Comprehensive open-source system for geophysical data acquisition, processing, and visualization

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Summary

Owing to its affordability and flexibility, open-source software offers substantial benefits yet it is often limited in scope and lacks user interfaces. For a number of years, we have been developing a new open-source package (called SIA, (http://seisweb.usask.ca/SIA/) which serves as a tool for the processing and analysis of several types of geophysical data and also as highly integrated framework for developing geophysical applications software.

Currently, the package consists of a processing core extending the capabilities of a seismic processing system, graphical user interface (GUI), and customizable interactive 2D/3D OpenGL visualization tool similar to those used in commercial seismic interpretation systems. The GUI has built-in capabilities for cluster and grid management, and both flow processing and some tools (such as 1D and 3D finite-difference modeling) are enabled for parallel execution. The following new features of the system might be particularly attractive for IRIS users:

- 1) Ability to handle controlled-source and earthquake waveforms, travel-times, potentialfield datasets (2D and 3-D), and metadata, with high throughput and integration of the tools;
- 2) Fully customizable visualization protocol based on OpenGL, allowing building complex, 3D interactive tools without the need to write any code in OpenGL.
- 3) Capability for full web-service operation allowing performing custom processing at a remote location. A library of processing examples was using created approach.(http://seisweb.usask.ca/temp/example
- 4) Tools for real-time data acquisition and management of a seismic network;
- 5) Extensive C++ code libraries, maintenance utilities, and automated documentation support;

virtually every task encountered in authors'

Seismic and non-seismic data handling;

Single- and multichannel digital filtering;

Travel times, grids, and models;

Inversion (wide-angle and 3D RF

Batch and interactive processes.

Full capability

for seismic data

processing

parallel

seismic system

processing

core

Databses

(relational,

velocity models,

TT curves,

Graphics:

Qt, GMT,

OpenGL,

User interface

(scripting language,

custom GUIs)

PostScript

PostScript and Interactive 3D OpenGL

Web services,

including interactive

web forms

Automated software

updates,

code and documentation

maintenance

Scope

research:

Potential fields;

Synthetics;

migration);

Graphics;

Potential fields

(2D and 3D)

Data formats

(SEGY, SEGP, SEG2, GSE3.0, SAC

SEED*)

Travel times

(IASP91,

2-D eikonal

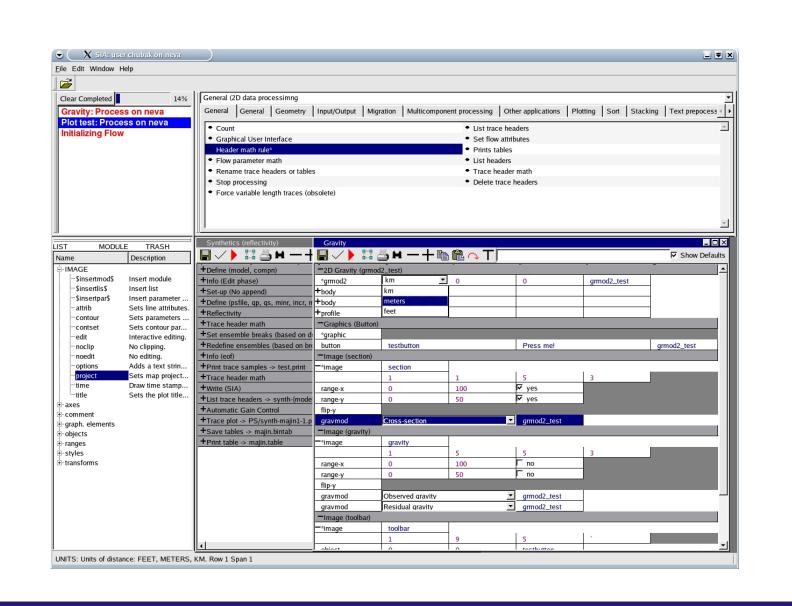
solver)

•Web service.

Graphical User Interface

Full-featured GUI:

- Multiplatform Qt implementation (standard in Linux)
- Editing and submission of multiple jobs;
- Monitoring and interaction with running jobs; Selectable libraries of packaged tools (e.g., earthquake, CDP, potential field packages);
- On-line documentation and tool tips.



