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Welcome & Overview of the Meeting

Felix J. Herrmann

SLIM
University of British Columbia

WIFI

Login:

Password:

The team...

Total of 25 (under)graduate students, PDFs, visitors, faculty, and staff...

John “Ernie” Esser (May 19, 1980 – March 8, 2015)

In memory of Ernie Esser, the UW Math Department, with additional generous funding from Ernie’s family and friends and Sub Salt Solution, has created the **Ernie Esser Undergraduate Support Fund**. Gifts to the fund will support undergraduate students who are engaged in research with faculty. The UW Math Department plans to increase the fund with further contributions from Ernie’s friends and others who share Ernie’s passion for enlarging the mathematical research community. For more information about supporting the Ernie Esser Undergraduate Support Fund, contact Alexandra Haslam, Associate Director of Advancement, Natural Sciences, at alexeck3@uw.edu • (206) 616-1989, Or, to make your gift online, please visit www.washington.edu/giving and search for “Ernie Esser Undergraduate Award.”

Sponsors

12 sponsors + matching by NSERC

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PGS

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woodside

Our mission

Development of the next-generation of seismic data acquisition, processing, imaging, & inversion technology

Dissemination of research findings to spark innovations

Training of the next-generation of seismologists at

- undergraduate
- graduate, and
- post-graduate level

Goals

Acquisition:

- order-of-magnitude improvement in the economics of acquisition
- reduce acquisition time & environmental impact (Arctic, marine)
- quantitative design criteria & assessment of risk

Wave-equation based inversion (WEI):

- order-of-magnitude improvement in computational efficiency
- reduced reliance on starting models, resilient & versatile workflows
- convergence guarantees & uncertainty quantification

Impact

Curvelet-based processing:

- noise removal, multiple elimination, sparse inversions, e.g. SRME & EPSI
- incorporated by Chevron & others leading to major improvements

Randomized (timelapse) acquisition / Compressive Sensing:

- validated & practiced by ConocoPhilips & SLB
- major (**5–10 X**) improvements in production & environmental imprint

Structure-promoting inversion by (convex) optimization:

- enabler of high-quality recovery from severe undersamplings
- Shell validated EPSI & time-lapse surveys will be shot

Impact

Randomized sampling in FWI:

- (**4 – 8 X**) reduction in computational costs
- makes WEI's computationally & economically feasible
- allowed Schlumberger to develop FWI into a viable service

FWI with extensions & convex constraints:

- removal of sensitivity to starting models
- EAGE distinguished lecture series
- automatic salt flooding developed in collaboration w/ Sub Salt Solutions

Bottom line

We have developed a suite of new approaches that

- greatly reduce acquisition & computational costs
- make the industry more cost effective in finding key resources in conventional as well as unconventional (sweet spots) plays
- add tangible value

Highlights '15

Disseminated research findings via

- **5** journal papers + **8** in review
- **17** presentations at the 2015 EAGE & SEG
- **31** SINBAD presentations
- **27** other presentations at ASEG, IEEE, SIAM, AIP, SEG Workshops, CSEG, others
- **14** software releases (Jan, May, Sept)

Software releases

https://sinbad.eos.ubc.ca/SoftwareReleases/highlights

Available at

https://www.slim.eos.ubc.ca/consortiumsoftware

SINBAD Consortium (SLIM)

GitHub, Inc. github.com/SINBADconsortium/ Reader

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SINBAD Consortium (SLIM)

SLIM's repositories for SINBAD consortium members

UBC EOS, Vancouver, BC, Canada https://www.slim.eos.ubc.ca

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Filters Find a repository... + New repository

SLIM-release-apps PRIVATE

Matlab ★ 4 ⑂ 0

Main SLIM software release to SINBAD sponsors - containing all applications, algorithms, tools, and utilities

Updated 4 days ago

SLIM-release-developers PRIVATE

HTML ★ 2 ⑂ 0

SLIM developer notes and templates

Updated 27 days ago

SLIM-release-comp PRIVATE

Shell ★ 2 ⑂ 1

3rd-party software for multi-user installation of SLIM software release to SINBAD sponsors - not required by some of appliactions from SLIM-release-apps

Updated on Aug 6

People 40 >

HM

Invite someone

Recent software releases

Stable Software Release (Added from Master Branch) — January 2015

1. **3D Frequency-Domain Modeling Kernel.** This package contains Matlab functions to manipulate the discrete 3D acoustic Helmholtz system in frequency domain. It is primarily based on a staggered grid-dispersion minimizing second-order finite-differences stencil first proposed by Stéphane Operto et al., using PML. In addition, we currently have implemented a standard second-order 7 points finite-difference stencil with PML (see PhD thesis by Xavier Pinel for more details). For questions contact Rafael Lago. [Read more] [GitHub]
2. **2D Wavefield Reconstruction Inversion.** Wavefield Reconstruction Inversion (WRI) is a recently introduced method for full-waveform inversion, based on a penalty-form objective. This software release contains a 2D implementation based on a direct solver, including an example where WRI performs much better than conventional FWI. For questions contact Bas Peters. [Read more] [GitHub]
3. **Total Variation Regularized Wavefield Reconstruction Inversion.** This code implements a scaled gradient projection method to minimize the wavefield reconstruction inversion (WRI) objective subject to total variation and spatially varying bound constraints. For questions contact Ernie Esser. [Read more] [GitHub]

Beta Software Release (Master Branch) — February 2015

1. **Rank minimization based source separation in time-jittered marine acquisition.** In this work, we present a computationally efficient rank-minimization algorithm to deblend seismic data in the case of time-jittered marine acquisition. The proposed algorithm is suitable for large-scale seismic data, since it avoids SVD computations and uses a low-rank factorized formulation instead. For questions contact Rajiv Kumar. [GitHub]
2. **Large-scale seismic data interpolation using SVD-free low-rank matrix factorization.** This software package allows you to complete a large-scale, distributed matrix with missing entries using the SPGLR algorithm. The L and R factors are themselves distributed along with the input data and a copy of the full data matrix is never explicitly formed. We apply this solver to interpolate a very large frequency slice with missing sources and/or receivers. For questions contact Curt DaSilva. [GitHub]
3. **Full-Waveform Inversion for time-lapse seismic data.** This package is an application for full-waveform inversion of time-lapse seismic data sets using a modified Gauss-Newton inversion framework. Ideas from distributed compressive sensing and stochastic optimization are exploited to create improved time-lapse models and speed-up the inversion, respectively. For questions contact Felix Oghenekohwo. [GitHub]

Recent software releases

1. **3D Frequency-Domain Modeling Kernel. (update in Master branch)** This package contains the Matlab functions to manipulate the discrete 3D acoustic wave equation operator in frequency domain. It is primarily based on a staggered grid dispersion minimizer second order finite differences stencil using PML. In addition, we currently have implemented the standard second order 7 points finite differences stencil with PM. For questions contact Rafael Lago. [Read more] [GitHub]
2. **Krylov solvers. (new in Master Branch)** This package contains all the basic Krylov solvers (such as CRMN, CGMN and FGMRES) we use for computing an approximate solution for the wave equation. This is not a standalone package, but instead used extensively by our 3D Frequency-Domain Modeling Kernel. For questions contact Rafael Lago. [GitHub]
3. **Multigrid Preconditioners. (new in Master branch)** A collection of multigrid preconditioners to be used together with FGMRES (from Krylov solvers package) for solving the time-harmonic wave equation. It implements some of the preconditioners from Calandra et al, but also extend and improve them for use with 27 points stencils. This is not a standalone package, but it is intended for use in the future by our 3D Frequency-Domain Modeling Kernel package. For questions contact Rafael Lago;. [GitHub]
4. **2D Frequency-domain acoustic modeling. (update in Master branch)** This package contains a MATLAB implementation of a 2D frequency-domain constant-density acoustic modeling operator and its Jacobian as well as the analytic Greens function for constant and linearly increasing velocity. For questions contact Curt DaSilva. [GitHub]
5. **Wavefield Reconstruction Inversion. (update in Master branch)** This toolbox provides functions that are the core for the Wavefield reconstruction Imaging application (SLIM-release-apps/applications/Imaging/WRimaging/) and the Wavefield Reconstruction Inversion application (not yet published). The scripts compute objective function values, gradients of the objective functions as well as a Gauss-Newton Hessian. For questions contact Curt DaSilva. [GitHub]

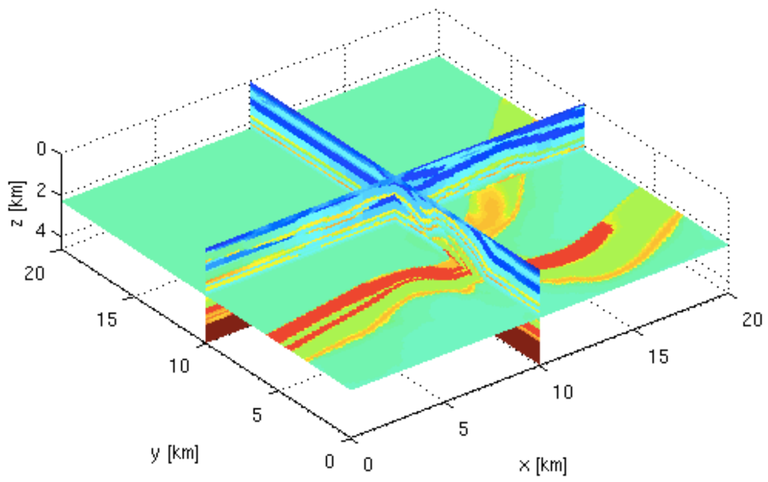
3D Frequency-domain FWI with batching: results

