Partnership for International Research and Education
A Global Living Laboratory for Cyberinfrastructure Application Enablement

Motion Estimation Using NVIDIA CUDA

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National Science Foundation

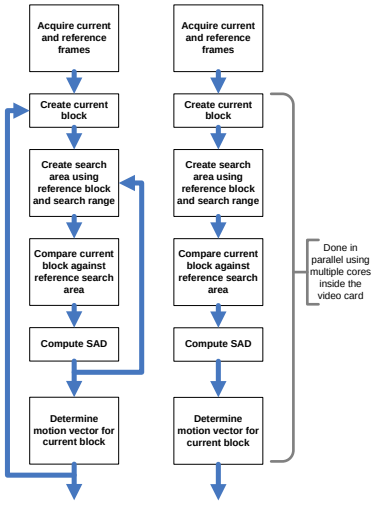
I. Research Overview and Outcome

Objective

- Computing motion vectors between two frames is the most computationally intensive step in video compression
- Our goal is to acquire motion vectors NVIDIA's CUDA

Design

Algorithms for the CPU (left) **and GPU** (right)



CUDA

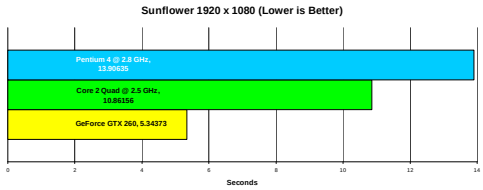
CUDA
- stands for Compute Unified Device Architecture
- is a parallel computing architecture developed by NVIDIA
- is the computing engine in NVIDIA graphics processing units (GPUs)
- is accessible to developers through 'C for CUDA' (C with NVIDIA extensions) for Windows, Linux, and Mac OS

Implementation

- Our first task was to port the existing code for motion estimation (ME) to CUDA
- After incurring a few issues, much of the time in researched was devoted to developing a different, novel algorithm
- Because of the number of processor cores available (216)
- Much of the time in this research was devoted to developing an efficient algorithm
- This approach would compute the difference in one pass, shift the reference frame, and continue this cycle
- While the current frame is stationary, the reference frame will shift from –RANGE to +RANGE in both the Y and X-axis
- This method proved to be a burden on the memory, thus causing undesirable delays
- In order to achieve parallelism, the frames were partitioned by BLOCK_SIZE and thread blocks
- Thread blocks computed the Sum of Absolute Difference (SAD) for their assigned MacroBlock

Test Environment and Results

	Machine 1	Machine 2
CPU	Pentium 4 @ 2.8 GHz	Core 2 Quad @ 2.5 GHz
Memory	2GB DDR1	2 GB DDR2
Video		GeForce GTX 260



Conclusion and Future Work

- We can clearly see that the performance increase has doubled
- However, the speedup of 2.03 was much lower than expected
- Our goal was to encode video using the H.264 standard in real-time
- Work still needs to continue in order to accomplish this task
- This can be done by:
  - Optimizing the existing CUDA configuration
  - Develop a different parallel algorithm, including the above mentioned
  - Taking advantage of CUDA's full potential by using 5 different types of memory
  - Using CUDA in conjunction with OpenCL
  - Enabling SLI to further distribute the workload by adding more video cards of the same model

II. International Experience

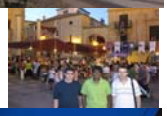
Valencia




Valencia is awesome. Probably one of the most beautiful cities I've ever visited. Paella is originally from Valencia and it is muy delicioso. A person can spend a whole year in Valencia and still have lots to see and do. Filled with museums, the beach, amazing architecture and culture. I didn't get to experience the nightlife but it does sound fun from what my friends say. We walked everywhere but I recommend taking a bike or rollerblades. I avoided all the restaurants meant for tourists because they are over-priced and don't seem authentic. We walked a few blocks into the city area and found a very nice, small café for the Paella. I can't wait to visit again!

Chinchilla

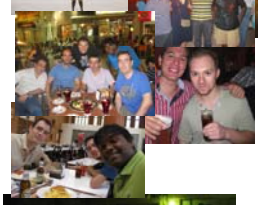





Chinchilla is a very nice town. I went with a few friends from work. The whole town is on top of a mountain, with a castle that looks down on the steep side. They had a medieval renaissance festival which was very cool. The town itself is so surreal and picturesque.

Albacete








The New York of La Mancha! Thanks to the PIRE project, not only did I get to learn a new culture, I got to experience the lifestyle. I made many friends from Germany, Norway, Boston/Poland, France/Argentina, and various parts of Spain. UCLM reminded me of FAU in many ways. The people I worked with are very friendly, smart and know how to have a good time. The nightlife is very easy to get accustomed to. A lot of the students and residents of Albacete think it's very quiet and not much to do when compared to other big cities. I like to think that Albacete is like Miami Beach without the ocean.

Blog

http://latinamericangrid.org/elgg/mark.rajan/weblog

III. Acknowledgement

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