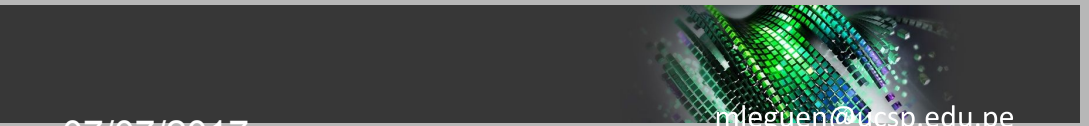
Universidad Católica San Pablo

CUDA Tools

Marc-Antoine Le Guen



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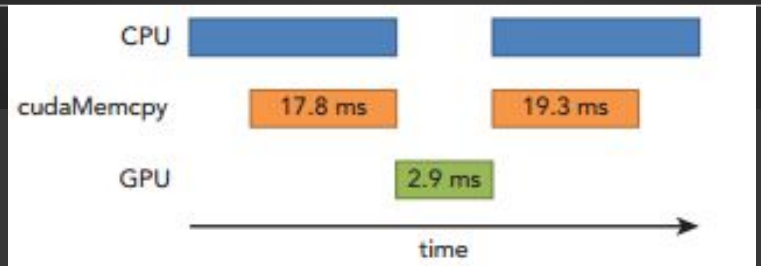
Timing nvprof

- línea de comando
- nvprof ./sumArraysOnGPU-timer

```
./sumArraysOnGPU-timer Starting... Using Device 0: Tesla M2070 ==17770== NVPROF is profiling process
17770, command: ./sumArraysOnGPU-timer Vector size 16777216 sumArraysOnGPU <<<16384, 1024>>> Time
elapsed 0.003266 sec Arrays match.

==17770== Profiling application: ./sumArraysOnGPU-timer
==17770== Profiling result: Time(%) Time Calls Avg Min Max Name
70.35% 52.667ms 3 17.556ms 17.415ms 17.800ms [CUDA memcpy HtoD]
25.77% 19.291ms 1 19.291ms 19.291ms 19.291ms [CUDA memcpy DtoH]
3.88% 2.9024ms 1 2.9024ms 2.9024ms 2.9024ms sumArraysOnGPU (float*, float*, int)
```



Manejar errores

- cudaMalloc
- cudaHostAlloc
- cudaMemcpy
- cudaEventCreate
- cudaStreamCreate
- cuda*****
- Cada una de estas funciones regresan una valor de tipo cudaError_t

Herramientas

LIBRARY NAME	DOMAIN
NVIDIA cuFFT	Fast Fourier Transforms
NVIDIA cuBLAS	Linear Algebra (BLAS Library)
CULA Tools	Linear Algebra
MAGMA	Next generation Linear Algebra
IMSL Fortran Numerical Library	Mathematics and Statistics
NVIDIA cuSPARSE	Sparse Linear Algebra
NVIDIA CUSP	Sparse Linear Algebra and Graph Computations
AccelerEyes ArrayFire	Mathematics, Signal and Image Processing, and Statistics
NVIDIA cuRAND	Random Number Generation
NVIDIA NPP	Image and Signal Processing
NVIDIA CUDA Math Library	Mathematics
Thrust	Parallel Algorithms and Data Structures
HiPLAR	Linear Algebra in R
Geometry Performance Primitives	Computational Geometry
Paralution	Sparse Iterative Methods
AmgX	Core Solvers