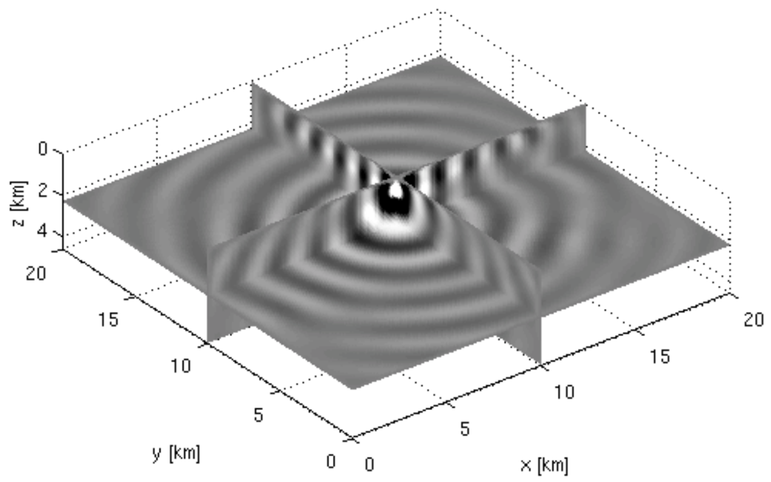
Contents

- CARP-CG
- FWI

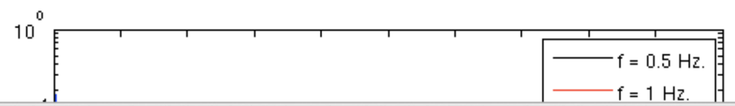
CARP-CG

Here we present some results of the Helmholtz solver on the overthrust model. The model and a wavefield for 2 Hz are shown below.

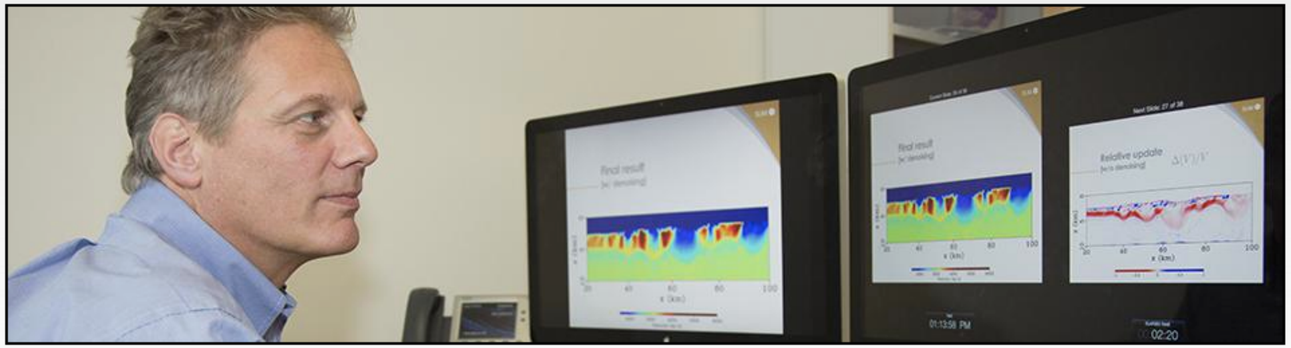




We compute the wavefield for various frequencies with a fixed number of gridpoints per wavelength. The convergence histories are shown below



Seismic Laboratory for Imaging and Modeling



SEARCH

Upcoming events

Mon, Aug 31st, 2015
Inaugural Full-Waveform Inversion Workshop, Brazil

Wed, Sep 9th, 2015
Hansruedi Maurer, ETH Zurich "The curse of dimensionality in exploring the subsurface" 4:00 PM, ESB 5104 - 2207 Main Mall, UBC Campus

more

SINBAD Consortium Meeting Fall 2015

New Publications

- **Affordable full subsurface image volume—an application to WEMVA** *Conference (EAGE Workshop on Wave Equation based Migration Velocity Analysis, Madrid)*
- **Irregular grid tensor completion** *Conference (Workshop on Low-rank Optimization and Applications, University of Bonn, Germany)*
- **Wavefield-denoising and source encoding** *Conference (SIAM Conference on Mathematical and Computational Issues in the Geosciences, Stanford University, California)*
- **Sparsity promoting seismic imaging and full-waveform inversion** *Thesis (PhD)*
- **Total variation regularization strategies in full waveform inversion for improving robustness to noise, limited data and poor initializations** *Tech Report*
- **Sparse least-squares seismic imaging with source estimation utilizing multiples** *Conference (PIMS Workshop on Advances in Seismic Imaging and Inversion, University of Alberta, Edmonton)*
- **A new take on compressive time-lapse seismic acquisition, imaging and inversion** *Conference (PIMS Workshop on Advances in Seismic Imaging and Inversion, University of Alberta, Edmonton)*
- **Compressive time-lapse seismic data processing using shared information** *Conference (CSEG,*

Biblio

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SEARCH

SEARCH PUBLICATIONS

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2015

Philipp Witte, Mathias Louboutin, and Felix J. Herrmann, "**Overview on anisotropic modeling and inversion**". 2015. Abstract BibTex

Felix J. Herrmann and Bas Peters, "**Pros and cons of full- and reduced-space methods for Wavefield Reconstruction Inversion**", in *SIAM Conference on Mathematical and Computational Issues in the Geosciences*, 2015. Abstract BibTex

Brendan Smithyman, Bas Peters, and Felix J. Herrmann, "**Constrained waveform inversion of colocated VSP and surface seismic data**", in *EAGE Annual Conference Proceedings*, 2015. Abstract BibTex

Zhilong Fang, Chia Ying Lee, Curt Da Silva, Felix J. Herrmann, and Rachel Kuske, "**Uncertainty quantification for Wavefield Reconstruction Inversion**", in *EAGE Annual Conference Proceedings*, 2015. Abstract BibTex

Felix Oghenekohwo, Rajiv Kumar, Ernie Esser, and Felix J. Herrmann, "**Using common information in compressive time-lapse full-waveform inversion**", in *EAGE Annual Conference Proceedings*, 2015. Abstract BibTex

Felix J. Herrmann, "**Randomized algorithms in exploration seismology**", in *ASEG Annual Conference Proceedings*, 2015. Abstract BibTex

Mathias Louboutin and Felix J. Herrmann, "**Time compressively sampled full-waveform inversion with stochastic optimization**". 2015. Abstract BibTex

2014

Felix J. Herrmann, Ernie Esser, Tristan van Leeuwen, and Bas Peters, "**Wavefield Reconstruction Inversion (WRI) – a new take on wave-equation based inversion**", in *SEG Workshop on Full Waveform Inversion - Elastic Approaches and Issues with Anisotropy, Nonshallow Inversion, Poor Starting Model; Denver*, 2014. BibTex

Rafael Lago, Art Petrenko, Zhilong Fang, and Felix J. Herrmann, "**Fast solution of time-harmonic wave-equation for full-waveform inversion**", in *EAGE Annual Conference Proceedings*, 2014. Abstract BibTex

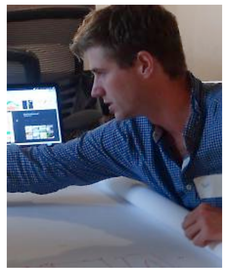
Zhilong Fang, Curt Da Silva, and Felix J. Herrmann, "**Fast uncertainty quantification for 2D full-waveform inversion with randomized source subsampling**", in *EAGE Annual Conference Proceedings*, 2014. Abstract BibTex

