Overview & Future Plans SINBAD Consortium

Felix J. Herrmann

SLIM
University of British Columbia

Hosts of the 2017 SINBAD Consortium Meeting

Guest wifi

Network: dugeoguest

Password: GuestsRgr8!

Outline

Mission & highlights

Move to the Georgia Institute of Technology

Research Overview

Our mission

Fast & agile development of next-generation of seismic data acquisition, processing, wave-equation based imaging & inversion technology

Dissemination of research findings to spark innovations

Training of the next-generation of computational problem solvers

- undergraduate
- graduate, and
- post-graduate level

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)
Modified, sparsity promoting, Gauss-Newton algorithm for seismic waveform inversion
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
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
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Rank Minimization
Weighted L1-minimization
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Generalized SPGL1
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Application to Seismic Data Interpolation
Application to denoising
Application to Seismic Data Interpolation
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Compressive Sensing in Seismic Acquisition
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Application to repeatability in 4D seismic
Application to sparsity promoting migration
Application to trace interpolation
Application to exploration seismology
Application to imaging with multiples
Control the linearization errors in L1 regularized inversion
Source separation w/ HSS and matrix completion
Matrix Completion
Lifting vectors to matrices
Application to blind deconvolution
Matrix completion on unstructured grids
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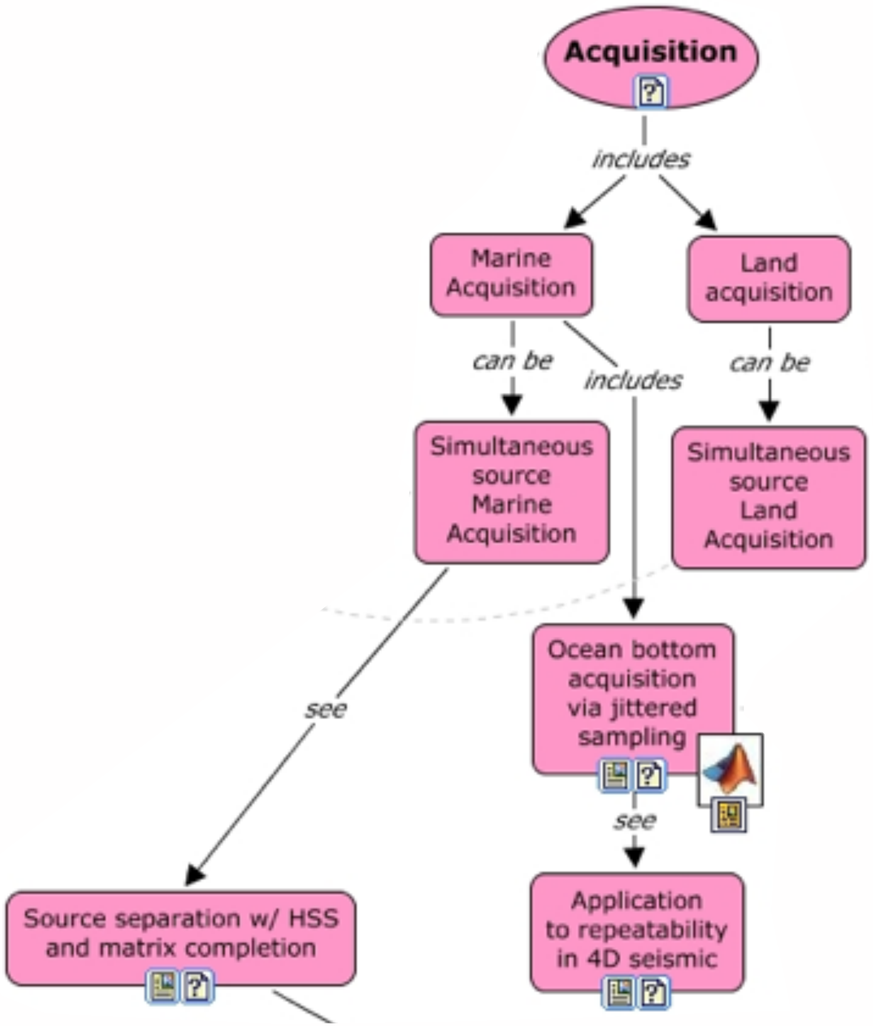
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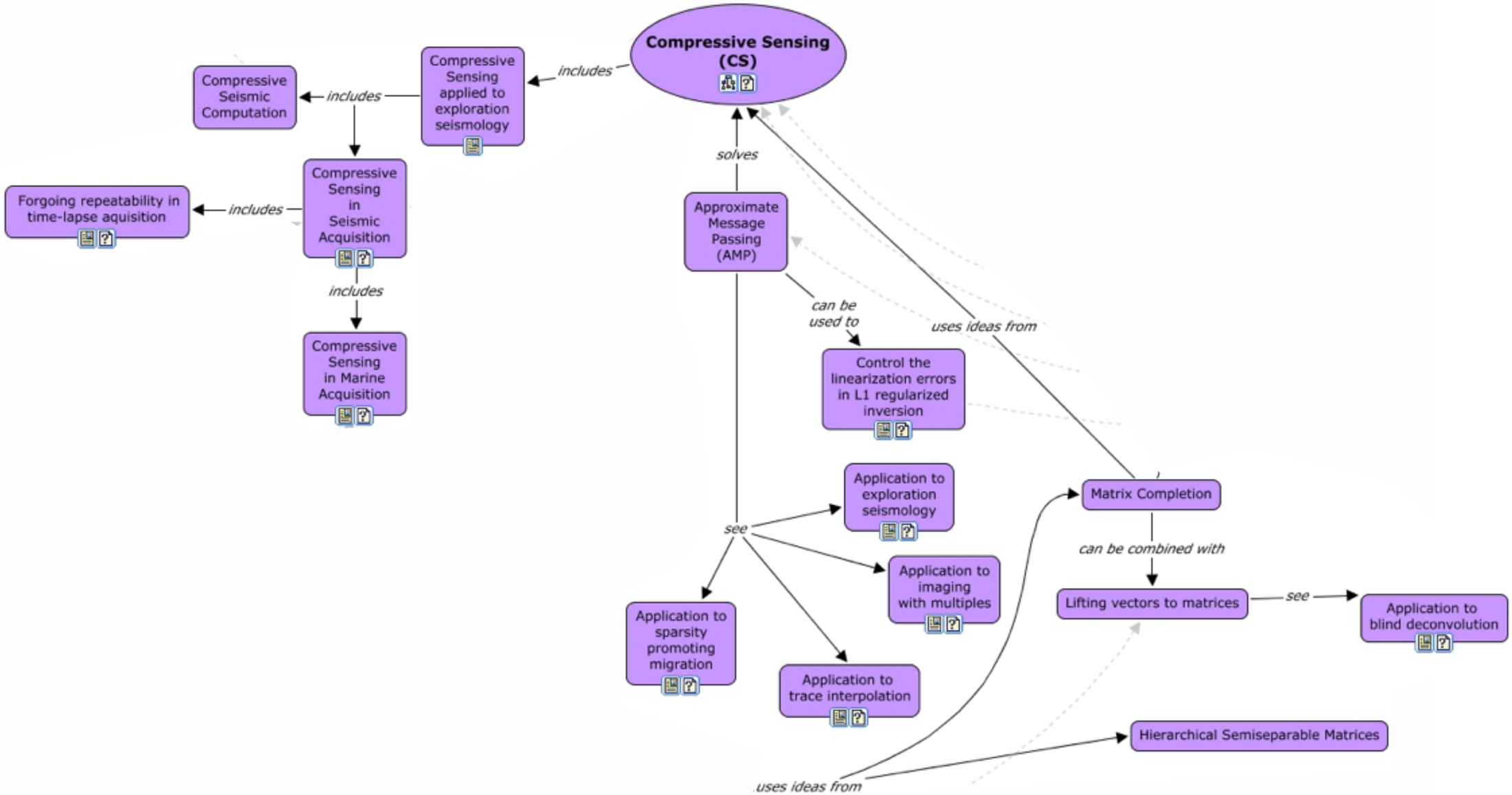
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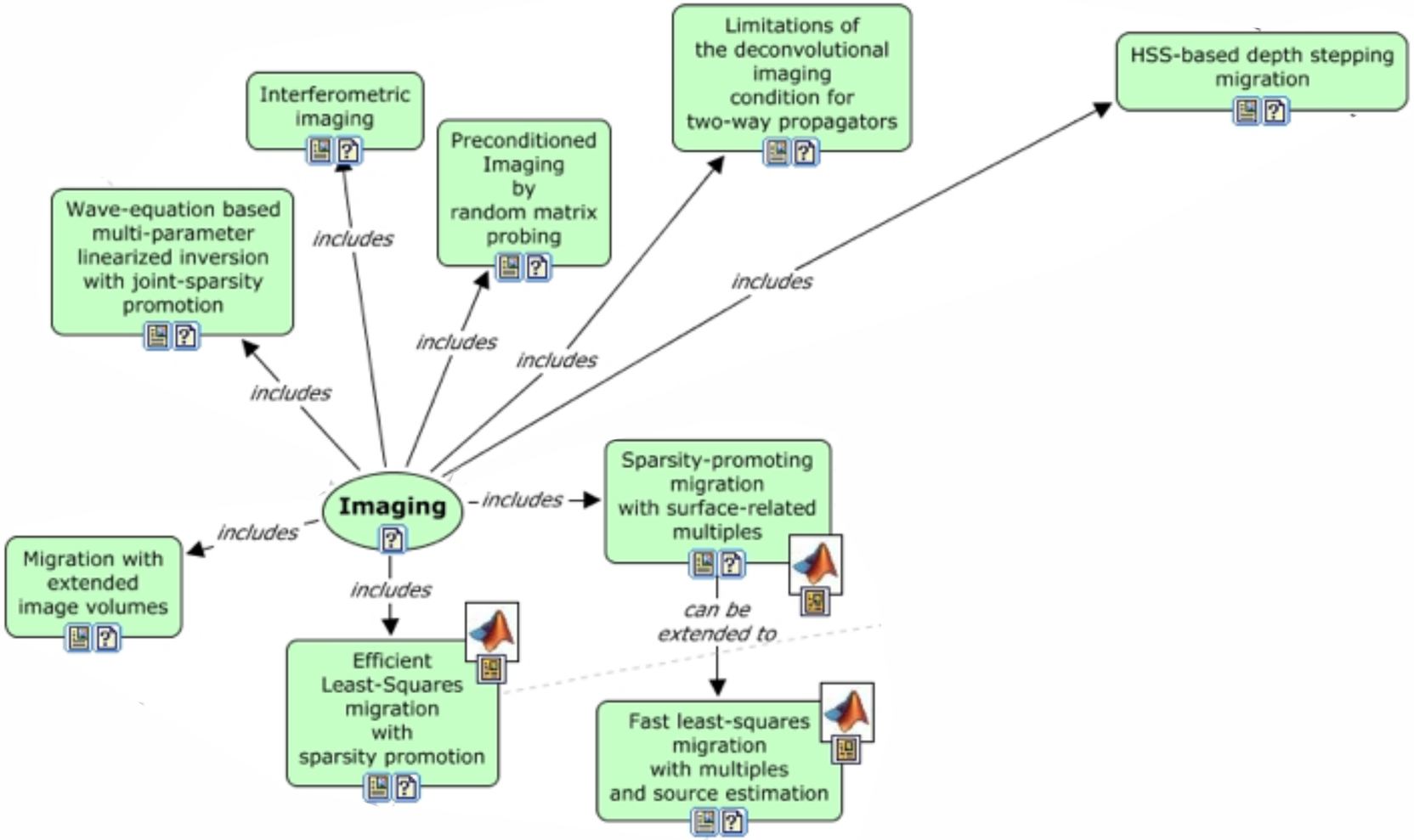
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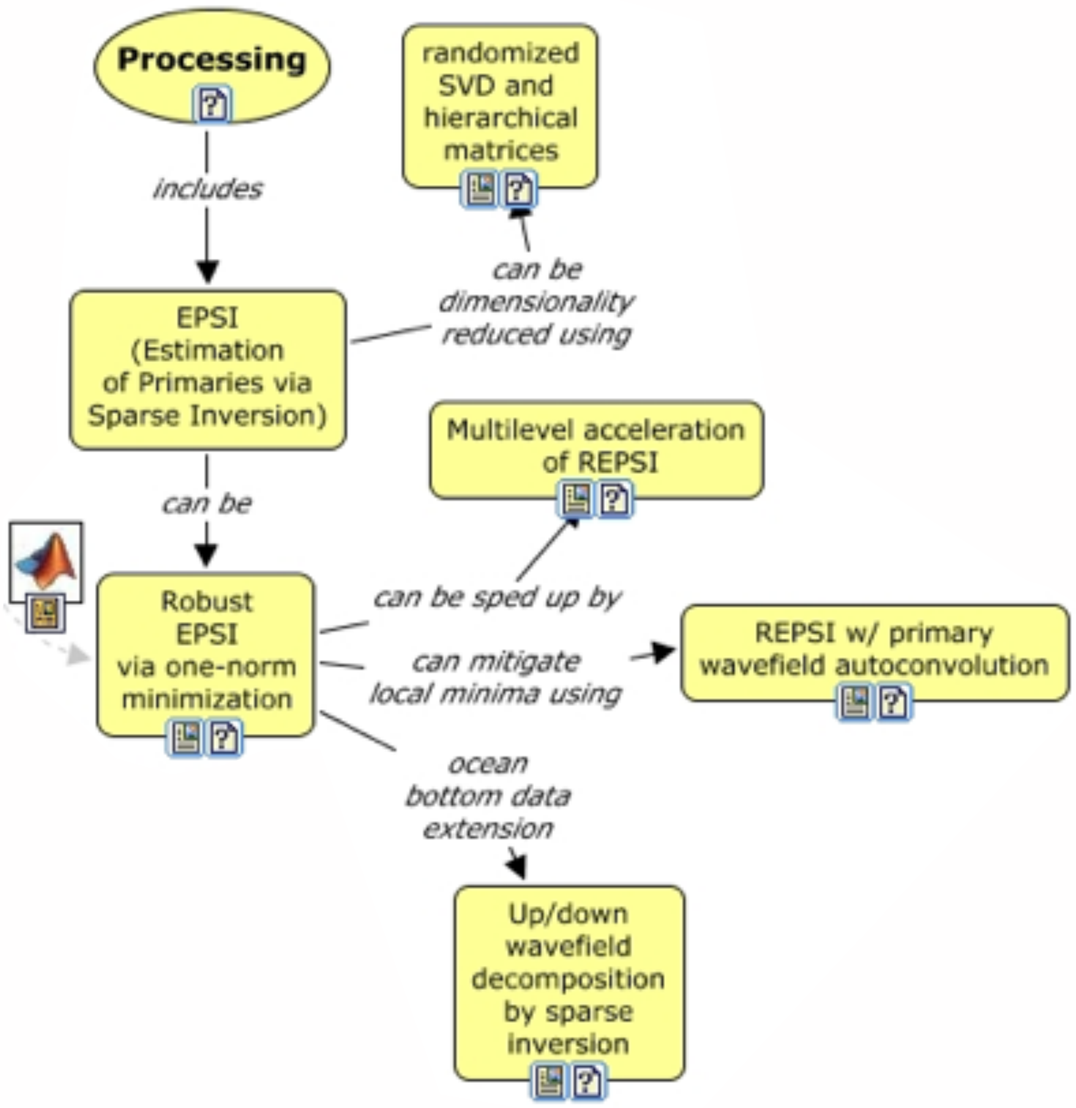
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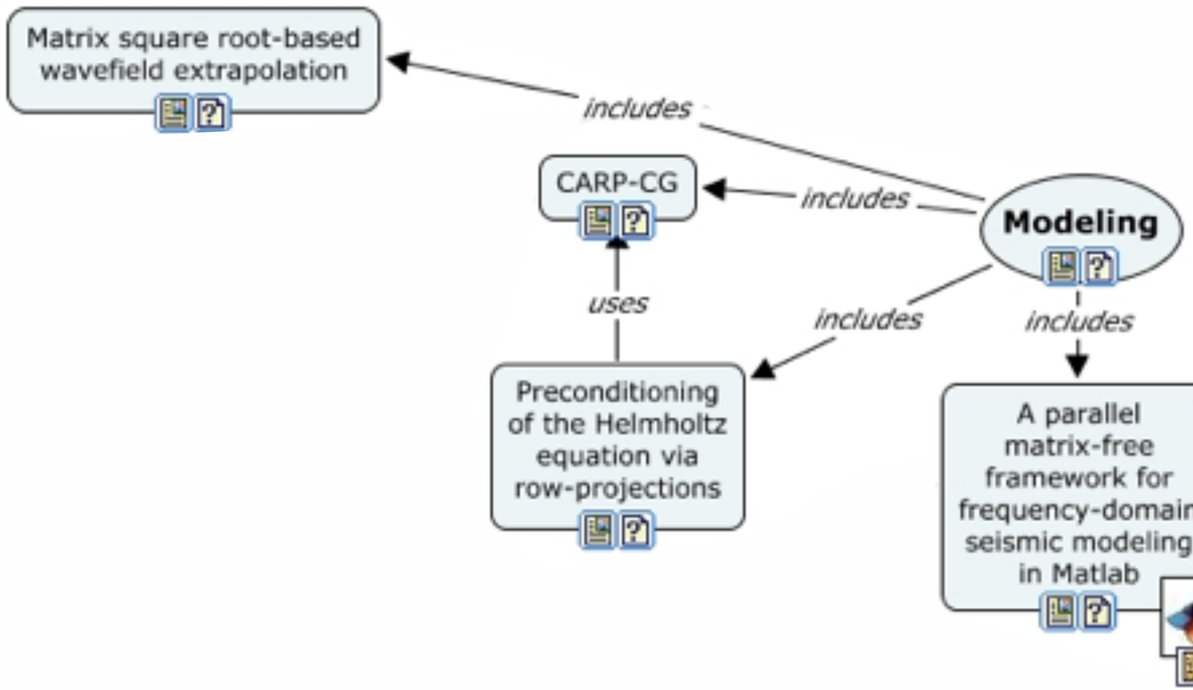
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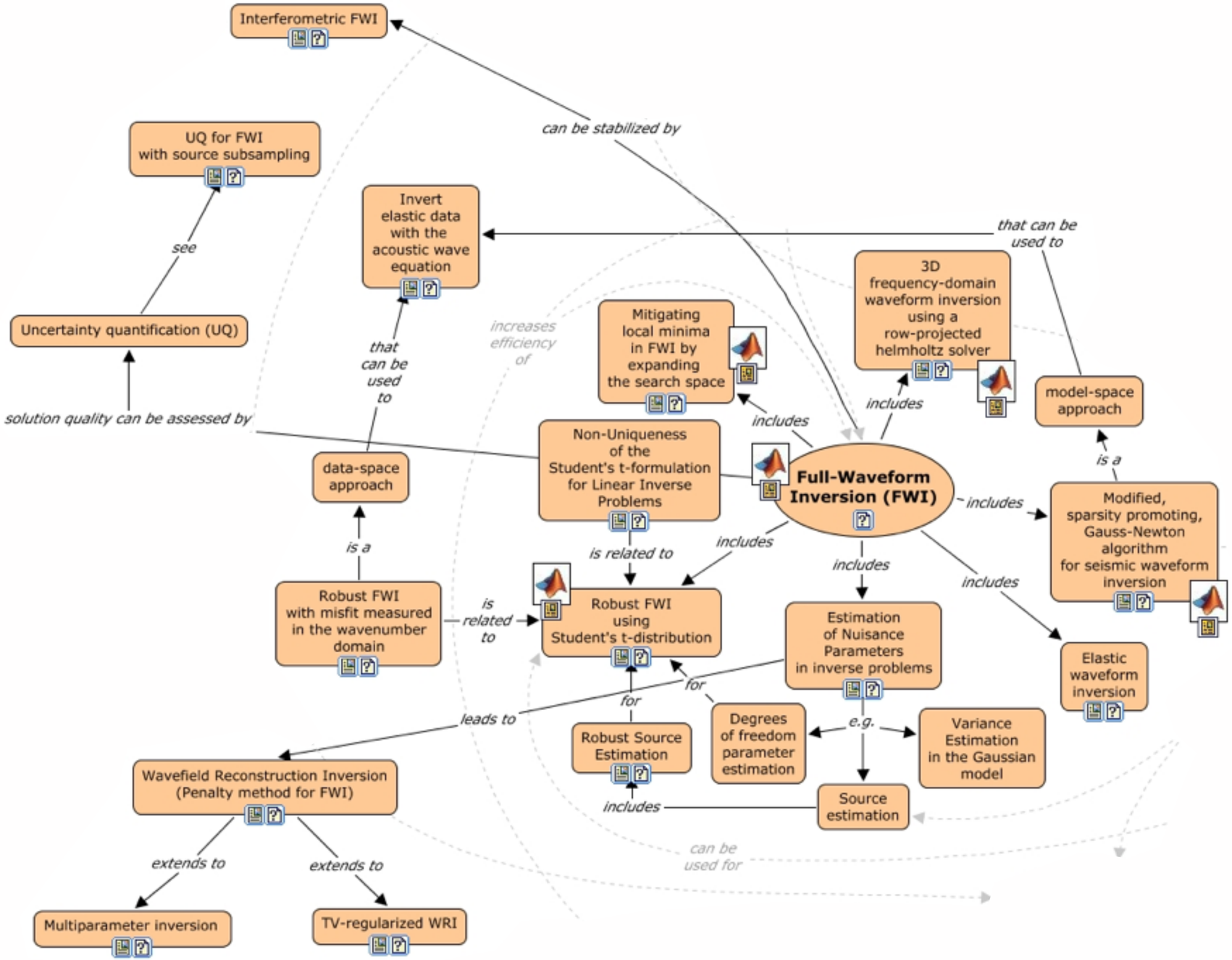