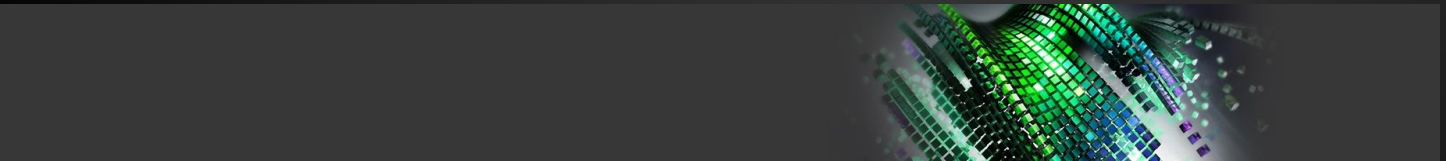
Herramientas

Para la instalación y uso de la librería

Profesional CUDA Programming Chapt. 8

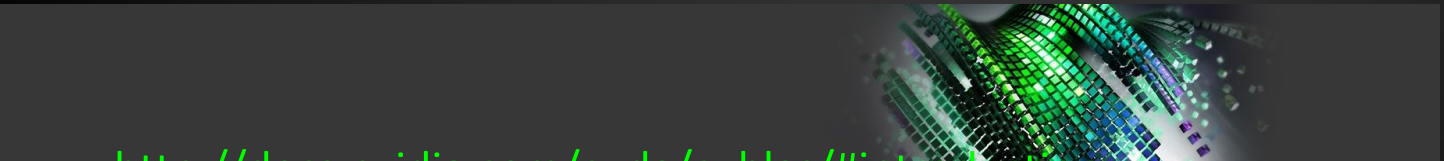
Herramientas

- CUFFT
- Una de las dos librerías incluidas en el CUDA toolkit
- Fast Fourier Transform
  - 2D - 3D transform hasta 16, 384 elementos por dimensión
  - 1D - 128 millones de elementos
- Librería de uso libre



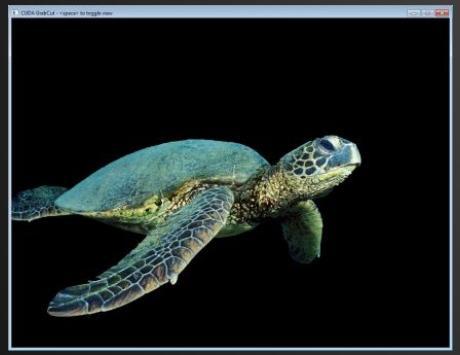
Herramientas

- CUBLAS (Basic Linear Algebra Subprograms)
- Segunda librería del CUDA toolkit
- 152 Rutinas de Álgebra lineal
  - Vectores
  - Matrices
- Single / Double precision
- Real / Complex data
- Fácil de acceso para los usuarios de BLAS



Herramientas

- Nvidia Performance Primitives
- Image, video and signal processing
  - 1900 image processing primitives
  - 600 signal processing primitives

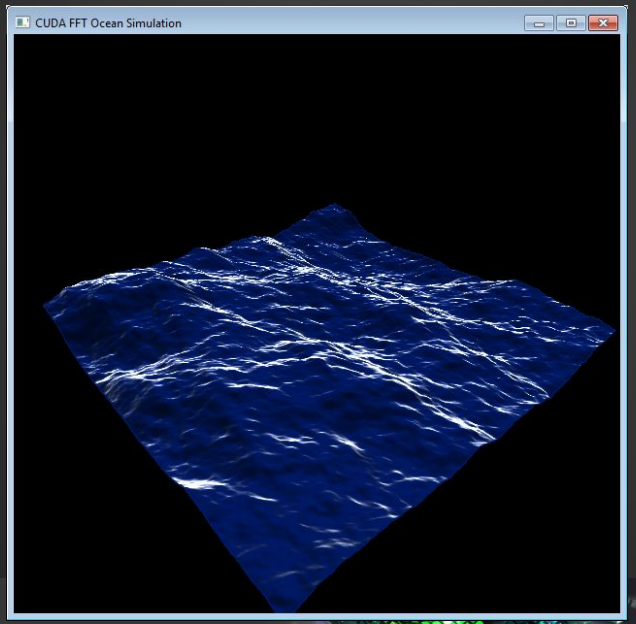


Herramientas

- Nvidia GPU Computing SDK
  - Samples
    - Simple
    - Utilities
    - Graphics
    - Finance
    - Imaging
    - Simulation
    - Advanced
    - Librerías CUDA

