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Acceleration of digital tomosynthesis mammography using graphics processors

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" Acceleration of Digital Tomosynthesis Mammography using Graphics Processors "

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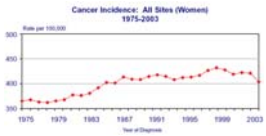
Motivation

"Every three minutes a woman is diagnosed with Breast cancer" (American Cancer Society, "Detailed Guide: Breast Cancer," 2006)



Taken From: National Cancer Institute

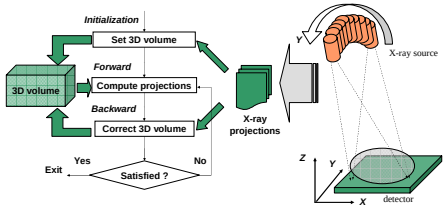
- Explore the use of new technology for solving intensive computational problems

Objective

- Help to improve the efficiency of early breast cancer detection
- Minimize the processing cost of the Digital Breast Tomosynthesis Mammography technique

Tomosynthesis reconstruction process

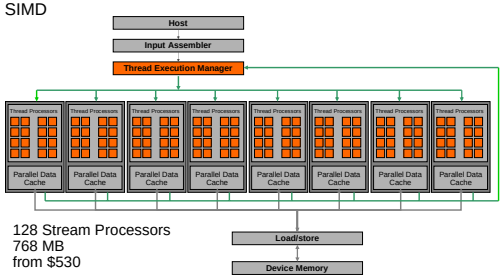
- Reconstructs a 3D image from multiple x-ray radiograph images
  - ➢ Detects and diagnoses breast cancer and abnormalities



Taken From presentation "Acceleration of Maximum Likelihood for Tomosynthesis Mammography" by *Juemin Zhang, Waleed Meleis, David Kaeli, Tao Wu. ICPADS'06*

NVIDIA GPU - GeForce 8800

- Data-parallel programming On-chip
- SIMD

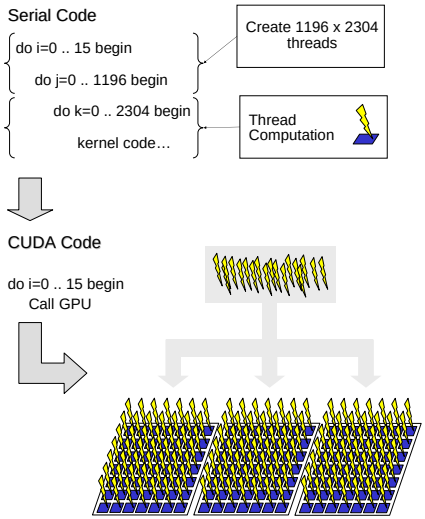


128 Stream Processors
768 MB
from $530

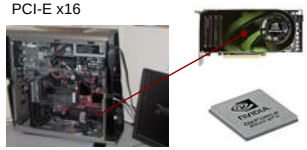
From presentation "GeForce 8800 & NVIDIA CUDA: A New architecture for Computing on the GPU" by Ian Buck, NVIDIA Corporation at Supercomputing '06 Workshop "General-Purpose GPU Computing: Practice And Experience", November 13 2006

- Compute Unified Device Architecture (CUDA) –a programming interface
  - ➢ Execute C code on NVIDIA GPU
  - ➢ CUDA libraries: FFT and BLAS

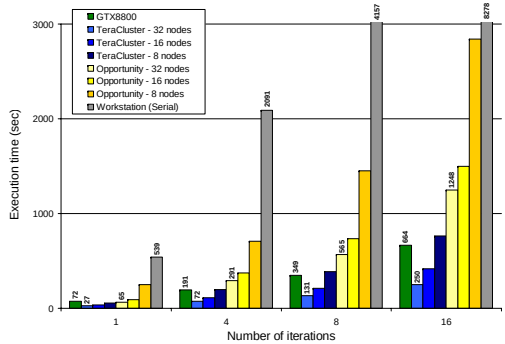
Porting Tomosynthesis reconstruction to the GPU



Evaluation environments

Nvidia GTX8800 (GPU)	128 Stream Processors, 1.35 GHz 768 MB Device memory (86.4 GB/Sec) PCI-E x16 
TeraCluster (Cluster)	33 Servers 4 nodes per server (dual processor, dual core) Intel Xeon, 2.0 GHz (Pentium M) 8/16GB RAM per server Gigabit Ethernet interconnect (among servers)
Opportunity (Cluster)	65 servers 2 nodes per server (dual processor) Xeon EMT 64, 3.2 GHz (Pentium IV) 4 GB RAM per server Gigabit Ethernet interconnect (among servers)
Workstation	Intel Core2 CPU (Using only 1), 1.86 GHz 3GB RAM

Tomosynthesis reconstruction Execution time (sec) vs. number of iterations



Simplicity

- All software development stages – design, implementation testing and deployment are done on one single environment
- Allow novice users to run, execute and work with Tomosynthesis algorithm on windows.

Summary

- GPU's performance comparable to HPC
  - ➢ Exploit inherent parallelism in algorithm
  - ➢ Reduce communication and synchronization
  - ➢ Launch high number of threads per multiprocessor
    - – Hide memory latency (Implementation is memory bound)
- First implementation of algorithm
  - ➢ Further development can improve performance on both CPU and GPU
    - – Improve memory allocation
    - – Reduce CPU/GPU communication overhead
    - – Optimize kernel threads (running on GPU)

Future work

- Optimize threads running on GPU, Improve CPU/GPU interaction
- Current performance enables further development of Tomosynthesis algorithm – reducing image noise
- Explore opportunities for speeding up additional applications using GPU

Acknowledgement

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