EXELIS
Visual Information Solutions

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ENVI Services Engine: Earth and Planetary Image Processing for the Cloud

http://www.exelisvis.com/agu

ENVI
IDL

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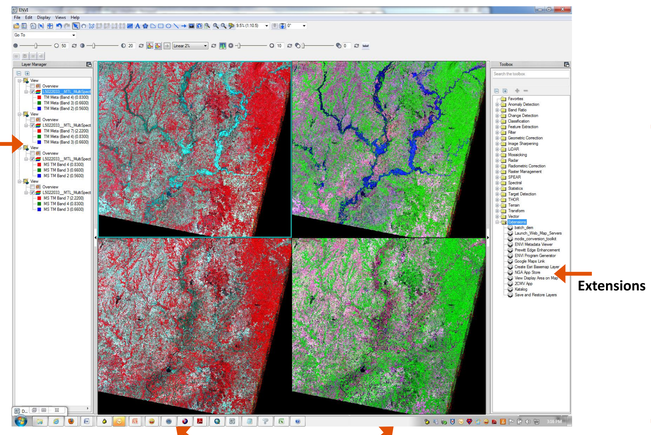

Figure 1, ENVI 5.0 desktop Interface, the extensions folder is where custom IDL tools can be deployed to the ENVI interface

Introduction

- The geospatial imagery analysis community has a growing need for online analytic capabilities.
- Work previously done on desktop workstations must migrate to a web-accessible environment to mitigate growing data volumetrics, bandwidth usage, and end user requirements.
- Web based applications (or 'apps') are intended to apply analytic methods, procedures, and routines to image datasets stored within centralized server repositories.
- Exelis Visual information Solutions (Exelis VIS) developed an enterprise-enabled processing engine that provides remote users access to the power of ENVI image analysis and IDL applications from a web or mobile client interface. The working name for this capability is the ENVI and IDL Services Engine.
- This Engine enables the remote user to access the same compiled ENVI and IDL functions and procedures that scientists have utilized for decades at the desktop level.
- The ENVI and IDL Services Engine operates in a RESTful state, listening for http calls to arrive that initiate a data processing operation once those messages are registered.
- The Engine can operate with any middleware, meaning users can implement this capability with their current enterprise architecture such as ESRI's ArcGIS® for Server or GeoServer.
- Flexibility and openness in middleware components is achieved through the use of OGC standards for messaging and data transfer.
- The ENVI and IDL Services Engine represents bringing long term earth science monitoring analysis capabilities to the cloud, harnessing existing ENVI and IDL tools, deploying them to the enterprise, and improving access to earth and planetary science data.

