HySpeed Computing, LLC

“Intelligent Acceleration”

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HySpeed Computing, LLC

- A spin-off company from Gordon-CenSSIS
- Acceleration of image analysis algorithms using GPU computing
- Addressing the increasing computation needs of the remote sensing and geo-spatial community
- Initial focus on hyperspectral remote sensing of coastal ecosystems
- Developing mechanisms for tech transfer of algorithms
- Establishing partnerships with Gordon-CenSSIS
Increasing Computer Processing Requirements

**Increasing Sensors/Data**
- NASA ‘A-train’ Satellite Constellation
- Hyperspectral Imagery

**Global Analysis/Modeling**
- Sea Surface Temperature
- Vegetation Indices
- Chlorophyll Concentration
Graphics Processing Unit (GPU) Computing

- 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 with 240 processing cores)

NVIDIA

AMD

NVIDIA Fermi Architecture
Initial Demonstration Project

- **Project selection:**
  - Select a computationally intensive remote sensing problem
  - Select an established algorithm, with successful application history

- **Selected application:**
  - Subsurface sensing of marine habitats, e.g., coral reefs
  - Algorithm developed by Goodman (2004), Goodman et al. (2008), Goodman and Ustin (2007)

- **Interested user community:**
  - Coral reef ecologist and coastal resource managers
  - Federal agencies - NRL, NOAA, NASA, USGS
  - Coastal remote sensing researchers
Remote Sensing of Submerged Marine Habitats

- Challenging image analysis problem
- Complex physical interactions

1. **Sensor Characteristics:**
   - Signal to Noise (S/N) Ratio
   - Spatial and Spectral Resolution

2. **Atmospheric Conditions:**
   - Scattering and Absorption
   - Gases and Aerosols

3. **Signal from the Water Column:**
   - Surface Conditions
   - Light Penetration
   - Bio-Optical Properties

4. **Signal from the Bottom:**
   - Water Depth
   - Bottom Type
   - Size of the Community
Hyperspectral Inversion Model

Raw AVIRIS Imagery

Image Pre-Processing
- Glint Removal
- Atmospheric Correction

Spectral Input Parameters
- Aquatic Absorption Properties
- Generic Bottom Reflectance

Inversion Model

Inversion Output
- Water Properties
- Bathymetry
- Bottom Albedo (550 nm)

Image Geometry
- Explicit pixel by pixel subsurface angles

View

Illumination
Spectral Unmixing Model

- **Pre-Processed AVIRIS Imagery**

- **Spectral Endmembers**
  - Reflectance vs. Wavelength (nm)
  - Graph showing absorption properties of Sand, SAV, and Coral.

- **Inversion Output**
  - Water Properties
  - Bathymetry

- **Forward Model**
  - Spectral Input Parameters
    - Aquatic Absorption Properties
    - Generic Bottom Reflectance
  - Image Geometry
    - Explicit pixel by pixel subsurface angles
    - View
    - Illumination

- **Unmixing Output**
  - Benthic Composition
    - Sand
    - Coral
    - SAV

Gordon-CenSSIS Site Visit 2010
Commercialization Objectives

- Leverage the processing power of GPU computing
- Develop modules for remote sensing and geo-spatial COTS software
- Develop and accelerate advanced remote sensing algorithms, e.g.,
  - calibration
  - classification
  - spectral unmixing
  - transformations
  - geo-correction
  - endmember identification
  - dimensionality reduction
  - inversion modeling
- Develop techniques for embedded processing