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Application to Seismic Data Interpolation
Weighted L1-minimization
PQNL1
Generalized SPGL1
Application to Seismic Data Interpolation
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Hierarchical Tucker Tensor Optimization
Application to Seismic Data Interpolation
Application to denoising
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EPSI (Estimation of Primaries via Sparse Inversion)
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Multilevel acceleration of REPSI
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Robust EPSI via one-norm minimization
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ocean bottom data extension
REPSI w/ primary wavefield autoconvolution
Up/down wavefield decomposition by sparse inversion
Compressive Sensing (CS)
Compressive Seismic Computation
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Compressive Sensing applied to exploration seismology
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Compressive Sensing in Seismic Acquisition
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Forgoing repeatability in time-lapse aquisition
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Simultaneous source Land Acquisition
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Ocean bottom acquisition via jittered sampling
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Application to repeatability in 4D seismic
Source separation w/ HSS and matrix completion
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Approximate Message Passing (AMP)
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Control the linearization errors in L1 regularized inversion
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see
Application to exploration seismology
Application to imaging with multiples
Application to sparsity promoting migration
Application to trace interpolation
Matrix Completion
can be combined with
Lifting vectors to matrices
see
Application to blind deconvolution
involves
Matrix completion on unstructured grids
Tools
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Linear operator Toolbox SPOT
Parallel Extensions to SPOT: pSPOT
A parallel matrix-free framework for frequency-domain seismic modeling, imaging and inversion in Matlab
uses
Hierarchical Semiseparable Matrices
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Last Update: July 18, 2014 by Curt Da Silva