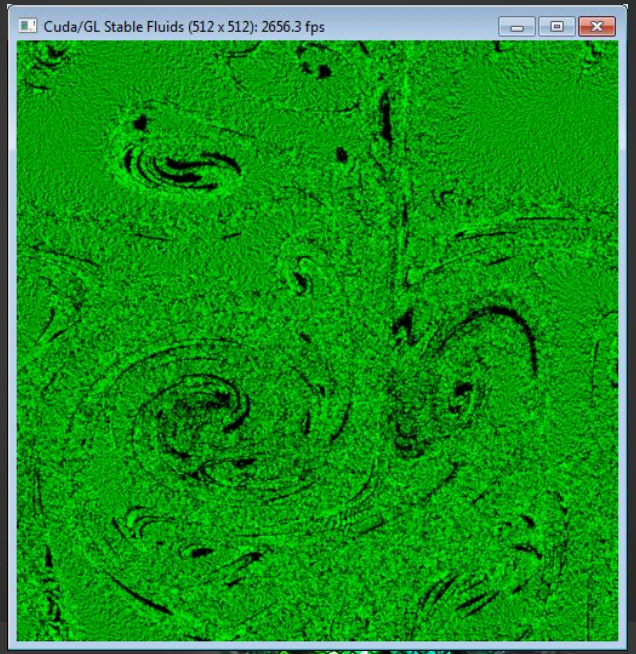
Herramientas

- Ocean FFT



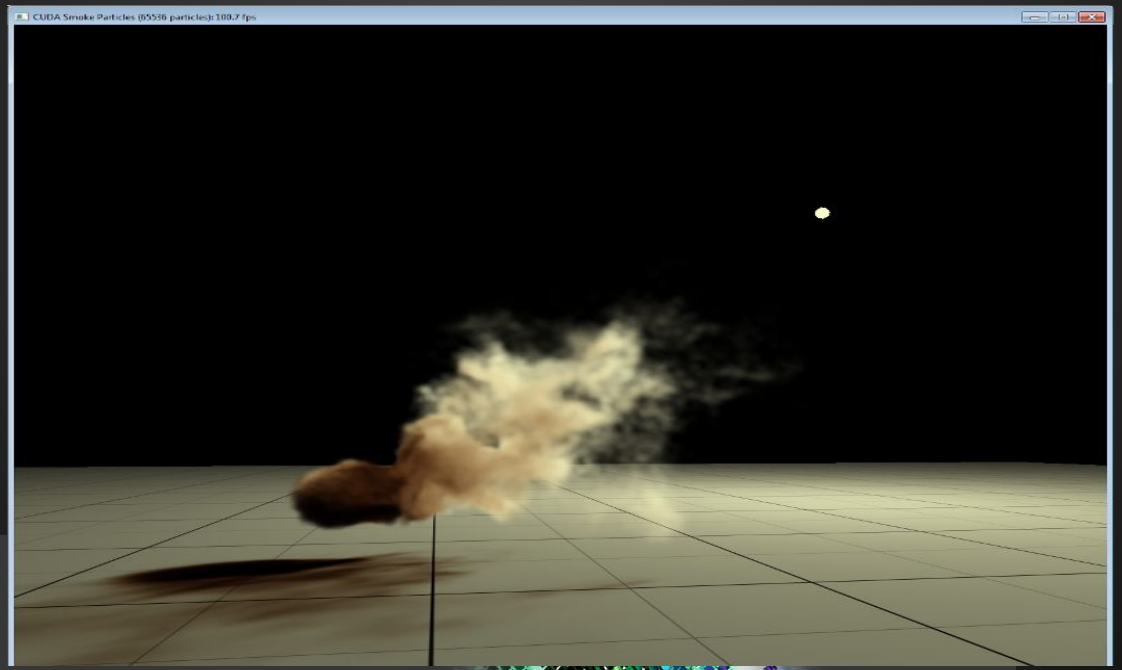
Herramientas

- Fluid OpenGL



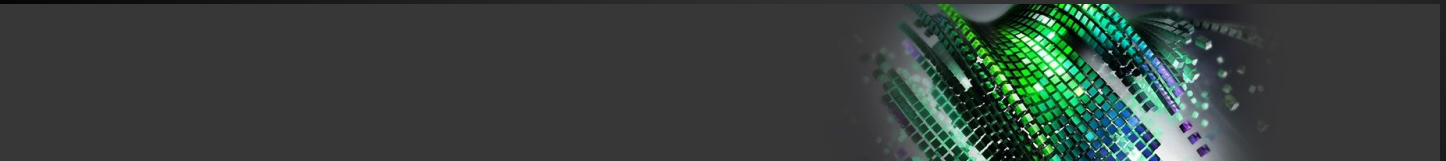
Herramientas

- Smoke OpenGL



Herramientas

- Debugging
  - No es posible depurar el código con herramientas tradicionales
  - printf : compute capabilities >=2.0
  - CUDA-GDB -> Linux based system
