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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

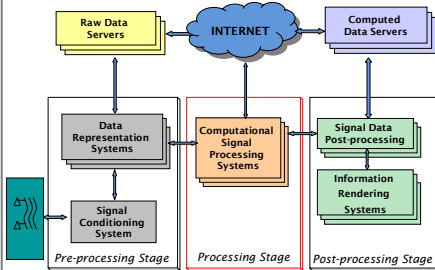


Fig. 1. Conceptual Model of WALSAIP

## 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.

Especially 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**.

Take advantage of **compile scripting languages, such as MATLAB<sup>®</sup>, into highly optimized machine code** (i.e. C, Java) [4].

## 4 Initial Target Area



Fig. 2. Jobs Bay Reserve

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

## 5 Proposed Architecture

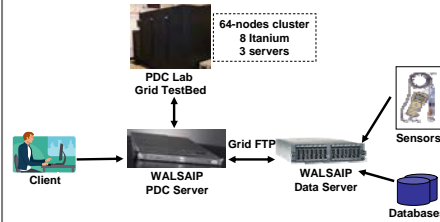


Fig. 3. System Architecture Approach of WALSAIP

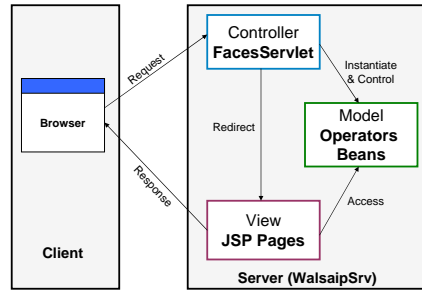


Fig. 4. Model-View-Controller Architecture for JCID

## 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.

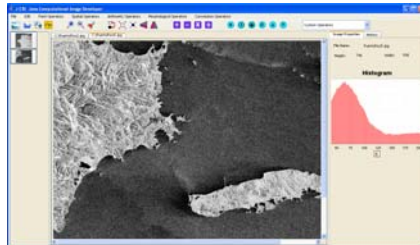


Fig. 5. Graphical User Interface of J-CID

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, Subtraction, 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.

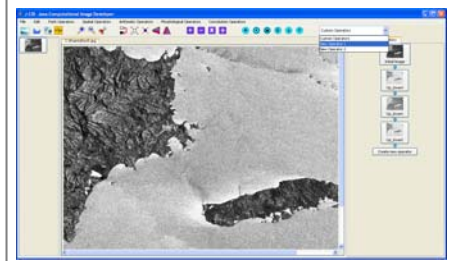


Fig. 6. Encapsulation of Operators

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 Jobs Bay Reserve; data can be downloaded in files into the local system and be displayed in graphs.

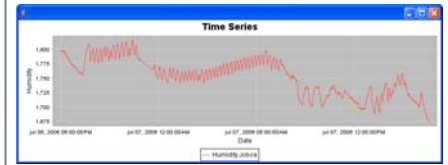


Fig. 7. Graphic of Humidity from Jobs Bay Reserve

## 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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- [2] C. Huallparimachi and D. Rodriguez, "Java-based Tool for Synthetic Aperture Radar Image Analysis," Proceedings of the 3rd International Symposium on Image and Signal Processing and Analysis, 2003.
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- [4] Kennedy, K. Broom, B. Chauhan, A. Fowler, R.J. Garvin, J. Koebel, C. McCosh, C. Mellor-Crummey, J. "Telescoping languages: a system for automatic generation of domain languages". Invited paper Proceedings IEEE Vol 93, No 2, February 2005.
- [5] Viessman, W., Lewis, G., Knapp, J. *Introduction to Hydrology*. 3<sup>rd</sup> Edition, 1989.