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
Modified, sparsity promoting, Gauss-Newton algorithm for seismic waveform inversion
Estimation of Nuisance Parameters in inverse problems
Elastic waveform inversion
Degrees of freedom parameter estimation
Variance Estimation in the Gaussian model
Robust Source Estimation
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
Sparsity-promoting migration with surface-related multiples
Migration with extended image volumes
Efficient Least-Squares migration with sparsity promotion
Fast least-squares migration with multiples and source estimation
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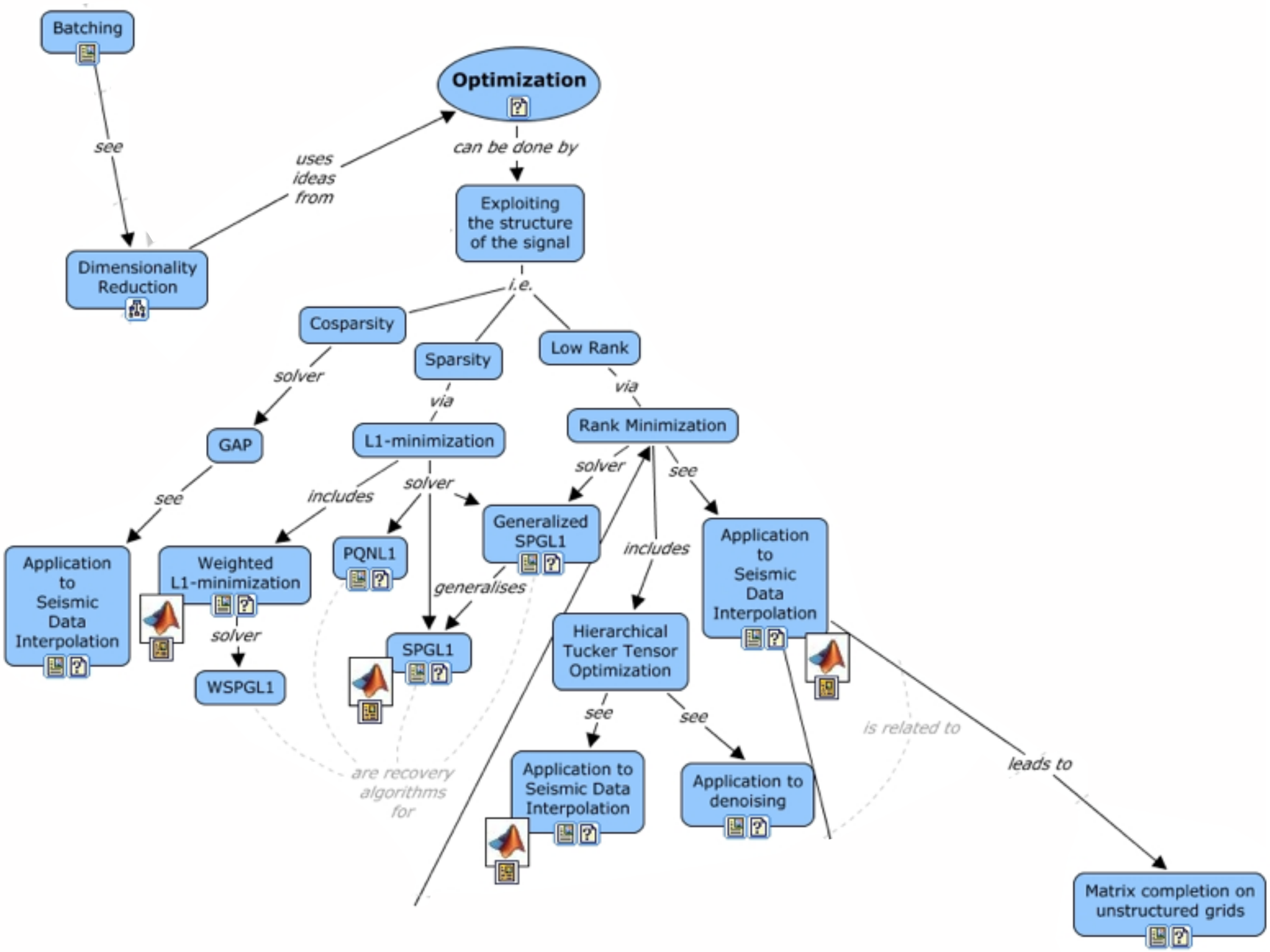
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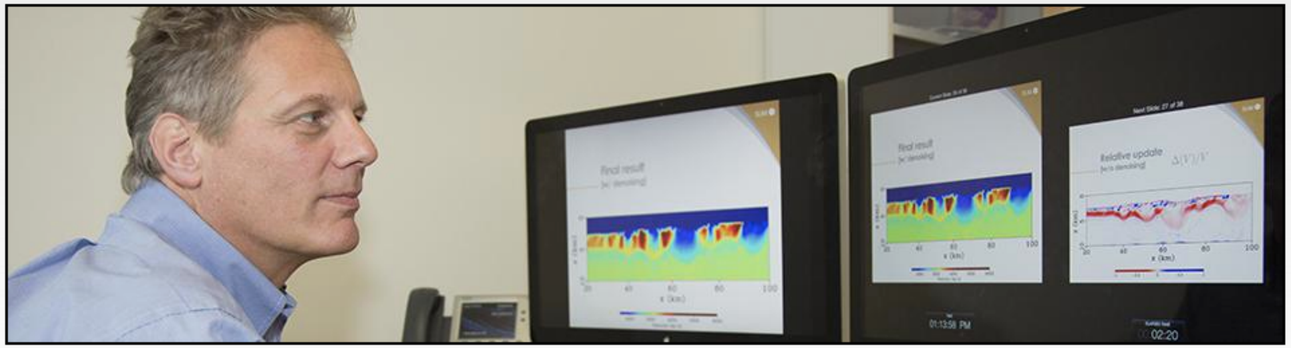
Last Update: July 18, 2014 by Curt Da Silva