    - Ver el estado de CUDA -> GPU + capabilities
    - Breakpoint CUDA C
    - GPU memory : all global and shared memory
    - Single stepping a warp of threads
    - cuda-memcheck
      - violación de acceso



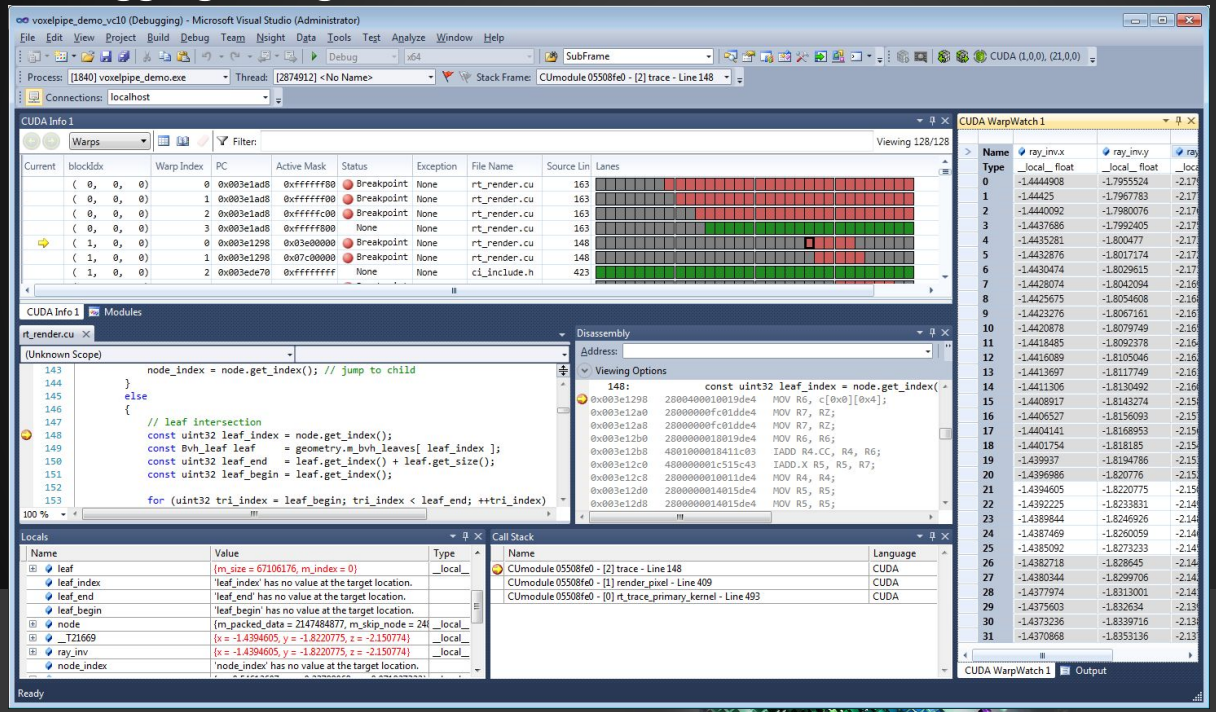
Herramientas

- Debugging - Nsight 4.1
- Mismas funciones que GDB
- Visual Studio - Windows
- Eclipse - Mac + Linux

