Real-Time Wind Velocity Estimation from Aerosol Lidar Data using Graphics Hardware

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Purpose: Remote Measurement of the Wind by Lidar

The REAL operates by transmitting pulses of infrared laser radiation into the atmosphere and measuring the backscattered laser radiation. The approach is to estimate wind vectors in regions along the scan line of the lidar by cross-correlating the previous scan with the current scan. This allows us to compute wind fields in real-time.

Discussion

Performance Test

We performed a test that would compare the performance of a high-end GPU with a high-end CPU. After developing our code using CUDA, we developed a CPU version using the OpenMP+FFTW library. We tested the code on a high-end CPU using the same Qt C++ framework as the GPU version but with OpenMP, SSE, and FFTW.

Future Considerations

The application provides a framework that we can use for other methods of calculating wind velocity from aerosol lidar data. The computational performance of GPUs will allow for more calculations to be performed along side our current method, or give us the ability to run more compute-intensive methods in the future.

Application

Lidar Receiver

Data Acquisition and Broadcast

GPU Workstation

Receive beams and path-theta centric space

Filtering

Lidar Workstation

Output filters

Real-Time Wind Velocity Estimation

Algorithm

Gridding

Cross Correlation

Vectors/Flow

References