The team...

Total of 15 (under)graduate students, PDFs, visitors, faculty, & staff...

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,*

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Chevron

PETROBRAS

Schlumberger

ConocoPhillips

HESS

woodside

Guests

- Bill Curry (ExxonMobil)
- Ramesh Neelamani (ExxonMobil)
- Partha Routh (ExxonMobil)
- Anatoly Baumstein (ExxonMobil)
- Min Zhou (Sinopec)
- Changhua Zhang (Sinopec)
- Shiyong Xu (Sinopec)
- Mingqiu Luo (Sinopec)
- Scott Morton

Moving on …

Haneet Wason — August

"Simultaneous-source seismic data acquisition & processing with compressive sensing"

Rajiv Kumar — August

"Enabling large-scale seismic data acquisition, processing & waveform-inversion via rank-minimization"

Felix Oghenekohwo — July

"Economic time-lapse seismic acquisition and imaging — Reaping the benefits of randomized sampling with distributed Compressive Sensing"

Curt Da Silva — August

"Large-scale optimization algorithms for missing data completion and inverse problems"

Moving on …..

Rongrong Wang, PhD.

Assistant Professor, Department of Computational Mathematics, Science and Engineering

Michigan State University (Fall 2017 to present)

Post-Doctoral Fellow, UBC SLIM (2013 to 2017)

Publications – journal

1 Rajiv Kumar, Haneet Wason, Shashin Sharan, and Felix J. Herrmann, "**Highly repeatable 3D compressive full-azimuth towed-streamer time-lapse acquisition –- a numerical feasibility study at scale**", *The Leading Edge*, vol. 36, p. 677-687, 2017. Abstract BibTex

2 Felix Oghenekohwo and Felix J. Herrmann, "**Highly repeatable time-lapse seismic with distributed Compressive Sensing–-mitigating effects of calibration errors**", *The Leading Edge*, vol. 36, p. 688-694, 2017. Abstract BibTex

3 Mathias Louboutin, Michael Lange, Felix J. Herrmann, Navjot Kukreja, and Gerard Gorman, "**Performance prediction of finite-difference solvers for different computer architectures**", *Computers & Geosciences*, vol. 105, p. 148-157, 2017. Abstract BibTex

4 Haneet Wason, Felix Oghenekohwo, and Felix J. Herrmann, "**Low-cost time-lapse seismic with distributed compressive sensing–-Part 2: impact on repeatability**", *Geophysics*, vol. 82, p. P15-P30, 2017. Abstract BibTex

5 Felix Oghenekohwo, Haneet Wason, Ernie Esser, and Felix J. Herrmann, "**Low-cost time-lapse seismic with distributed compressive sensing–-Part 1: exploiting common information among the vintages**", *Geophysics*, vol. 82, p. P1-P13, 2017. Abstract BibTex

6 Rajiv Kumar, Oscar Lopez, Damek Davis, Aleksandr Y. Aravkin, and Felix J. Herrmann, "**Beating level-set methods for 5D seismic data interpolation: a primal-dual alternating approach**", *IEEE Transactions on Computational Imaging*, 2017. Abstract BibTex

7 Can Evren Yarman, Rajiv Kumar, and James Rickett, "**A model based data driven dictionary learning for seismic data representation**", *Geophysical Prospecting*, 2017. Abstract BibTex

8 Tristan van Leeuwen, Rajiv Kumar, and Felix J. Herrmann, "**Enabling affordable omnidirectional subsurface extended image volumes via probing**", *Geophysical Prospecting*, vol. 65, p. 385-406, 2017. Abstract BibTex

9 Bas Peters and Felix J. Herrmann, "**Constraints versus penalties for edge-preserving full-waveform inversion**", *The Leading Edge*, vol. 36, p. 94-100, 2017. Abstract BibTex

Submitted

1 Curt Da Silva and Felix J. Herrmann, "**A unified 2D/3D large scale software environment for nonlinear inverse problems**". 2017. Abstract BibTex

Publications – expanded abstracts

1 Rongrong Wang and Felix J. Herrmann, "**A denoising formulation of full-waveform inversion**", in *SEG Technical Program Expanded Abstracts*, 2017. Abstract BibTex

2 Emmanouil Daskalakis, Rachel Kuske, and Felix J. Herrmann, "**Developments in the direction of solving extremly large problems in Geophysics**", in *SEG Technical Program Expanded Abstracts*, 2017. Abstract BibTex

3 Mengmeng Yang, Emmanouil Daskalakis, and Felix J. Herrmann, "**Fast sparsity-promoting least-squares migration with multiples in time domain**", in *SEG Technical Program Expanded Abstracts*, 2017. Abstract BibTex

4 Shashin Sharan, Rongrong Wang, and Felix J. Herrmann, "**High resolution fast microseismic source collocation and source time function estimation**", in *SEG Technical Program Expanded Abstracts*, 2017. Abstract BibTex

5 Yiming Zhang, Curt Da Silva, Rajiv Kumar, and Felix J. Herrmann, "**Massive 3D seismic data compression and inversion with hierarchical Tucker**", in *SEG Technical Program Expanded Abstracts*, 2017. Abstract BibTex

6 Ali M. Alfaraj, Rajiv Kumar, and Felix J. Herrmann, "**Reconstruction of S-waves from low-cost randomized and simultaneous acquisition by joint sparse inversion**", in *SEG Technical Program Expanded Abstracts*, 2017. Abstract BibTex

7 Michael Lange, Navjot Kukreja, Fabio Luporini, Mathias Louboutin, Charles Yount, Jan {Hückelheim}, and Gerard Gorman, "**Optimised finite difference computation from symbolic equations**", in *Python in Science Conference Proceedings*, 2017, p. 89–96. Abstract BibTex

8 Mathias Louboutin, Lluís Guasch, and Felix J. Herrmann, "**Data normalization strategies for full-waveform inversion**", in *EAGE Annual Conference Proceedings*, 2017. Abstract BibTex