Attribute	GeForce GTX 670 Compute Capability: 3.0 Driver Model: WDDM
ASYNC_ENGINE_COUNT	1
CAN_MAP_HOST_MEMORY	1
CAN_TEX2D_GATHER	1
CLOCK_RATE	1058500
COMPUTE_CAPABILITY_MAJOR	3
COMPUTE_CAPABILITY_MINOR	0
COMPUTE_MODE	0
CONCURRENT_KERNELS	1
DISPLAY_NAME	GeForce GTX 670
ECC_ENABLED	0
GLOBAL_L1_CACHE_SUPPORTED	0
GLOBAL_MEMORY_BUS_WIDTH	256
GPU_OVERLAP	1
GPU_PCI_DEVICE_ID	294195422
GPU_PCI_EXT_DEVICE_ID	4489
GPU_PCI_EXT_DOWNSTREAM_LINK_RATE	5000
GPU_PCI_EXT_DOWNSTREAM_LINK_WIDTH	16
GPU_PCI_EXT_GEN	1
GPU_PCI_EXT_GPU_GEN	2
GPU_PCI_EXT_GPU_LINK_RATE	5000
GPU_PCI_EXT_GPU_LINK_WIDTH	16
GPU_PCI_REVISION_ID	161
GPU_PCI_SUB_SYSTEM_ID	893523032
INTEGRATED	0
KERNEL_EXEC_TIMEOUT	1

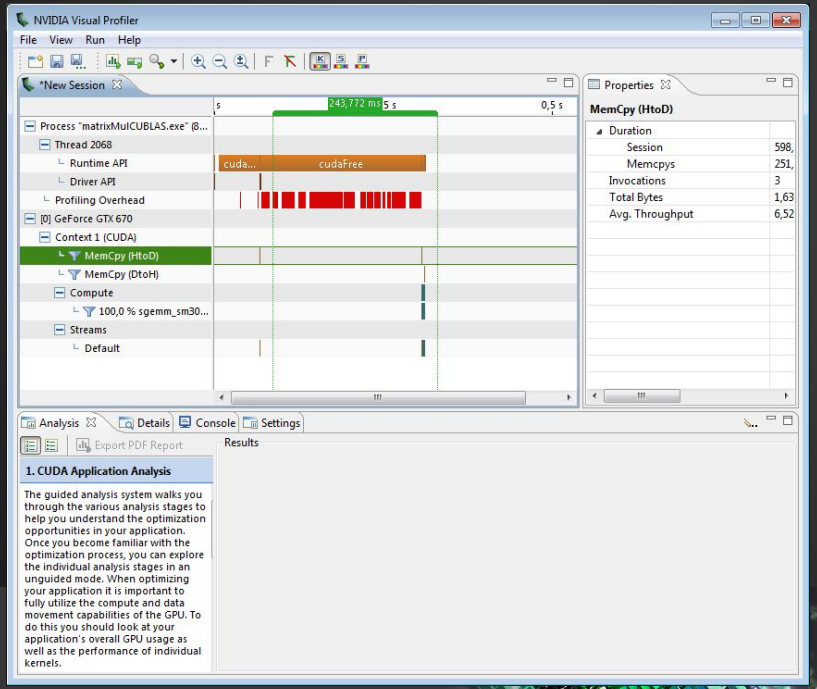
Herramientas

- Debugging - Nsight 4.1



Herramientas

- CUDA Visual Profiler



https://developer.nvidia.com/nvidia-visual-profiler

Documentación y lectura

- Documentación y lectura
- Nvidia cuda Programming guide
  - http://docs.nvidia.com/cuda/cuda-c-programming-guide/#abstract
- Programming Massively Parallel Processors: A Hands-on Approach
  - David Kirk y Wen-mei W. Hwu
- Cuda by example (2010)
  - Jason Sanders y Edward Kandrot
- Professional CUDA C programming (2014)
  - John Cheng, Max Grossman, Ty McKercher
- Cuda Education and Training
  - materiales : cursos, ejercicios, etc
  - https://developer.nvidia.com/cuda-education-training