

GPUS FOR LARTPCs

GUIDE FOR DISCUSSION

WESLEY KETCHUM (LANL)

WHY GPU?

- LArTPC algorithms *seem* well-suited for massive parallelization
 - Handling of raw waveforms → hits done per channel or region-of-interest
 - Multi-threaded Image-processing algorithms exist
 - Higher-level clustering and tracking algorithms can be parallelized
 - Even simulation could be parallelized
 - Improvements to speed of electron drifting and photon propagation
- GPUs are available, commercial product that have shown good performance on massively parallelizable applications

OVERSIMPLIFYING THE ISSUE

GPUs provide

- More processors, giving more cores, that each can run many threads (SIMD)
- Simple C/C++/Python/FORTRAN-based programming environments exist
 - OpenCL
 - NVIDIA's CUDA

The downsides

- Memory is at more of a premium, and memory access is important to understand
- Memory transfer to/from GPU can be a big bottleneck
- Easy to program, harder to optimize

RESOURCES WE HAVE AT FNAL

Personal machines

- My desktop (oppenheimer.fnal.gov) has an NVIDIA Tesla K20 GPU
- Jonathan's machine does too
- You may have a CUDA-capable GPU in your laptop
- OpenCL works on variety of devices, and can work on multi-core CPUs
- More...?

DAQ

- uboonedaq-trig has two Tesla K20s in it
 - Sits at DAQ test stand in LArTF
 - There for development of fast online monitoring and online software trigger development

TWO, NOT EXCLUSIVE, TRACKS

Realtime reconstruction

- Using GPUs to work with data in real time
- Focus on handling of raw waveform → hits → tracks
 - Huffman decoding per channel?
 - Simple, plane-based hit-finding?
 - Only pattern recognition?
- Also handling of PMT data → flash-track matching
- Focus on speed
 - Can we monitor continuously read data in real time?

Offline/nearline simulation and reconstruction

- More generically, how can we make our algorithms faster
 - Possibly important for better online monitoring
 - Better for just making our lives easier!
- Use faster algorithms to give improvements in simulation and reconstruction

(SOME) POINTS FOR DISCUSSION

People's interests

- Including any ongoing/planned work

Strategy for development

Establishing meeting times?

Relevant IIT work

- Wire/hit reconstruction
- Two-pass reconstruction