9 Rajiv Kumar, Nick Moldoveanu, and Felix J. Herrmann, "**Denoising high-amplitude cross-flow noise using curvelet-based stable principle component pursuit**", in *EAGE Annual Conference Proceedings*, 2017. Abstract BibTex

10 Mathias Louboutin and Felix J. Herrmann, "**Extending the search space of time-domain adjoint-state FWI with randomized implicit time shifts**", in *EAGE Annual Conference Proceedings*, 2017. Abstract BibTex

11 Felix Oghenekohwo and Felix J. Herrmann, "**Improved time-lapse data repeatability with randomized sampling and distributed compressive sensing**", in *EAGE Annual Conference Proceedings*, 2017. Abstract BibTex

12 Ali M. Alfaraj, Rajiv Kumar, and Felix J. Herrmann, "**Shear wave reconstruction from low cost randomized acquisition**", in *EAGE Annual Conference Proceedings*, 2017. Abstract BibTex

Publications – expanded abstracts (cont'd)

1 Philipp A. Witte, Mengmeng Yang, and Felix J. Herrmann, "**Sparsity-promoting least-squares migration with the linearized inverse scattering imaging condition**", in *EAGE Annual Conference Proceedings*, 2017. Abstract BibTex

2 Zhilong Fang, Curt Da Silva, and Felix J. Herrmann, "**An efficient penalty method for PDE-constrained optimization problem with source estimation and stochastic optimization**", in *Applied Inverse Problems Annual Conference Proceedings*, 2017, p. 40. Abstract BibTex

3 Zhilong Fang, Curt Da Silva, Rachel Kuske, and Felix J. Herrmann, "**Uncertainty quantification for inverse problems with a weak wave-equation constraint**", in *WAVES 2017 –- 13th International Conference on Mathematical and Numerical Aspects of Wave Propagation*, 2017, p. 127–128. Abstract BibTex

4 Navjot Kukreja, Mathias Louboutin, Michael Lange, Fabio Luporini, and Gerard Gorman, "**Leveraging symbolic math for rapid development of applications for seismic modeling**", in *OGHPC*, 2017. Abstract BibTex

5 Navjot Kukreja, Michael Lange, Mathias Louboutin, Fabio Luporini, and Gerard Gorman, "**Devito: symbolic math for automated fast finite difference computations**", in *SIAM Conference on Computational Science and Engineering*, 2017.BibTex

6 Felix J. Herrmann and Curt Da Silva, "**Domain-specific abstractions for full-waveform inversion**", in *SIAM Conference on Computational Science and Engineering*, 2017.BibTex

7 Philipp A. Witte, Mathias Louboutin, and Felix J. Herrmann, "**Large-scale workflows for wave-equation based inversion in Julia**", in *SIAM Conference on Computational Science and Engineering*, 2017. Abstract BibTex

8 Mathias Louboutin, Michael Lange, Navjot Kukreja, Fabio Luporini, Felix J. Herrmann, and Gerard Gorman, "**Raising the abstraction to separate concerns: enabling different physics for geophysical exploration**", in *SIAM Conference on Computational Science and Engineering*, 2017. Abstract BibTex

Recent software releases – February

1. **Devito: Fast Finite Difference Computations. (slim branch)** Devito is a new Python tool for performing optimised Finite Difference (FD) computation from high-level symbolic problem definitions. Devito performs automated code generation and Just-In-time (JIT) compilation based on symbolic equations defined in SymPy to create and execute highly optimised Finite Difference kernels on multiple computer platforms. For questions contact Mathias Louboutin. (GitHub)
2. **JOLI — Julia Operators LIbrary. (master branch)** Julia framework for constructing matrix-free linear operators and applying them in basic algebraic matrix-vector operations. It is a Julia implementation of our MATLAB-based SPOT. For questions contact Henryk Modzelewski. (GitHub)
3. **Julia interface for Devito. (master branch)** This Julia package is a large-scale seismic modeling workflow and provides a framework for wave-equation based inversion methods, such as full waveform inversion or least squares migration. The framework is based on the Devito. The flexible workflow is based on abstract matrix-free linear operators (JOLI) and enables developers to write code that closely resembles the underlying math, while at the same time leveraging highly optimized wave equation solvers, allowing us to solve large-scale three-dimensional inverse problems. For questions contact Mathias Louboutin. (GitHub)
4. **Time-domain seismic modeling. (master branch)** This application demonstrates application of our Julia framework for 2D and 3D seismic modeling and inversion in the time domain. The underlying Julia module offers functions for solving the forward and adjoint acoustic wave equation as well as the linearized acoustic wave equation (Born modeling). This module is also based on JOLI abstract matrix-free linear operators, which allow easy formulation of algorithms for PDE-constrained optimization problems, such as least squares migration (LSRTM) and full waveform inversion (FWI). We use Devito (via our Julia interface for Devito) for solving wave equations. For questions contact Philipp Witte. (Read more) (GitHub)
5. **Time-domain seismic imaging. (master branch)** This application demonstrates our Julia tools for reverse time migration (RTM) and least squares RTM (LSRTM) with and without sparsity constraints. Furthermore the underlying Julia module contains several pre-conditioners for LSRTM, namely model- and data-space topmutes, depth scaling and data scaling. For questions contact Philipp Witte. (Read more)(GitHub)