Seismic Laboratory for Imaging and Modeling

SLIM

Matrix square root-based wavefield extrapolation
CARP-CG
Modeling
Preconditioning of the Helmholtz equation via row-projections
A parallel matrix-free framework for frequency-domain seismic modeling in Matlab
Interferometric FWI
UQ for FWI with source subsampling
Uncertainty quantification (UQ)
Invert elastic data with the acoustic wave equation
Mitigating local minima in FWI by expanding the search space
3D frequency-domain waveform inversion using a row-projected helmholtz solver
model-space approach
Non-Uniqueness of the Student's t-formulation for Linear Inverse Problems
Full-Waveform Inversion (FWI)
data-space approach
Robust FWI with misfit measured in the wavenumber domain
Robust FWI using Student's t-distribution
Estimation of Nuisance Parameters in inverse problems
Modified, sparsity promoting, Gauss-Newton algorithm for seismic waveform inversion
Elastic waveform inversion
Robust Source Estimation
Degrees of freedom parameter estimation
Variance Estimation in the Gaussian model
Source estimation
Wavefield Reconstruction Inversion (Penalty method for FWI)
Multiparameter inversion
TV-regularized WRI
Interferometric imaging
Preconditioned Imaging by random matrix probing
Limitations of the deconvolutional imaging condition for two-way propagators
HSS-based depth stepping migration
Wave-equation based multi-parameter linearized inversion with joint-sparsity promotion
Imaging
Migration with extended image volumes
Sparsity-promoting migration with surface-related multiples
Efficient Least-Squares migration with sparsity promotion
Fast least-squares migration with multiples and source estimation
Batching
Dimensionality Reduction
Optimization
Exploiting the structure of the signal
Cosparsity
Sparsity
Low Rank
GAP
L1-minimization
Rank Minimization
Application to Seismic Data Interpolation
Weighted L1-minimization
PQNL1
Generalized SPGL1
SPGL1
WSPGL1
Hierarchical Tucker Tensor Optimization
Application to Seismic Data Interpolation
Application to denoising
Processing
randomized SVD and hierarchical matrices
EPSI (Estimation of Primaries via Sparse Inversion)
Multilevel acceleration of REPSI
Robust EPSI via one-norm minimization
REPSI w/ primary wavefield autoconvolution
Up/down wavefield decomposition by sparse inversion
Compressive Sensing (CS)
Compressive Seismic Computation
Compressive Sensing applied to exploration seismology
Forgoing repeatability in time-lapse aquisition
Compressive Sensing in Seismic Acquisition
Compressive Sensing in Marine Acquisition
Acquisition
Marine Acquisition
Land acquisition
Simultaneous source Marine Acquisition
Simultaneous source Land Acquisition
Ocean bottom acquisition via jittered sampling
Application to repeatability in 4D seismic
Approximate Message Passing (AMP)
Control the linearization errors in L1 regularized inversion
Application to exploration seismology
Application to imaging with multiples
Application to sparsity promoting migration
Application to trace interpolation
Source separation w/ HSS and matrix completion
Matrix Completion
Lifting vectors to matrices
Application to blind deconvolution
Matrix completion on unstructured grids
Hierarchical Semiseparable Matrices
Tools
Linear operator Toolbox SPOT
Parallel Extensions to SPOT: pSPOT
A parallel matrix-free framework for frequency-domain seismic modeling, imaging and inversion in Matlab

New hires



Ben Bougher — MSc works on deep learning & AVO

Philipp Witte — PhD works on anisotropic FWI & RTM

Shashin Sharan — PhD works on simulation based acquisition design & noise

New hires

Ali Alfaraj — new PhD, formerly with Delft, ETH Zurich.

Yiming Zhang— new MSc, top Geophysics grad 2015 from China University of Petroleum (East)

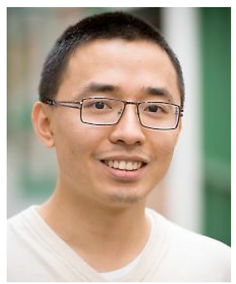
Moving on…

Ian Hanlon

Xiang Li

Tim Lin

Rafael Lago



Ning Tu

Xiang Li's Thesis

Sparsity promoting
seismic imaging and full-waveform inversion

software release: Time-domain Gauss-Newton full-waveform inversion for Chevron 2014 benchmark datase

defended July 7, joined PGS

SLIM

least-squares migration (linear problem)

is applied to

modified Gauss-Newton Method

is applied to

full-waveform inversion (nonlinear problem)

uses

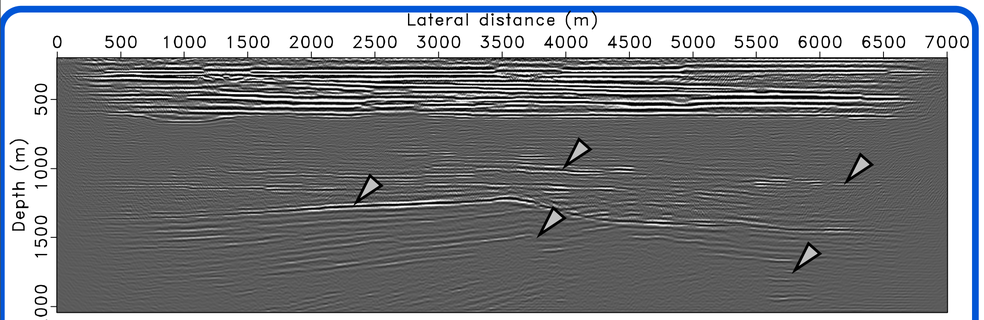
dimensionality Reduction

+

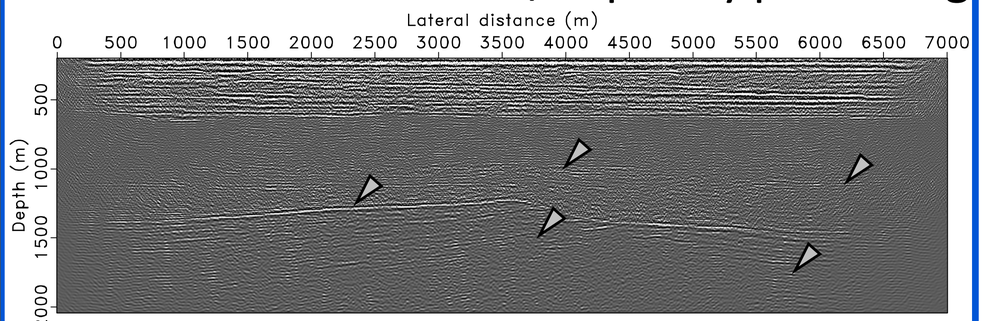
sparsity promoting inversion

can be done by

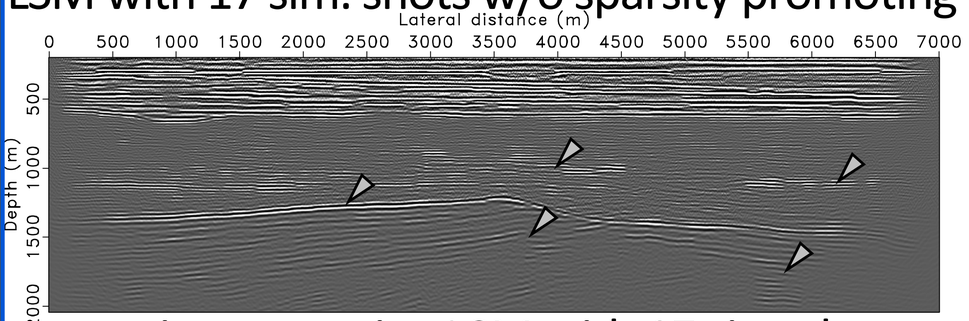
exploiting the subsurface structure in the **curvelet domain**



