A Flexible Software Architecture for High Performance Synthetic Aperture Processing

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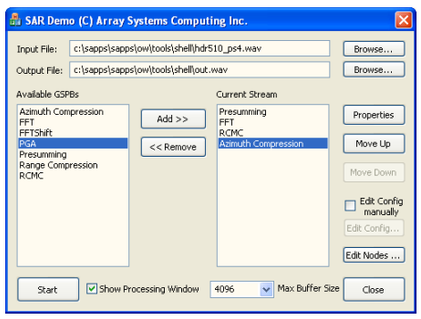
Introduction

Array has developed a novel software architecture, for implementation at the Swedish Naval Underwater Sensors Analysis Centre (MUSAC), which enables users and scientists to easily construct new applications by using a "Lego" style technique. The technique provides the user with building blocks of processing functions that are selected, one by one, in order to graphically modify existing applications or to construct new applications. Array's unique design then parallelizes the application, for immediate processing on a cluster of processors.

This design offers many flexible features: users can easily construct or modify applications; users can design new building blocks and integrate them without recompiling the original system code; the system can be effortlessly scaled simply by adding more processors. In addition to offering flexibility for sonar applications, such as Synthetic Aperture Sonar (SAS) and Matched Field Processing (MFP), this new design has already been successfully used to parallelize Synthetic Aperture Radar (SAR) processing on a Beowulf cluster.

GUI for SAR Rapid Prototyping



A Scalable and Flexible Software Architecture

Array's *Generic Signal Processor (GSP)* is scalable and flexible. The scalability allows processors to be added or removed, without needing to recompile the existing software. This gives the user the ability to boost system performance when new high performance processors are available in the marketplace, extending the life of the system.

The GSP uses modular signal processing blocks, known as *Generic Signal Processing Blocks* (GSPBs). The GSPBs can be linked dynamically at run-time providing plug-in functionality, allowing the capabilities of the system to be extended.

Customers can use personal computers to create and test new GSPBs for their existing target system.

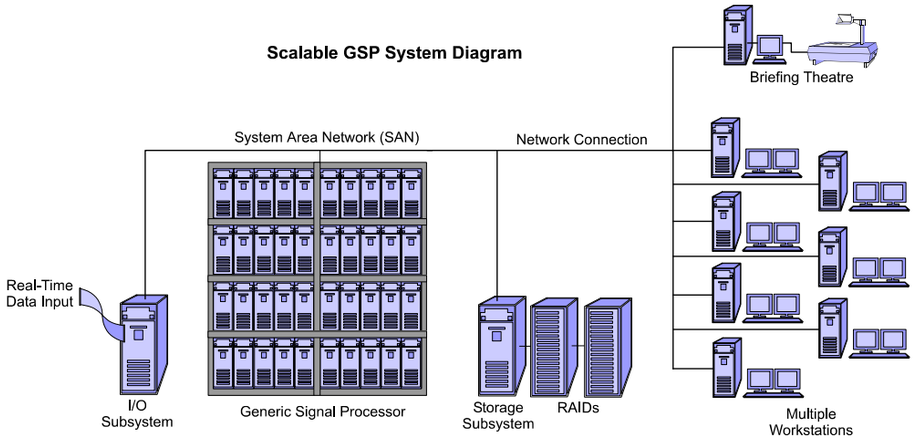
Features and Benefits

- An Open System using Open Source and Open Standards: Linux, MPI and VSIPL
- Object-Oriented Auto-Scaling Generic Signal Processor Software
- Automatic Load Balancing
- Full-Featured Support for Sonar Post Analysis Systems
- Extensive Support for Synthetic Aperture Processing
- A Practical Framework for Truly Rapid Prototyping

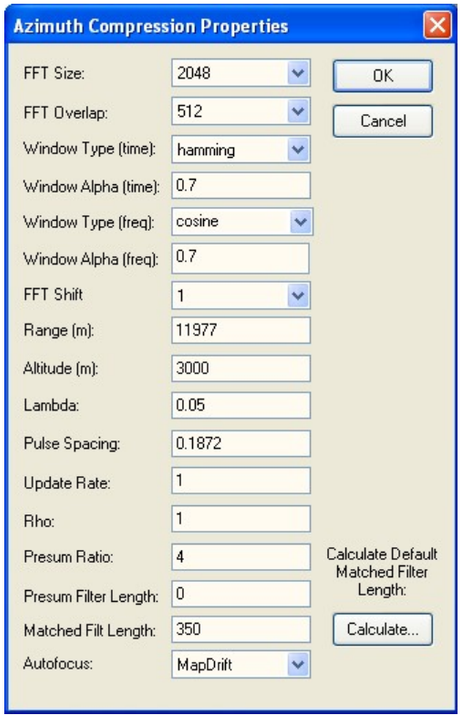
Universal Beamformer

The Universal Beamformer accepts data from a wide variety of sensors, both active and passive, and allows the user to beamform data from sensors configured to any geometry. Both time and frequency domain beamforming are supported.

Scalable GSP System Diagram



Property Dialog Window for Modifying "Azimuth Compression" GSPB Internal Parameters



Future Directions

Moore's law predicts that computing performance increases by a factor of 1.84 yearly, using statistics from http://www.top500.org.

Array has developed a new software architecture for high performance computing that allows developers and end users to use Moore's law to their advantage.

The robustness and fault tolerance of this architecture make it ideal for the following applications:

- Software Defined Radio (SDR)
- Spaceborne GMTI
- Smart Antennas

"Perhaps the central problem we face in all of computer science is how we are to get to the situation where we build on top of the work of others rather then redoing so much of it in a trivially different way."
R.W. Hamming, 1968

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