Developing a GPU Processing Framework for Accelerating Remote Sensing Algorithms

James Goodman, PhD, PE
President
HySpeed Computing LLC
jgoodman@hyspeedcomputing.com
Dept. Electrical and Computer Engineering
Univ. Puerto Rico at Mayaguez
james.goodman1@upr.edu

Dana Schaa, Matthew Sellitto, David Kaeli, PhD
Dept. Electrical and Computer Engineering
Northeastern University
dschaa@ece.neu.edu
sellitto.ma@husky.neu.edu
kaeli@ece.neu.edu
HySpeed Computing LLC and Gordon-CenSSIS/ALERT

- Achieving effective technology transfer through collaboration
- Leveraging small business innovation and university research

Defining the collaboration

- What is HySpeed Computing LLC?
- How did the collaboration evolve?
- What are the objectives of the NSF SECO award?
- What has already been achieved?
- Where is the collaboration going?
HySpeed Computing LLC

- Developing advanced algorithm and software tools using GPU computing
  - Founded in 2010 by Gordon-CenSSIS researcher J. Goodman
  - Pursuing a “diverse problems – similar solutions” paradigm

- Short-term market focus (1-3 years)
  - Provide the geospatial community with advanced analysis tools
  - Utilize GPU computing to achieve significant software acceleration

- Long-term market focus (3-10 years)
  - Lateral expansion to other technical/scientific application areas
  - Extend software and computing capabilities to additional domains

- Maintain a strong link with academia and other research groups
How did the collaboration evolve?

Gordon-CenSSIS

Remote Sensing Research
U. Puerto Rico at Mayaguez
Goodman, Velez-Reyes, et al.

GPU Computing Research
Northeastern University
D. Kaeli, et al.

GPU Acceleration of Coastal Remote Sensing Algorithm
Northeastern U. and U. Puerto Rico at Mayaguez
Publications: 1 journal + 2 conference proceedings

HySpeed Computing LLC
J. Goodman founded in 2010

NSF SECO Project
Algorithm commercialization

HySpeed Computing LLC
What is the HySpeed/Gordon-CenSSIS NSF SECO Project?

- Commercialize a coastal remote sensing algorithm
- Develop a GPU computing framework for image analysis
- Involve students in algorithm and software development

What is the coastal algorithm?

- Derives environmental information from hyperspectral imagery
What are Graphics Processor Units (GPUs)?

- GPUs are the parallel processing hardware contained on video cards
- GPUs increasingly being utilized for general purpose computing
- GPUs provide 100’s of available cores for parallel processing tasks
- GPUs are relatively inexpensive (e.g., < $1000 NVIDIA Tesla C1060)
- GPUs can be embedded in hardware solutions

How much speedup can be achieved using GPUs?

- Reported results of 2x to over 1000x acceleration using GPUs

Images: NVIDIA CUDA Apps (www.nvidia.com)
Preliminary project results

- A software prototype has been successfully created
- GPU achieves 360x speedup over the CPU

Example image: 16 tiles
Where is the collaboration going?

- Expand student and faculty involvement through algorithm challenges
  - Leverage knowledge base in other research projects
  - e.g., image segmentation, spectral unmixing, etc.
- Explore opportunities to commercialize other existing algorithms
  - Facilitate technology transfer of established research products
  - e.g., the HIAT and HyCIAT toolboxes
- Extend collaboration to others within the Research Alliance
  - Incorporate other application areas and research domains
  - Integrate other university and industry partners
- Pursue future joint proposal opportunities