LSM with all 350 shots w/o sparsity promoting



LSM with 17 sim. shots w/o sparsity promoting

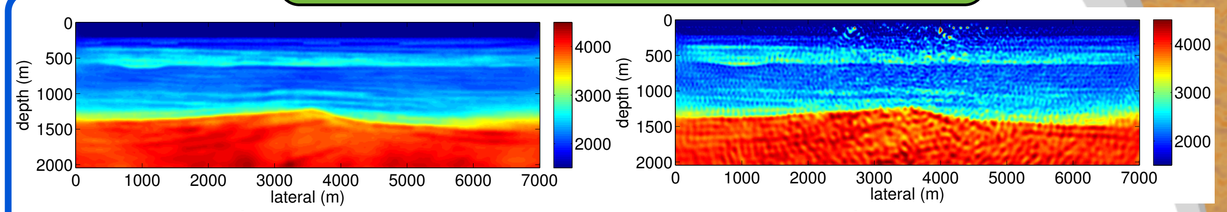


sparsity promoting LSM with 17 sim. shots

24

speedup: x20 times

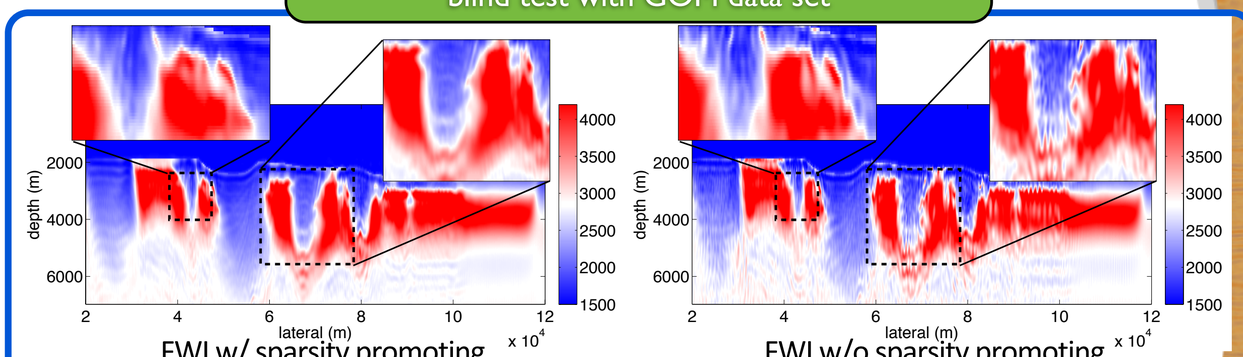
inverse crime data example



FWI w/ sparsity promoting

FWI w/o sparsity promoting

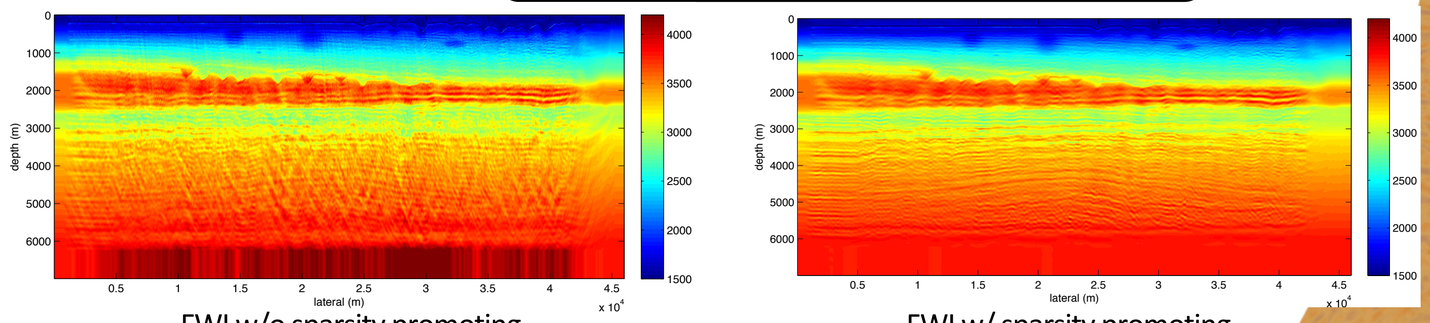
blind test with GOM data set



FWI w/ sparsity promoting

FWI w/o sparsity promoting

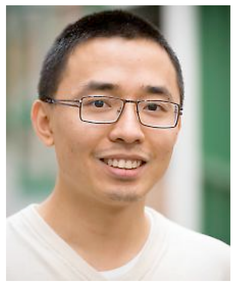
blind test with North-sea data set



FWI w/o sparsity promoting

FWI w/ sparsity promoting

future work

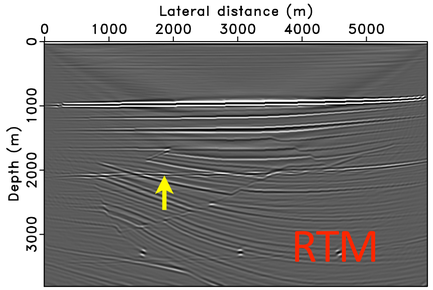


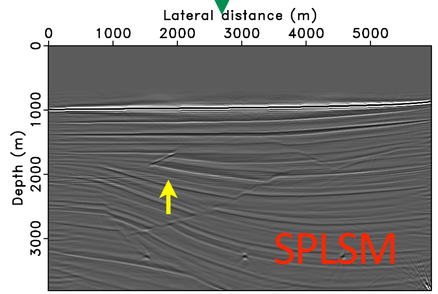
Tu Ning's Thesis

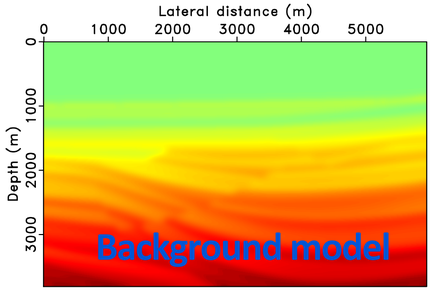
Fast imaging
with surface-related multiples

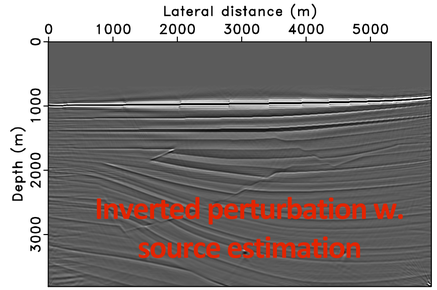
Software release: Fast least-squares imaging with source estimation using multiples

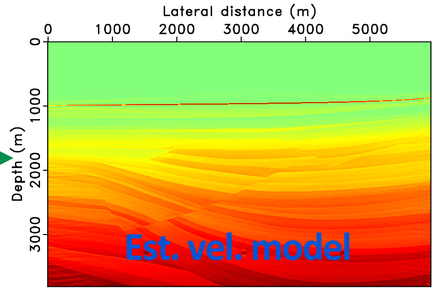
Defended July 23, will become professor @ Tongi











Sparse least-squares imaging with surface-related multiples (Chapter 2)

Theory

+

Source estimation using surface-related multiples (Chapter 5)

Sparse inversion **simplified** (Chapter 7)

Application

Application to field data (Chapter 6)

Using multiples for **extended imaging/ MVA** (Chapter 7)

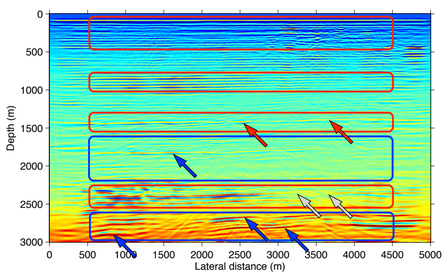
Extension and future work

Improving robustness to modelling/ linearization errors (Chapter 3)

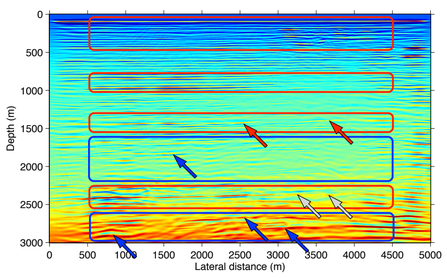
Supporting materials

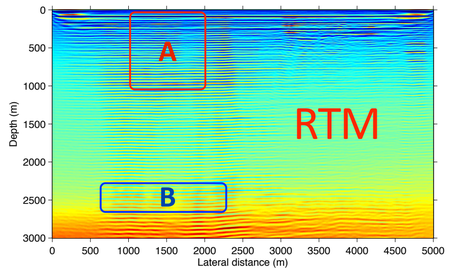
Inadequacies of using the deconvolutional imaging condition (Chapter 4)

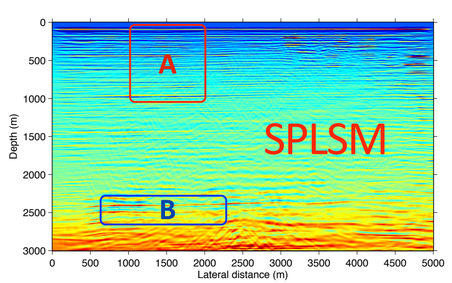
primary image

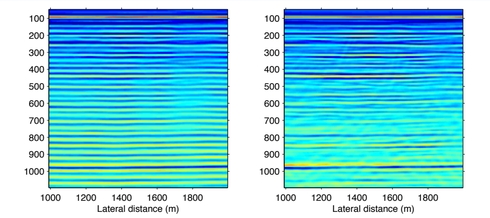


total data image

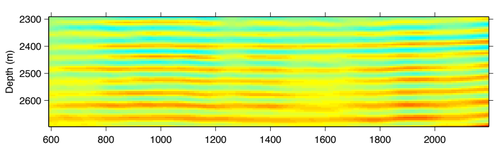




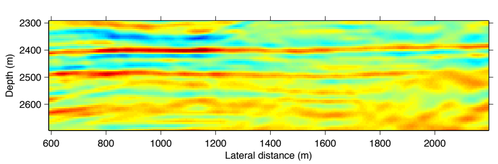




A zoom



B zoom



Tim Lin's Thesis

Primary estimation with
sparsity-promoting bi-convex optimization

software release: Multilevel Robust EPSI with scattering-based multiple prediction for near-offset interpolation

Will join Sub Salt Solutions, November 1

Primary estimation with sparsity-promoting bi-convex optimization

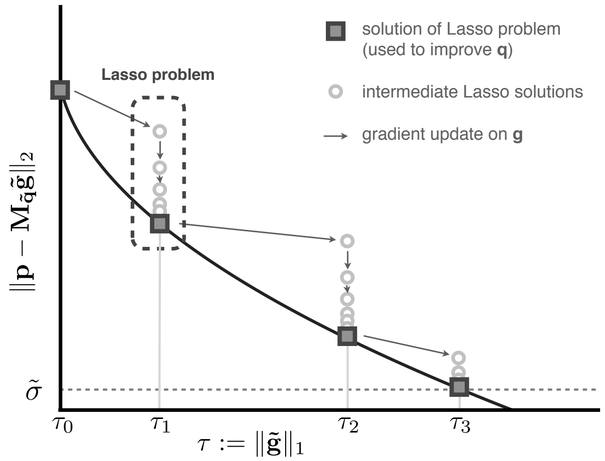
1. **Robust EPSI**, a new formulation of the EPSI primary estimation problem which avoids *ad-hoc parameter adjustments* in favour of *self-tuning bi-convex optimization*

