Web-based Signal Data Processing for Hydro-Ecological Applications

WALSAIP

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1 Problem Formulation

There is a need for a unified integrated infrastructure (cyber-infrastructure) to monitor, collect, process and render array sensor-based information, in an automated and timely manner, for the assessment and proper management of Earth's geophysical, environmental and ecological issues such as:

- Landslides, deforestation, etc.
- River dynamics: watersheds, flashfloods, etc.
- Soil moisture, wetlands, land use, etc.
- Water pollution: pathogens, solid waste, etc.

2 Conceptual Model

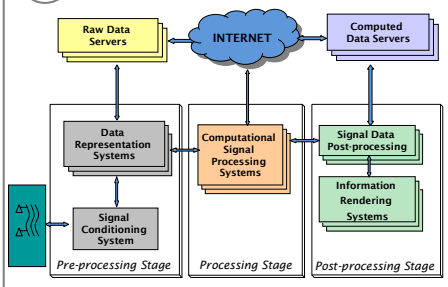

Fig. 1. Conceptual Model of WALSAIP

3 Theoretical Formulation

This work deals with the development of a Java-based environment for the treatment of remote sensing imaging information on a cyber-infrastructure. Especial attention is given to the development of a computational signal algebra framework for the modeling and simulation of digital image interferometry processing applications.

Correlated digital interferometry (CDI) for imaging radars deals with the use of signal correlation techniques to process the phase information of digital image representations of microwave imaging signals.

A huge productivity advantage would be possible if applications written in scripting languages, such MATLAB®, could be compiled into highly optimized machine code (i.e. C, Java). It implies a library-preprocessing phase to extensively analyze and optimize collections of libraries that define an extended language [4].

4 Initial Target Area

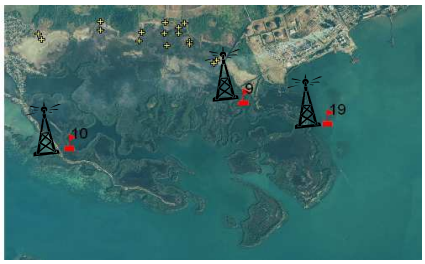

Fig. 2. Jobos Bay Reserve

Type of sources of data:
- In-situ sensors
- Aero-transported sensors
- Space borne sensors

5 Proposed Architecture

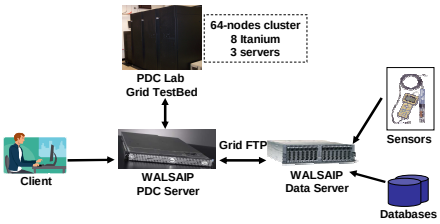

Fig. 3. System Architecture Approach of WALSAIP

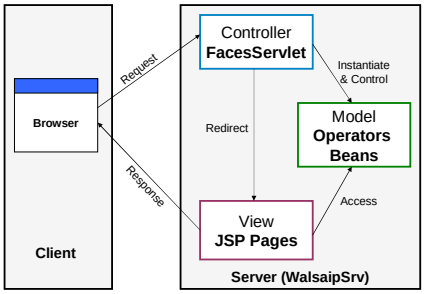

Fig. 4. Model-View-Controller Architecture for JCID

6 Java-based Environment

J-CID (Java Computational Image Developer) provides a set of operators for Image Processing according to the constraints imposed by the Signal Algebra of complex-valued images.

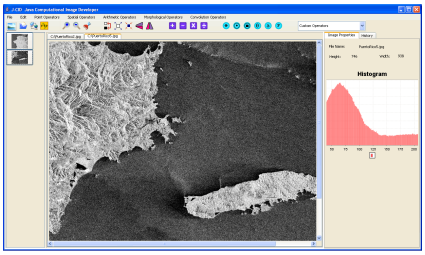

Fig. 5. Graphical User Interface of J-CID

Some of the operators invoke methods from the Java Advanced Imaging API which supports a simple programming model to manipulate images. Also it is used the Java Image I/O API which provides "a pluggable architecture for working with images stored in files and accessed across the network".

A partial list of the implemented operators is:

- Point Operators
  Absolute value, Clamp, Color Convert
- Arithmetic Operators
  Addition, Substraction, Multiplication, Division
- Spatial Operators
  Crop, Resizing, Rotation and Flipping
- Convolution Operators
  Sharpening, Blurring, Embossing, Edge Detection
- Filtering Operators
  Low-pass, High-pass, Laplacian, Gaussian, 2-D Fourier Transform
- Cyclic and Complex Operators
  Cyclic Convolution, Cyclic Correlation, Conjugate, Phase, Hadamard Product and Shifting.

J-CID has the option of allowing end-users to add their own customized algorithms as encapsulated operators.

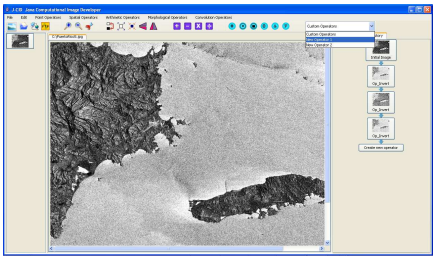

Fig. 6. Encapsulation of Operators

J-CID also permits to establish remote connection with the database that stores the data obtained from the experimental sensors that has been located in some points of the Jobos Bay Reserve; data can be downloaded in files into the local system and can be displayed in graphs.

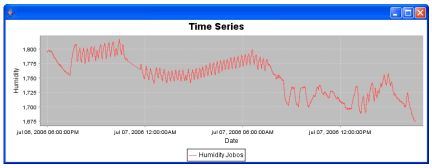

Fig. 7. Graphic of Humidity from Jobos Bay Reserve

7 Conclusions and Future Work

- The developing environment is being designed to be a useful tool for geologists, hydrologists, and scientists in related areas. It provides a friendly access to basic and advance operators, with encapsulation capabilities.
- One of the most important features of the environment is the portability offered by Java, that also facilitates the availability of the source code for potential users.
- Include functionalities of GIS to facilitate the loading of other kind of data.

8 References

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