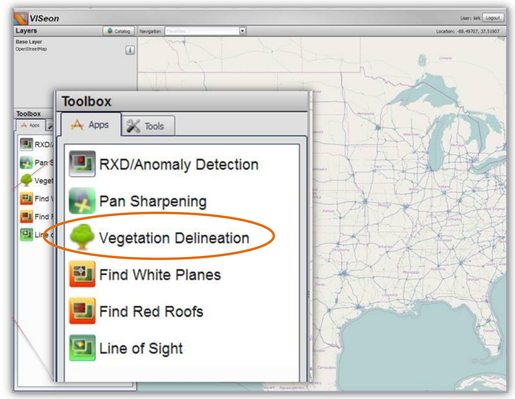

Figure 5, Thin client Interface to select an "App" from a Mozilla web browser

Background

- ENVI is an advanced image analysis software package that allows users to extract information from remotely sensed data (e.g. optical , thermal, radar, LiDAR, and two dimensional array data). See Figure 1.
- ENVI is written in the IDL programming language, which allows remote sensing tasks to be automated or custom algorithms and workflows Implemented. See Figure 2.
- IDL has been used by the earth and planetary science community for 35 years for scientific data visualization and analysis. It can be used as a standalone programming language or to enhance ENVI's capabilities.
- ENVI and IDL are compatible with hundreds of different data types including scientific formats like NetCDF and HDF5. Both applications contain a wide range of analysis functions ranging from data preprocessing, calibration, math and statistical functions, and spectral and feature based analysis tools, etc.
- The ENVI and IDL Services Engine deploys data access, analysis, and visualization capabilities to an enterprise level. The Engine is deployable in a cloud computing environment and leverages a number of vetted specifications to allow for middleware interoperability (e.g. ArcGIS Server or GeoServer) with any enterprise IT infrastructure.
- Once an ENVI or IDL routine is developed, it is quite simple to wrap it as a service and deploy it in the engine for consumption by remote end users, other apps, or services running in the enterprise.
- The Engine makes processing requests via HTTP REST calls. HTTP REST requests made to the Engine from a middleware component will subsequently call and run ENVI and IDL routines, with the results being pushed back through the middleware components to the requesting application. See Figure 3.
- Results are delivered from the Engine and can be saved, utilized in further analysis, or displayed in a variety of web, desktop, or mobile clients.
- Exelis VIS has also developed a solution for ESRI's ArcGIS® for Server, which embeds ENVI image analysis tools into the ArcGIS® for Server environment. See Figure 4.
- An 'App Store' can also be used to deploy apps back to desktop users so vetted or approved apps can be run on the desktop version of ENVI and IDL or server side.

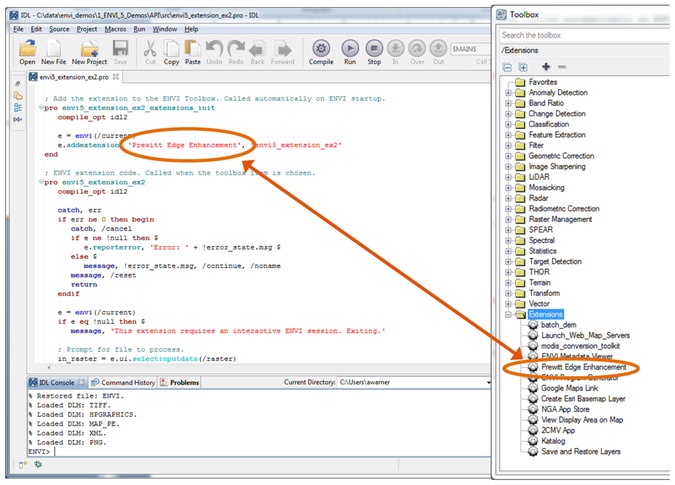

Figure 2, Using IDL to script and implement an edge detection algorithm that is publishable in the ENVI Extensions folder

A Reference Implementation

- In an effort to provide examples of how the ENVI and IDL Services Engine can be used, Exelis VIS created a reference implementation that redeploys several pieces of existing ENVI code as 'apps'. These include:
  - Anomaly Detection for detection of spurious material in a large image
  - Pan Sharpening for enhancing multispectral data with high resolution panchromatic imagery
  - Vegetation Delineation for identifying vegetation presence and level of vigor
  - Line of Sight to create a viewshed using terrain data
  - Spectral Identification to show using a spectral library to classify materials in a hyperspectral dataset. See Figures 5, 6, 7 and 8.
- This implementation envisions a web client or mobile app calling the ENVI and IDL Services Engine via a middleware component such as MapServer, GeoServer, or some other development environment and employs a web based GUI and/or a mobile app for Android or iPhone as an access mechanism.
- Thin and mobile clients are used to discover data using a cataloguing specification such as Web Catalog Service (CS-W) and to make Open Geospatial Consortium (OGC)-compliant analysis requests via Web Processing Service (WPS) calls to The ENVI and IDL Services Engine via the middleware.
- One use case example could be looking at the Landsat archival data with the vegetation delineation tool. For a region or a specific scene, this ENVI and IDL Service Engine implementation would facilitate in discovering imagery, identifying vegetation and analyzing change over time. Results could include an animation, a profile of vegetation change over time, or specific points correlated to ground truth measurements. These results could be delivered to web, mobile or a desktop clients.