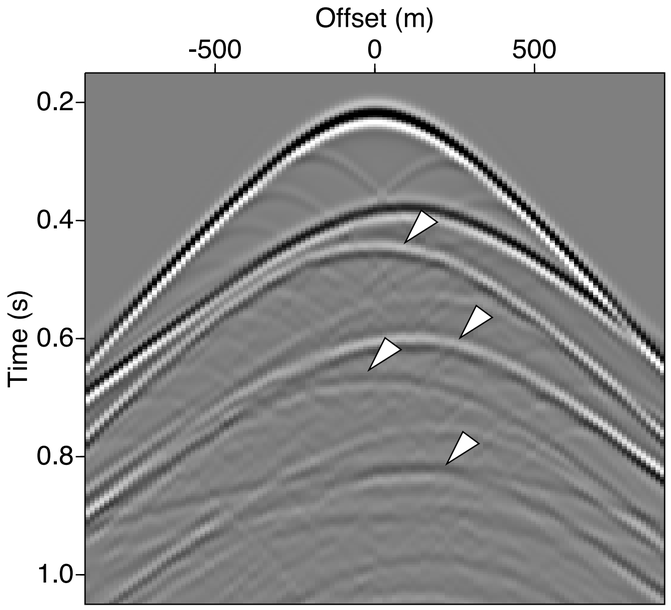
2. **Near-offset mitigation with scattering**, a correction to the multiple prediction in face of missing data, using Born scattering off the free surface. A powerful alternative to near-offset reconstruction in REPSI.

3. **A multigrid acceleration strategy** for REPSI, can *greatly reduce* REPSI computation time (1 order of magnitude in 2D, 2 order in 3D)

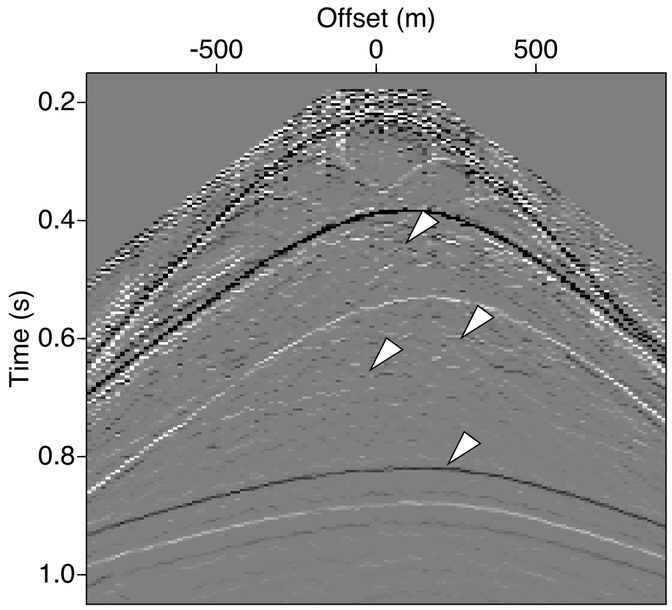
Robust EPSI

New formulation of the EPSI primary estimation problem which avoids *ad-hoc parameter adjustments* in favour of *self-tuning bi-convex optimization*

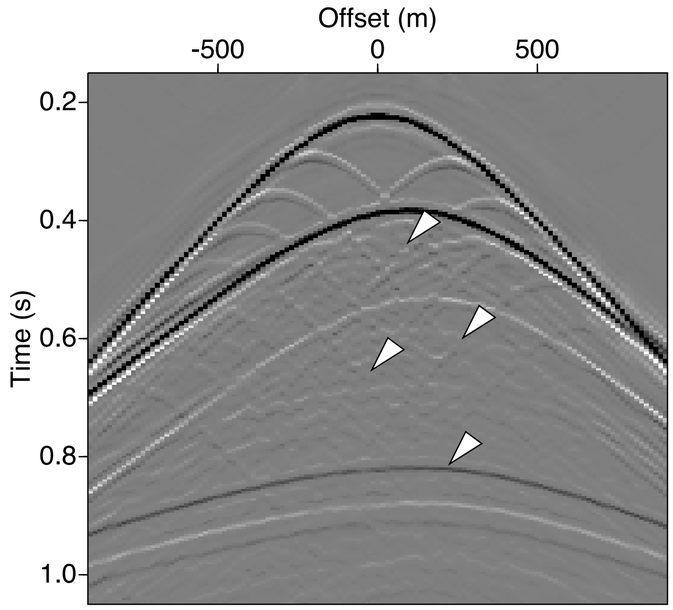




Data



EPSI Solution



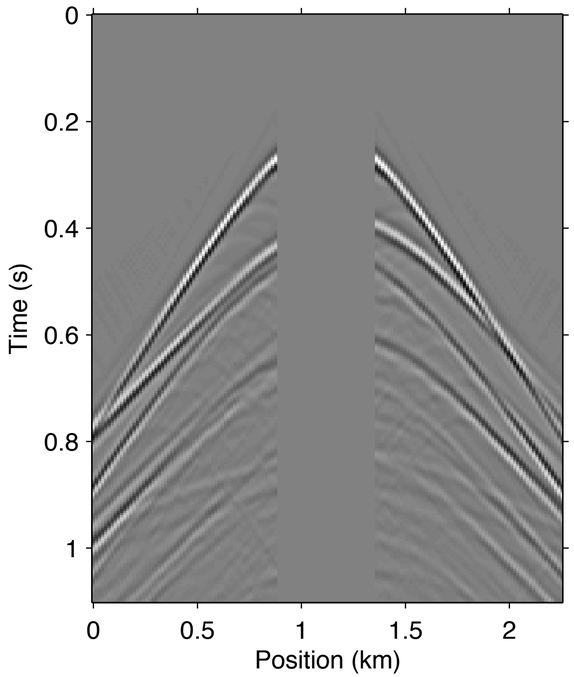
Robust EPSI Solution

Near-offset mitigation with scattering

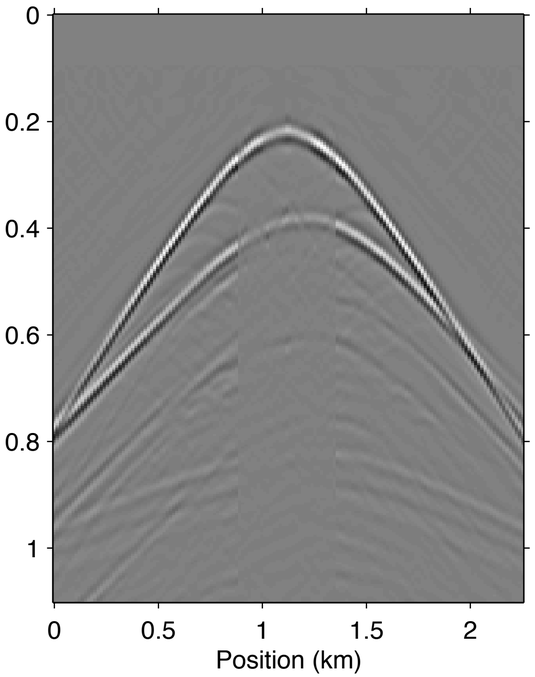
A correction to the multiple prediction in face of missing data using Born scattering off the free surface. *A powerful alternative to near-offset reconstruction in REPSI.*

$$\begin{aligned}\widetilde{\mathcal{M}}(\mathbf{G},\mathbf{Q};\mathbf{P}') =& \mathbf{K}\circ\left[\mathbf{GQ}+\mathbf{RGP}'\right.\\ \text{2nd Order Scattering} \quad &+ \mathbf{RGK_c}\circ(\mathbf{GQ}+\mathbf{RGP}')\\ \text{3rd Order Scattering} \quad &+ \mathbf{RGK_c}\circ(\mathbf{RGK_c}\circ(\mathbf{GQ}+\mathbf{RGP}'))\\ &+ \left.\mathcal{O}(\mathbf{G}^4)\right]\\ :=& \mathbf{K}\circ\sum_{n=0}^{\infty}(\mathbf{RGK_c}\circ)^n(\mathbf{GQ}+\mathbf{RGP}')\,.\end{aligned}$$

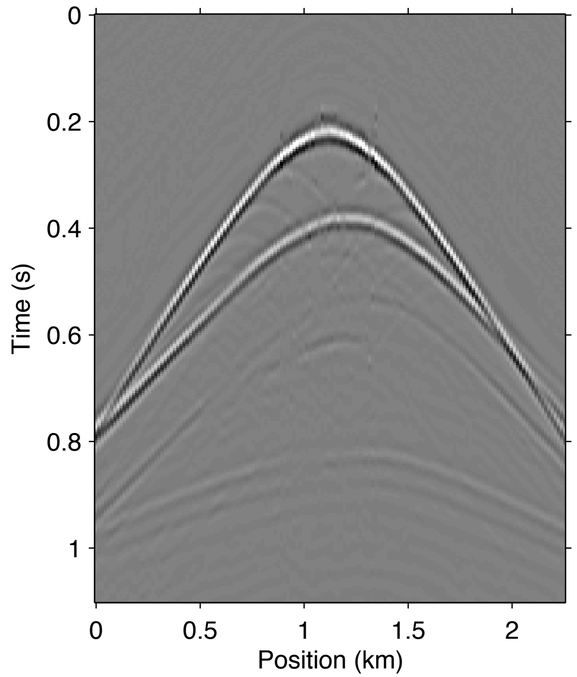
Data



Explicit Reconstruct.

