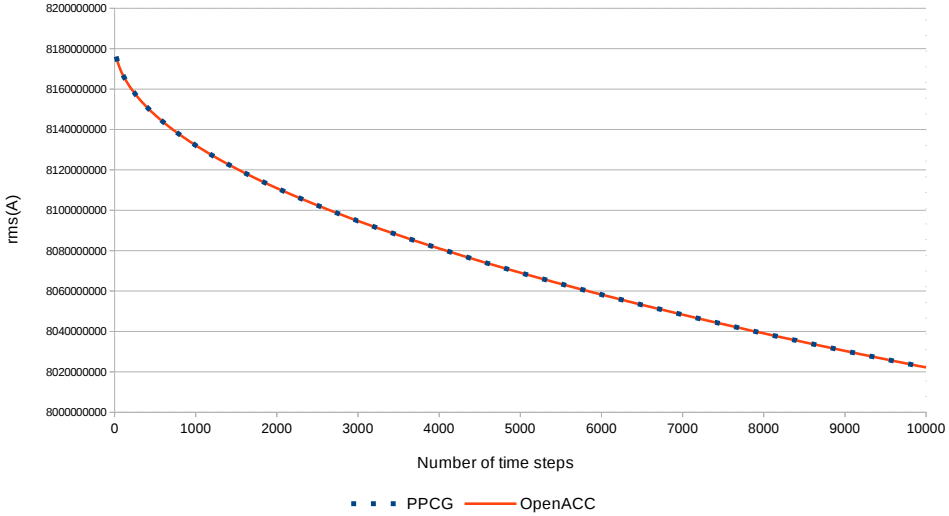
Benchmark configuration

- NVIDIA K40c on tesla-cmc
- PPCG fa4e683fb467eb5d89733b3dd1e638a9d050968a
- LLVM c59decb902128c7b68baf98f5eadcf26fbfa5a08
- PGI OpenACC 15.7-0 64-bit
- NVIDIA CUDA 7.0, V7.0.27

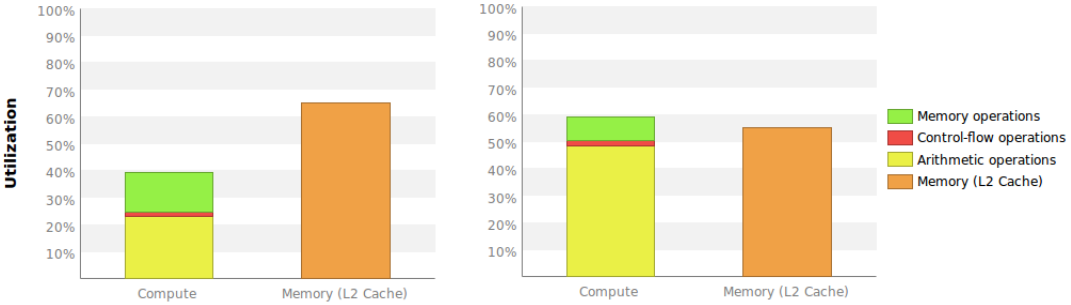
Benchmark performance results



Benchmark accuracy results



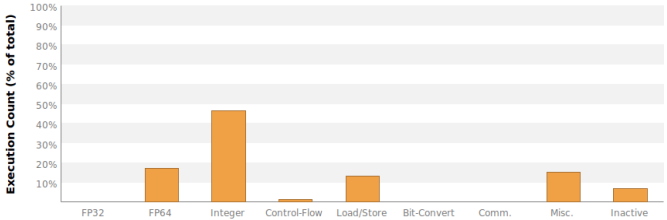
Profiling: Memory VS Compute



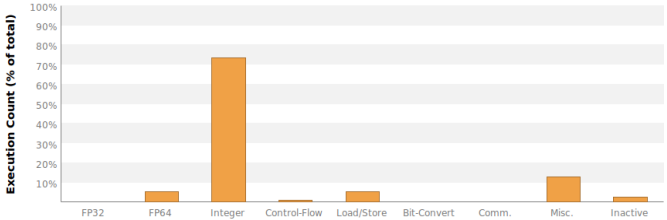
PPCG

OpenACC

Profiling: instructions



PPCG



OpenACC

Profiling: Memory throughput

	Transactions	Bandwidth	Transactions	Bandwidth
L1/Shared Memory				
Local Loads	0	0 B/s	0	0 B/s
Local Stores	0	0 B/s	0	0 B/s
Shared Loads	0	0 B/s	0	0 B/s
Shared Stores	0	0 B/s	0	0 B/s
Global Loads	9644000	182.798 GB/s	7375000	170.234 GB/s
Global Stores	1879000	35.011 GB/s	1500000	34.821 GB/s
Atomic	0	0 B/s	0	0 B/s
L1/Shared Total	11523000	217.809 GB/s	8875000	205.055 GB/s
L2 Cache				
L1 Reads	23516000	182.798 GB/s	22000000	170.234 GB/s
L1 Writes	4504000	35.011 GB/s	4500000	34.821 GB/s
Texture Reads	0	0 B/s	0	0 B/s
Atomic	0	0 B/s	0	0 B/s
Noncoherent Reads	0	0 B/s	0	0 B/s
Total	28020000	217.809 GB/s	26500000	205.055 GB/s
Texture Cache				
Reads	0	0 B/s	0	0 B/s
Device Memory				
Reads	4242869	32.981 GB/s	4008603	31.018 GB/s
Writes	4233634	32.909 GB/s	4169169	32.261 GB/s
Total	8476503	65.891 GB/s	8177772	63.279 GB/s
System Memory	[PCIe configuration: Gen2 x16, 5 Gbit/s]			
Reads	0	0 B/s	0	0 B/s
Writes	6	46.639 kB/s	8	61.903 kB/s

PPCG OpenACC

Profiling: Memory throughput

Variable	Achieved	Theoretical	Device Limit	Achieved	Theoretical	Device Limit
Occupancy Per SM						
Active Blocks		4	16		12	16
Active Warps	57.84	64	64	43.14	48	64
Active Threads		2048	2048		1536	2048
Occupancy	90.4%	100%	100%	67.4%	75%	100%
Warps						
Threads/Block		512	1024		128	1024
Warps/Block		16	32		4	32
Block Limit		4	16		16	16
Registers						
Registers/Thread		20	255		40	255
Registers/Block		12288	65536		5120	65536
Block Limit		5	16		12	16
Shared Memory						
Shared Memory/Block		0	49152		0	49152
Block Limit			16			16

PPCG OpenACC

Conclusion

- PPCG outperforms OpenACC by 4% with identical results
- PPCG chooses grid configuration resulting into better occupancy