Parallel Functionality

System operation is inherently parallelized: •GUI, processing flows, 3D interactive viewer, PostScript viewers, etc, operate in separate

- processes across a computer network; Live PVM communication;
- The GUI Includes graphical cluster configuration tool (below)

	Function	Node	Channel	Command
1	fileout	this_host	pvm	▼ sia_fo %s
2	filein	this_host	pvm	▼ sia_fi %s
3	psview	▼ dvina _	csh	kghostview %s
4	xview	▼ Display_3D _	pvm1	▼ siaviewer
5	print	▼ dvina •	csh	▼ echo %s
6	gmt	this_host	csh	▼ %s
7	rayinvr	this_host	csh	xrayinvr3 %s
8	vmodel	this_host	csh	▼ vmodel %s
9	plotmtv	this_host	csh	plotmtv -nodate -landscape %s
10	master	this_host	pvm	▼ sia_exec %s
, y	Help Do	efaults		Ok Cancel

Collaboration

Collaboration,

updates is provided

installation;

multiple sites;

them.

Software Distribution

and Automatic Updates

Web service for software distribution and

New code can be developed at any

•The source code becomes available to

•When the GUI is started, it automatically

checks for a list of updates available from

components, and the system downloads

the source codes, compiles and installs

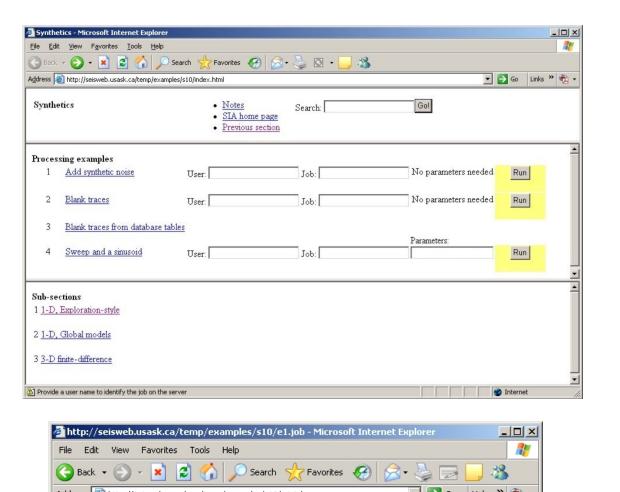
(htp://seisweb.usask.ca/SIA/cs.php):

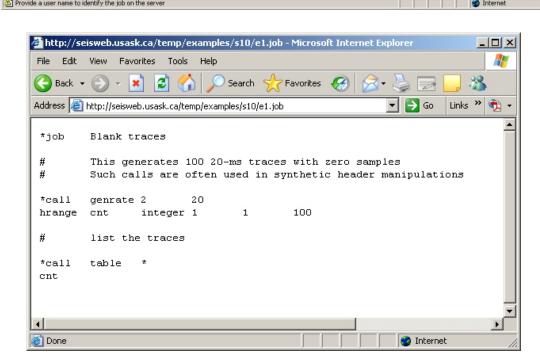
other subscribing SIA sites;

The user selects the desired

Tools for sharing processing expertise by the users:

- •Entire jobs or their fragments can be submitted for posting on local or Internet web site;
- Posted jobs can be executed on the server or copied to the local processing flows.
- Jobs are presented in auto-generated interactive web forms:
- User enters parameters, runs the job, and retrieves the results;
- In the ongoing development, jobs will also be associated with complex, custom web pages
- Search utility provided;





LEX

Cancel

Location

Save

New Version Source

http://chubak.ca

http://chubak.ca

http://chubak.ca

Update

http://seisweb.usask.ca

http://seisweb.usask.ca

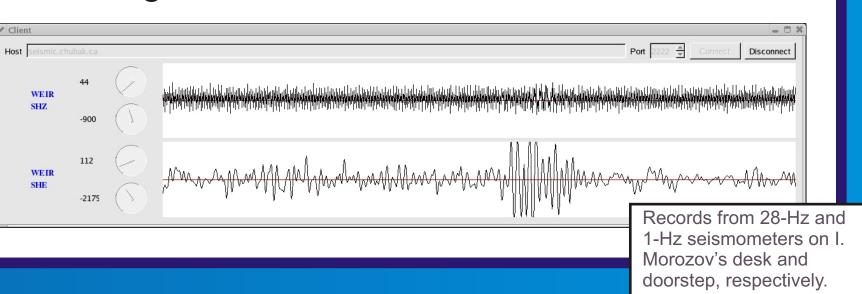
http://seisweb.usask.ca

Cancel

Real-Time Data Acquisition

Tools for seismographic network management and real-time data acquisition:

- 4-channel 24-bit seismograph by Symmetric Research (symres.com);
- Our own software integrated with SIA system
- Graphical Qt data client (below);
- •Real-time data acquisition, archiving, and processing;
- •Web service fior remote system management.