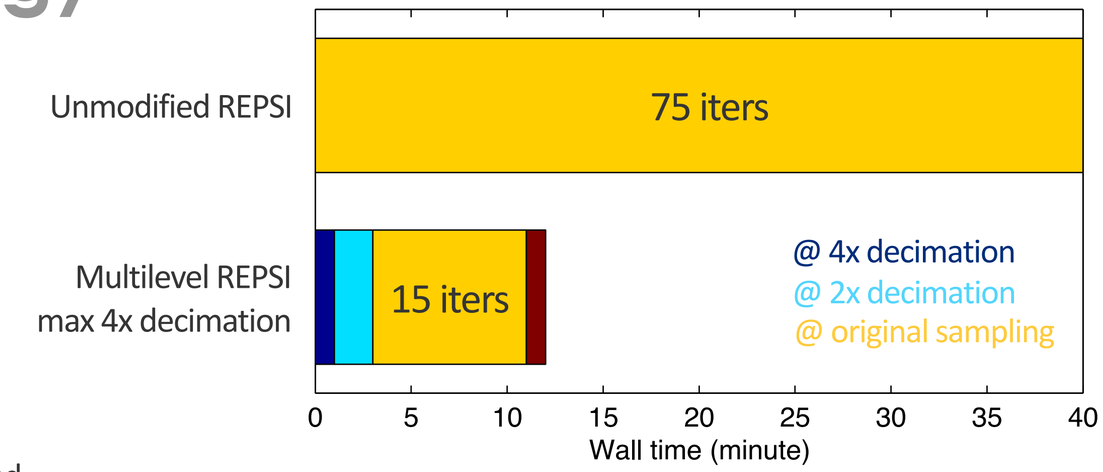


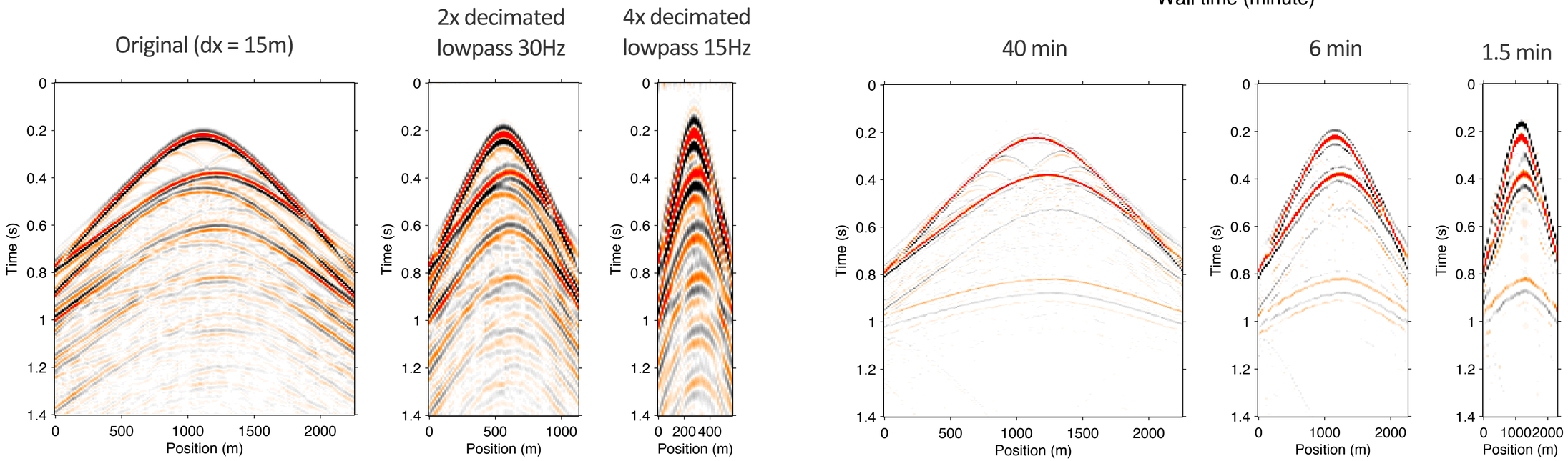
Correction w/ 3rd Ord. Scattering



Multigrid acceleration strategy

A multigrid iterative bootstrapping strategy for REPSI, can *greatly reduce* REPSI computation time (1 order of magnitude in 2D, 2 order in 3D)





Data **mapped to coarse grids** **Solution** **solved at coarse grids**

DNOISE III

DNOISE II ended in August

Wrote new proposal entitled:

"DNOISE III – Exploration Seismology in the Petascale Age"

Designed to maximally leverage extended research team & industry contributions.

DNOISE III — Exploration Seismology in the Petascale Age

Felix J. Herrmann
Seismic Laboratory for Imaging and Modeling (SLIM), University of British Columbia, Canada

Synopsis

This current proposal describes a comprehensive five-year continuation of our research project in dynamic nonlinear optimization for imaging in seismic exploration (DNOISE). **DNOISE III—Exploration Seismology in the Petascale Age** builds on the proven track record of our multidisciplinary research team that conducts transformative research in the fields of seismic-data acquisition, processing, and wave-equation based inversion. The overarching goals of the DNOISE series of projects can be simply summarized as:

> *"How to image more deeply and with more detail?"* and *"How to do more with less data?"*

Also, to help overcome the current substantial challenges in the oil and gas industry, we maintain this focus with more specific follow-up questions such as:

> *"How can we control costs and remove acquisition-related artifacts in 3D (time-lapse) seismic data sets?"* and *"How can we replace conventional seismic data processing with wave-equation based inversion, control computational costs, assess uncertainties, extract reservoir information and remove sensitivity to starting models?"*

To answer these questions, we have assembled an expanded cross-disciplinary research team with backgrounds in scientific computing (SC), machine learning (ML), compressive sensing (CS), hardware design, and computational and observational exploration seismology (ES). With this team, we will continue to drive innovations in ES by utilizing our unparalleled access to high-performance computing (HPC), our expertise and experience in CS and wave-equation based inversion (WEI) and our proven abilities in incorporating our research findings into practical scalable software of our inversion solutions.

https://www.slim.eos.ubc.ca/Publications/Private/TechReport/NSERC/2014/DNOISEIII/crd.html

Update

Proposal was met with a “perfect storm”

- NSERC changed their interpretation of their policies regarding eligibility of companies for matching
- downturn in the oil price & the associated uncertainty
- decided to hold off

Next steps

- considering to recycle the proposal
- refocus on changed situation
- possible in the form of a Canadian research chair

III – International Inversion Initiative

Collaboration between

- UFRN in Natal
- FULLWAVE Consortium at Imperial College London
- SINBAD Consortium at the University of British Columbia

Sponsored by BG Group (from the pre-salt levy) & Supported by SENAI

Enabler of technology validation on 3-D seismic

Research findings will be shared amongst SINBAD members

Wednesday, 28 October, 15

III – International Inversion Initiative

Yemoja compute system:

- #1 in Latin America
- 17k cores, 405 Teraflop, 132k GB RAM, 2Petabyte storage, 18GBs IO
- largest (4k workers) parallel matlab installation in the world
- very strict access control

Designed for

- technology validation for wave-equation based inversions
- development of practical workflows on 3D field data sets
- training


CIMATEC
yemoja
anp
BG BRASIL
FIEB SENAI


CIMATEC
yemoja

service6:1 (henryk) – VNC Viewer

Applications Places System

Mon Aug 24, 7:17 PM henryk

henryk@r3i6n1:~

File Edit View Search Terminal Help

```
top - 19:17:39 up 34 days, 10:02,  1 user,  load average: 2.69, 3.01, 1.85
Tasks: 907 total,   1 running, 906 sleeping,   0 stopped,   0 zombie
Cpu(s):  0.0%us,  0.0%sy,  0.0%ni,100.0%id,  0.0%wa,  0.0%hi,  0.0%si,  0.0%st
Mem:  132001796k total, 53643552k used, 78358244k free,        0k buffers
Swap:        0k total,        0k used,        0k free,   595648k cached

  PID USER      PR  NI  VIRT  RES  SHR S %CPU %MEM    TIME+  COMMAND
 7676 henryk    20   0 13800 1940  960 R  0.7  0.0   0:00.28 top
 6651 henryk    20   0 8201m 5.0g 110m S  0.3  4.0   0:45.76 MATLAB
 6648 henryk    20   0 8200m 5.0g 110m S  0.0  4.0   0:46.94 MATLAB
 6649 henryk    20   0 8201m 5.0g 110m S  0.0  4.0   0:46.06 MATLAB
 6650 henryk    20   0 8202m 5.0g 111m S  0.0  4.0   0:45.83 MATLAB
 6652 henryk    20   0 8202m 5.0g 111m S  0.0  4.0   0:46.20 MATLAB
 6653 henryk    20   0 8202m 5.0g 110m S  0.0  4.0   0:46.56 MATLAB
 6654 henryk    20   0 8202m 5.0g 111m S  0.0  4.0   0:47.02 MATLAB
 6655 henryk    20   0 8201m 5.0g 110m S  0.0  4.0   0:46.59 MATLAB
 6656 henryk    20   0 8202m 5.0g 111m S  0.0  4.0   0:46.23 MATLAB
 6657 henryk    20   0 8202m 5.0g 110m S  0.0  4.0   0:46.70 MATLAB
 7638 henryk    20   0  150m 2296  824 S  0.0  0.0   0:00.00 sshd
 7639 henryk    20   0  104m 1928 1468 S  0.0  0.0   0:00.00 bash
```