Figure 6, accessing a data catalogue with a JavaScript interface

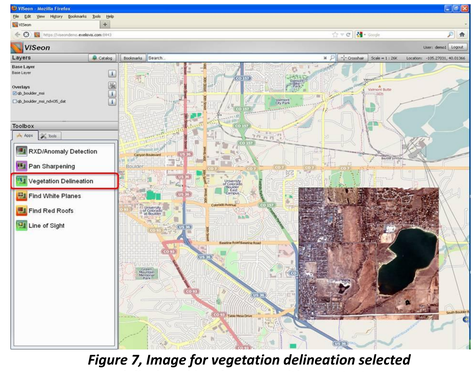

Figure 7, Image for vegetation delineation selected and displayed in a browser with a context map

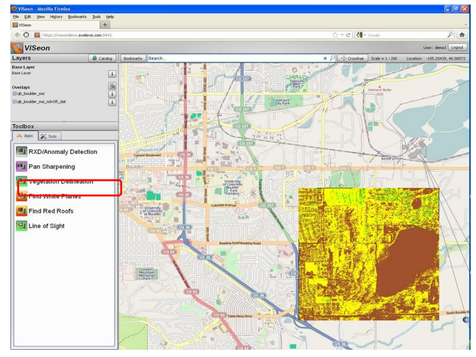

Figure 8, Vegetation Delineation results displayed to the web browser

Summary

- The way imagery data is being stored and analyzed is changing. ENVI and IDL have long been tools used in Earth and Planetary science communities. The ENVI and IDL Services Engine helps scientific data users transition to the cloud while still being able to use legacy code and algorithms.
- The flexible REST implementation makes implementing the ENVI and IDL Services Engine in existing cloud architecture straightforward and stable.
- The ability to host and disseminate data and complex functionality within the cloud will lead to wider enterprise-wide hosting and dissemination of earth and planetary science data in the future. The work behind ENVI and IDL Services Engine is aimed at making this concept a reality. More people being able to access and process scientific data means more discoveries, more collaboration, and more progress toward big geophysical problems.

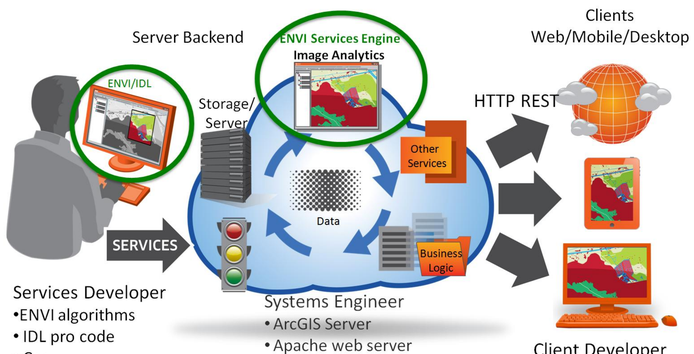

Figure 3, ENVI and IDL Services Engine conceptual rendering

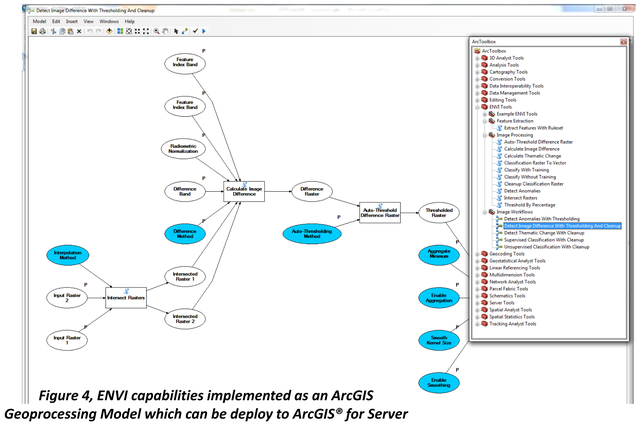

Figure 4, ENVI capabilities implemented as an ArcGIS Geoprocessing Model which can be deploy to ArcGIS® for Server