Conclusions

Nearly the entire scope of issues have been addressed in this highly integrated software package:

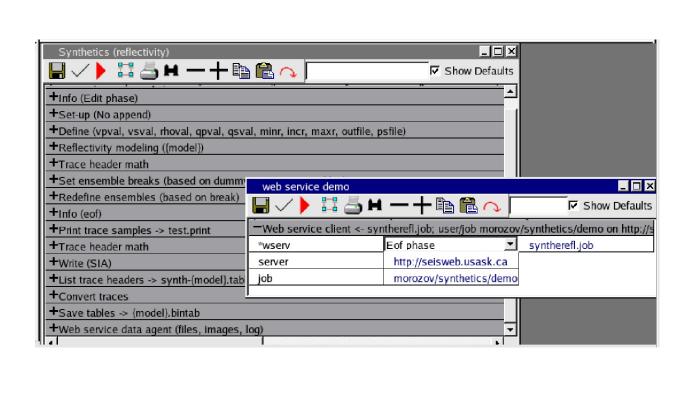
- Single-and multichannel waveform processing;
- Potential-field data processing;
- •Handling and processing of other data (travel times, models, metadata);
- Real-time data acquisition;
- Parallelization and grid/cluster management;
- PostScript and interactive 3D/2D graphics;
- Interfaces to popular packages;
- Web service operation;
- Collaboration via Internet;
- Software maintenance and distributed automatic updates.

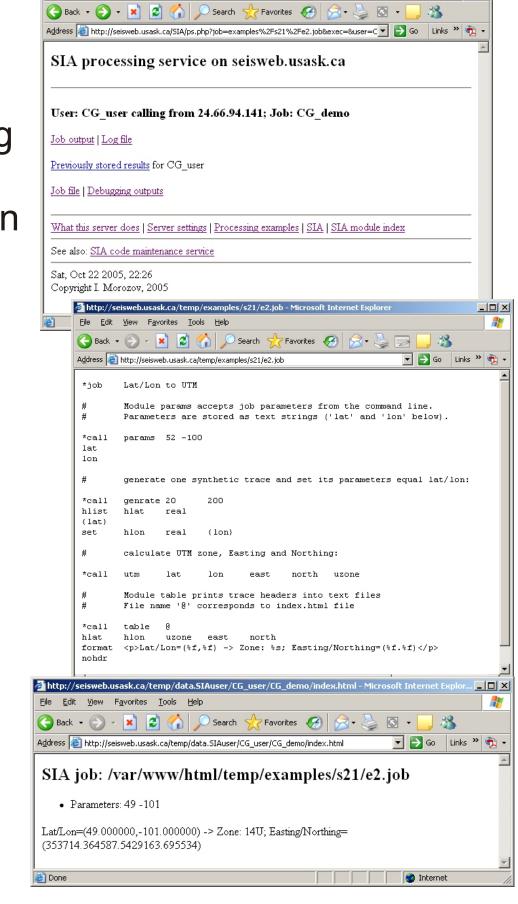
Processing Web Service

The system is fully functional as a web service:

- Any jobs can be submitted to a web server; •The server performs the requested processing
- and returns images, web pages, or data files. •In principle, the service should also work as an
- Only Apache web server is necessary to enable the service;
- •As an example, a user-contributed library of processing examples is supported using this service:

http://seisweb.usask.ca/temp/examples





Interactive 3D/2D Graphics

Test Server

☑ agc 2006.3

☑ .gui 2006.0

☑ pickfb 2006.0

☑ .source 2006.0

☑ .xviewer 2006.0

Select All

University of Saskatchewan

Previous Version

Foundation for a new interpretation package:

- Operates in parallel, two-way communicating with multiple jobs;
- OpenGL graphics with hardware acceleration;
- •Displays are fully configured by the processing flows; •All graphics performed in 3D, with full user
- interactions with the displays and underlying processing flows;
- Supports stereoscopic viewing (e.g., by using GeoWall);
- •Custom GUIs with buttons, sliders, etc., can be generated by the flows (see Example 2).
- •Built-in GMT (NETCDF) global GIS databases coming soon.