MATLAB R2015a

Search Documentation

Code / Time / ommands — Simulink Library — Layout — Preferences / Set Path / Parallel — Help — Community / Request Support / Add-Ons

CODE | SIMULINK | ENVIRONMENT | RESOURCES

ources for Getting Started.

```
rties:

ected: true
rkers: 6
uster: yemoja_local_r2015a
Files: {}
meout: 300 minute(s) (300 minutes remaining)
abled: true

ing the 'yemoja_local_r2015a' profile is shutting d
rpool('Cluster128G',1,200,10)
sterInfo settings.

Before submitting a job to YEMOJA, you must specify the partition.

                >> % E.g. set partition to 'test'
                >> ClusterInfo.setQueueName('test')

Starting parallel pool (parpool) using the 'yemoja_local_r2015a' pr
additionalSubmitArgs =

-N 200 --ntasks-per-node 10 -n 2000 --partition=Cluster128G -t 1:00

connected to 2000 workers.

pool =

 Pool with properties:

            Connected: true
           NumWorkers: 2000
              Cluster: yemoja_local_r2015a
        AttachedFiles: {}
          IdleTimeout: 300 minute(s) (300 minutes remaining)
          SpmdEnabled: true

>> a=distributed.rand(10000,10000,10000);
>>
```

Command History

```
%-- 08/21/2015 10:24:38 PM --%
path
%-- 08/21/2015 10:42:51 PM --%
```

Sview

Actions Options Query Help

Jobs | Partitions | Reservations | Visible Tabs

JobID	Partition	UserID	Name	State	Time Ru
1875	Cluster128G	henryk	Job6	RUNNING	00:08:5
0	Cluster128G	henryk	worker	RUNNING	00:08:5

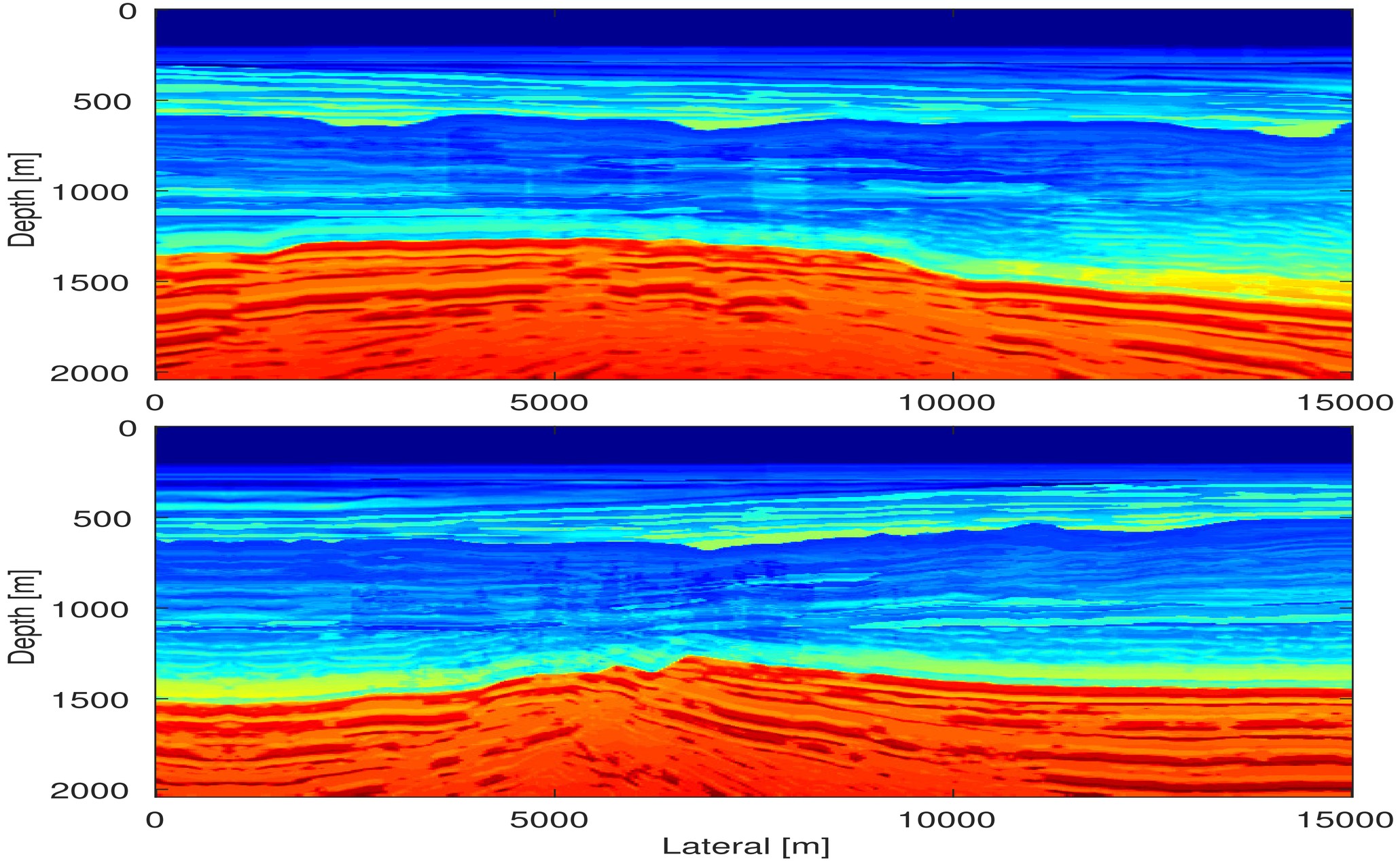
Details

Workspace

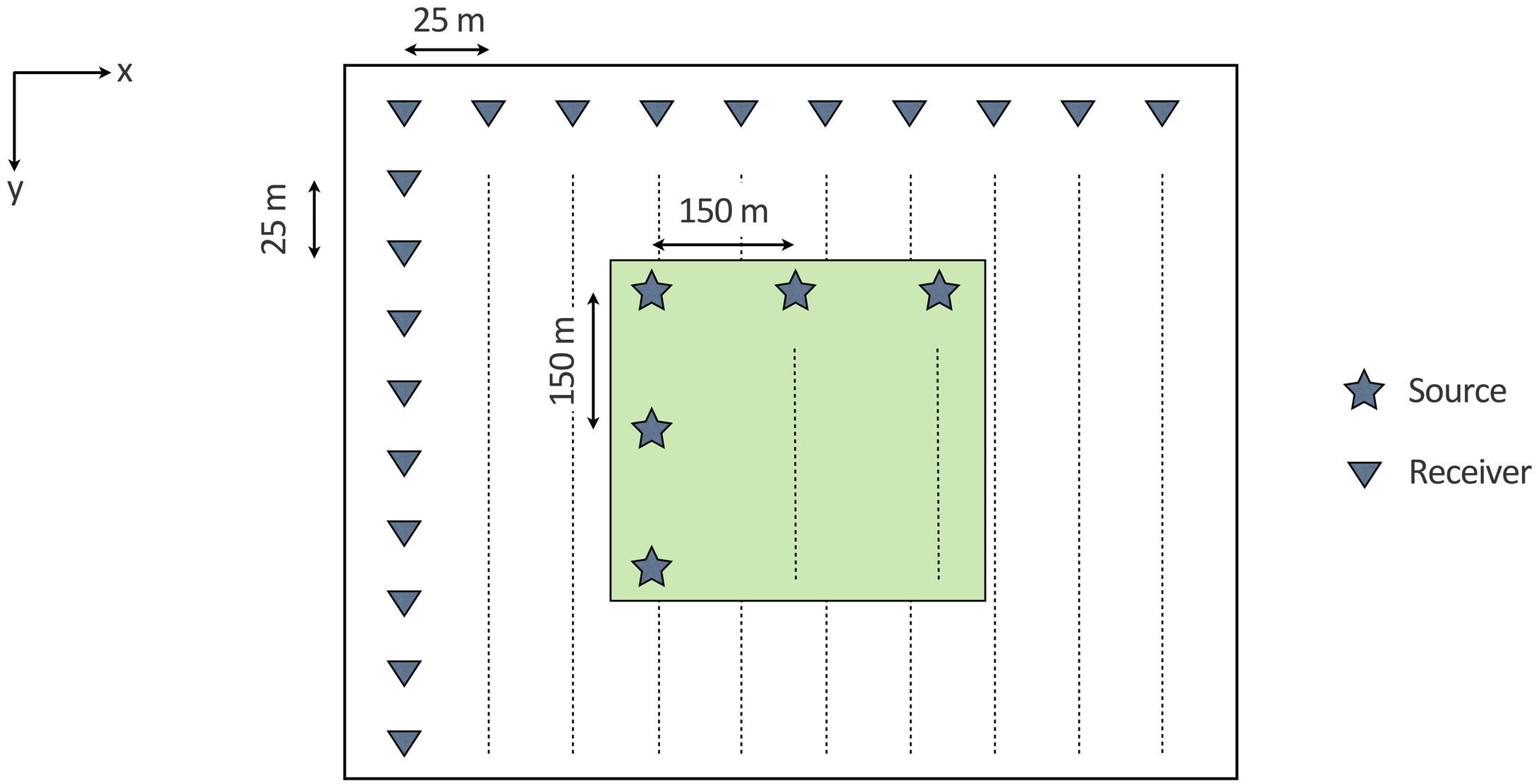
Name	Value
a	10000x10000x1...
ans	1x1 CJSCommuni...
ME	1x1 MException
pool	1x1 Pool
slimapps	'/home/henryk/S...
slimcomp	'/home/henryk/S...

```
2x slurm.listClusterJobs
  slurm.getClusterJob(2)
  slurm.getClusterJob(4)
  pool=slurm.parpool('Cluster128G',1,2,3)
  parpool_close
  pool=slurm.parpool('Cluster128G',1,200,10)
  a=distributed.rand(10000,10000,10000);
```

