The HICO Online Processing System
A Web-Accessible Hyperspectral Imagery Processing System

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Abstract

HySpeed Computing and Exelis VIS are developing the HICO Online Processing System (HOPS), a cloud computing system that will provide online, on-demand, scalable remote sensing image processing capabilities. The goal of HOPS is to supply image processing analytics (IPA) that is routinely generated within the geosciences into the hands of the larger global user community.

The HICO Online Processing Tool project is funded by Center for the Advancement of Science in Space (CASS), and uses imagery from The Hyperspectral Imager for the Coastal Ocean (HICO), an imaging spectrometer that is on the International Space Station (ISS) that is optimized for acquisition of aquatic targets.

Hyspeed has implemented a collection of coastal remote sensing algorithms for deriving information on water properties, water depth, and habitat characteristics. Example applications implemented in this project are directed at deriving critical information on water and habitat characteristics of our vulnerable coastal environment. The project leverages the ENVI Services Engine as the framework for all image processing tasks to accommodate the rapid integration of new algorithms and processing tools. Users will only need a browser and internet connection to perform the analysis.

Architecture

- The ENVI and IDL Services Engine (ESE) was deployed on Amazon Web Services
- ESE was deployed on AWS with GeoServer, an open source server for sharing geospatial data. GeoServer was used to route user processing requests to ESE, and to return results back to the user interface.
- ENVI and IDL routines were deployed as a services for consumption by remote end users, other apps, or services running in the enterprise.
- The ENVI Services Engine provides REST-compliant web services.
- ESE responds to processing requests by listening for HTTP calls in a RESTful state. HTTP REST requests made to ESE from GeoServer will run ENVI and IDL routines, with the results being pushed back through GeoServer to the requesting web client. See Figure 1.
- The ENVI Services Engine is able to scale and load balance because of its REST architecture and is designed to run on a cluster. As requests arrive from any number of clients, the master web server will accept and route the request. If the request is for information about a task (or the system in general) then the master will return the requested information to the client.

Additional Algorithms

- Additional workflows and algorithms include a land/cloud mask, quasi-analytical algorithm, and a semi-analytical inversion model

HICO Scene

Land/Cloud Mask

QAA Algorithm

HICO Scene

Land/Cloud Mask

Inversion Mode

Time

1- Band Image

HICO Scene

Land/Cloud Mask

1- Band Image

mask = 0 for land/cloud; 1 for water

NDWI = McFeeters 1996

4-Band Image

a383 = total absorption (m⁻¹)
aph383 = phytoplankton absorption (m⁻¹)
ag440 = detritus/gelbstoff absorption (m⁻¹)
bb438 = particle/angle/sea state absorption (m⁻¹)
bbp440 = total backscattering (m⁻¹)²
bb438 = total backscattering (m⁻¹)²

QAAAlgs - Lee et al. 2009, 2002

7-Band Image

a440 = phytoplankton absorption (m⁻¹)
ag440 = detritus/gelbstoff absorption (m⁻¹)
bb440 = particle/angle/sea state absorption (m⁻¹)
RSSD = bottom albedo (-)
H = water depth (m)

a383 = total absorption (m⁻¹)
bb438 = total backscattering (m⁻¹)²

Goodman et al. 2008; Lee et al. 1999, 1998

Processing tool facilitates on-demand implementation of algorithms across a global range of HICO scenes

Figure 1. HOPS architecture diagram