BG 3D Compass model



Source-receiver layout



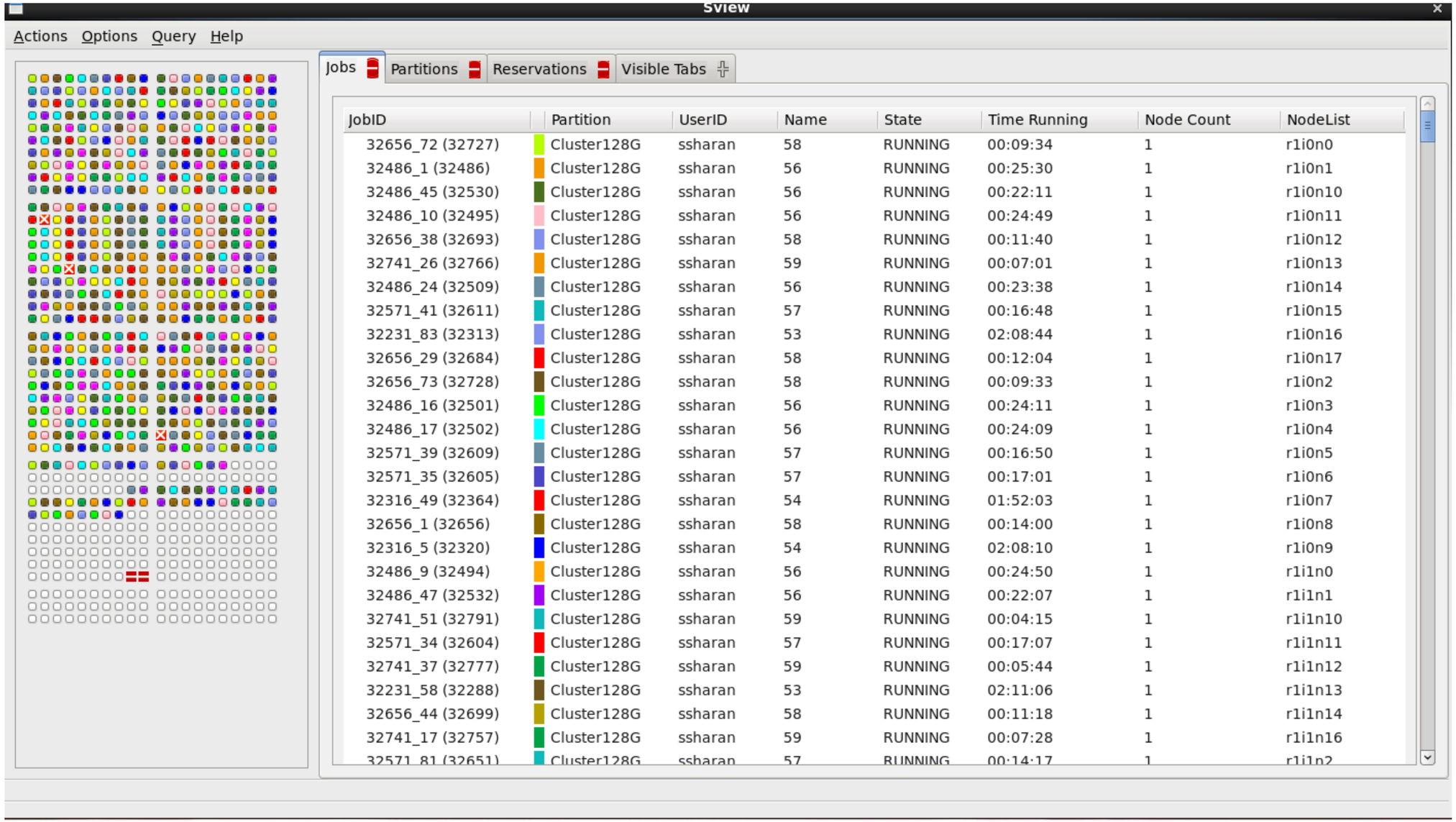
Computational resources used

Node partition: 128 GB
Number of nodes: 660

Time & memory usage

Simulation per 3D shot: 1.5 hours
Cumulative simulation time (85 x 85 shots): 27 hours
Memory storage of one shot record: 2.5 GB
Memory storage of all shot records: 18 TB

Running jobs & activated nodes (SENAI Yemoja cluster)



JobID	Partition	UserID	Name	State	Time Running	Node Count	NodeList
32656_72 (32727)	Cluster128G	ssharan	58	RUNNING	00:09:34	1	r1i0n0
32486_1 (32486)	Cluster128G	ssharan	56	RUNNING	00:25:30	1	r1i0n1
32486_45 (32530)	Cluster128G	ssharan	56	RUNNING	00:22:11	1	r1i0n10
32486_10 (32495)	Cluster128G	ssharan	56	RUNNING	00:24:49	1	r1i0n11
32656_38 (32693)	Cluster128G	ssharan	58	RUNNING	00:11:40	1	r1i0n12
32741_26 (32766)	Cluster128G	ssharan	59	RUNNING	00:07:01	1	r1i0n13
32486_24 (32509)	Cluster128G	ssharan	56	RUNNING	00:23:38	1	r1i0n14
32571_41 (32611)	Cluster128G	ssharan	57	RUNNING	00:16:48	1	r1i0n15
32231_83 (32313)	Cluster128G	ssharan	53	RUNNING	02:08:44	1	r1i0n16
32656_29 (32684)	Cluster128G	ssharan	58	RUNNING	00:12:04	1	r1i0n17
32656_73 (32728)	Cluster128G	ssharan	58	RUNNING	00:09:33	1	r1i0n2
32486_16 (32501)	Cluster128G	ssharan	56	RUNNING	00:24:11	1	r1i0n3
32486_17 (32502)	Cluster128G	ssharan	56	RUNNING	00:24:09	1	r1i0n4
32571_39 (32609)	Cluster128G	ssharan	57	RUNNING	00:16:50	1	r1i0n5
32571_35 (32605)	Cluster128G	ssharan	57	RUNNING	00:17:01	1	r1i0n6
32316_49 (32364)	Cluster128G	ssharan	54	RUNNING	01:52:03	1	r1i0n7
32656_1 (32656)	Cluster128G	ssharan	58	RUNNING	00:14:00	1	r1i0n8
32316_5 (32320)	Cluster128G	ssharan	54	RUNNING	02:08:10	1	r1i0n9
32486_9 (32494)	Cluster128G	ssharan	56	RUNNING	00:24:50	1	r1i1n0
32486_47 (32532)	Cluster128G	ssharan	56	RUNNING	00:22:07	1	r1i1n1
32741_51 (32791)	Cluster128G	ssharan	59	RUNNING	00:04:15	1	r1i1n10
32571_34 (32604)	Cluster128G	ssharan	57	RUNNING	00:17:07	1	r1i1n11
32741_37 (32777)	Cluster128G	ssharan	59	RUNNING	00:05:44	1	r1i1n12
32231_58 (32288)	Cluster128G	ssharan	53	RUNNING	02:11:06	1	r1i1n13
32656_44 (32699)	Cluster128G	ssharan	58	RUNNING	00:11:18	1	r1i1n14
32741_17 (32757)	Cluster128G	ssharan	59	RUNNING	00:07:28	1	r1i1n16
32571_81 (32651)	Cluster128G	ssharan	57	RUNNING	00:14:17	1	r1i1n2

Program

Monday:

- Randomized Seismic Survey Design & Recovery
- Wave-equation based Inversion – leveraging (multiple) reflections
- Wave-equation based Inversion – recent developments in FWI

Tuesday:

- Wave-equation based Inversion – novel formulations & convex constraints
- Wave-equation based Inversion – UQ & computational aspects

Online program

https://www.slim.eos.ubc.ca/SINBAD2015Fall