Recent software releases – September

1. **Residual Constrained Alternating Minimization (RCAM) (new on master branch)** A Julia factorization-based alternating minimization scheme for large scale matrix completion on parallel computing architectures. For questions contact Rajiv Kumar. [GitHub]
2. **GenSPGL (new on master branch)** A Julia solver for large scale minimization problems using any provided norm. GenSPGL supports implicit arrays(JOLI), explicit arrays, and functions as modelling operators **A**. For questions contact Rajiv Kumar. [GitHub]
3. **SeisIO (new on master branch)** A Julia package for reading and writing SEGY Rev 1 files. In addition to providing tools for reading/writing entire files, SeisIO provides a scanner that turns SEGY volumes into an object with direct out-of-core access to the underlying data. For questions contact Keegan Lensink. [GitHub]
4. **Devito: Fast Finite Difference Computation. (updates to master branch)** Devito is a Python tool for performing optimized Finite Difference (FD) computation from high-level symbolic problem definitions. Multiple updates improving performance and stability of the package. For questions contact Mathias Louboutin. [GitHub]
5. **Julia interface for Devito. (updates to master branch)** A Devito-based large-scale seismic modeling workflow and provides a framework for wave-equation based inversion methods, like full waveform inversion or least squares migration. Updates to use our SeisIO package for SEGY input/output, out-off-core functionality, and performance improvements. For questions contact Mathias Louboutin. [GitHub]
6. **Time-domain seismic imaging. (updates to master branch)** This application demonstrates our Julia tools for reverse time migration (RTM) and least squares RTM (LSRTM) with and without sparsity constraints. Added examples for 2D least-square RTM. For questions contact Philipp Witte. [Read more] [GitHub]
7. **Time-domain FWI. (new on master branch)** This application demonstrates using software to perform full-waveform inversion. Includes example for 2D-Overthrust model. For questions contact Philipp Witte. [GitHub]
8. **3D time-domain FWI. (new on developer branch)** This prototype application (in script fwi_overthrust_3D.jl) demonstrates using software to perform full-waveform inversion, but for 3D synthetic data (including script generate_data_overthrust.jl to generate data). For questions contact Philipp Witte. [GitHub]
9. **JOLI - Julia Operators LIbrary. (updates to master branch)** Julia framework for constructing matrix-free linear operators and applying them in basic algebraic matrix-vector operations. Added numerous new operators. For questions contact Henryk Modzelewski. [GitHub]

28 september 2017

"Sterke wiskunde voor toepassingen in de geofysica"

Clarence Karcher Award voor Tristan van Leeuwen

Tristan van Leeuwen ontvangt de Clarence Karcher Award van SEG President Bill Abriel

Collaborators

Mike Warner & Gerard Gorman
(Imperial College London)

Rongrong Wang
(Michigan State)

Ben Recht
(Berkeley)

Tristan van Leeuwen
(Utrecht University)

Sasha Aravkin
(UoW)

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
- randomized time-lapse surveys will be shot

The Leading Edge®

Special Section: Impact of compressive sensing on seismic data acquisition and processing

Annual Meeting preview

SEG
INTERNATIONAL EXPOSITION AND 87TH ANNUAL MEETING
HOUSTON, TEXAS
24-29 SEPTEMBER 2017

SEG SOCIETY OF EXPLORATION GEOPHYSICISTS
August 2017 · Volume 36, No. 8
ISSN 1070-485X

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
- constraints instead of penalties

CAI – Compressive time-lapse Acquisition & Imaging

Grant proposal submitted:

- to ITF's call IMPROVED RESERVOIR IMAGING 2016 in the UK in collaboration w/ Gerard Gorman
- budget: 2,524,000 GPB
- duration: 36 months

Personnel:

- 6 FTEs for post-doctoral fellows
- 3 FTEs research faculty/associate
- 1.5 FTEs of a software support person
- 3 FTEs of student research time

CAI – objectives

Form & analyze high-amplitude fidelity full-subsurface pre-stack image volumes for target-oriented reservoir delineation, characterization & monitoring

Create 3D artifact-free highly repeatable high-resolution time-lapse images from data with multiples in (shallow) marine settings

Create an agile 3D imaging framework that will enable rapid at scale deployment

Minimize cost of acquiring 3D time-lapse seismic data without impacting 4D repeatability

Make developed acquisition and imaging technology available in the cloud

Interest from:

- Exxonmobil
- Total

Research themes & outcomes

Scalable low-rank representations:

- recovery & on-the-fly shot generation
- handle full subsurface offset image volumes w/ probing & randomized linear algebra

Economic time-lapse seismic w/ joint-recovery model:

- exploit information shared amongst the vintages
- stable w.r.t. calibration errors obtain high degrees repeatability w/o in-field replication

High-performant automatic code generation & abstractions:

- verifiable high-performance time-stepping code w/ domain-specific language (Devito)
- agile wave-equation based inversion framework

Research themes & outcomes

Large-scale optimization with constraints:

- (accelerated) imaging & microseismic w/ sparsity promotion
- novel (dual) formulations for WRI & FWI

Multiple imaging modalities:

- physics based imaging technology for sensor networks
- medical imaging, radar, and nondestructive testing

Machine learning for inversion:

- incorporate generative deep convolutional networks in data completion problems
- alternative formulations for wave-equation based inversion

Georgia Institute of Technology

October 1st – Started cross-appointments at CSE, EE & Earth Sciences

- connect w/ very strong engineering school
- use GT's extensive corporate ties w/ industry & access to federal funding
- leverage machine learning PhD program

First- & second semester next academic year – move my research team to GT

- easier access to the US job market
- ability to connect to strong faculty

By Spring 2018

- start new diversified research program
- move our activities to the cloud

Georgia Institute of Technology

By Jan 2018 turn SINBAD into two-tier gift/project program:

- perpetual industry affiliate program w/o explicit deliverables
- simplifies IP structure & avoids overhead
- second-tier periodic proprietary projects w/ deliverables
- w/ separate tailored IP arrangements that carry overhead

New funding model:

- spearheading sustainable computational experiment lab in the cloud @GT
- drive innovations by developing at scale services in the cloud
- public private partnership between academia, cloud providers, and industry affiliates possibly partnering w/ startup companies (Osokey & juliacomp)

Main activities

Training of graduate students

- in theoretical & computational aspects
- to incorporate ideas from mathematics & computers science (compressive sensing and machine learning)
- prototype development

Bespoke solutions for individual projects that include at-scale technology validation (NEW)

Development and delivery of our innovative solutions in the cloud (NEW).

First-tier membership

Opportunity to work with us on bespoke solutions addressing particular research questions and needs

Delivery of project-based research outcomes according to agreed upon milestones

Arrangements for access to IP

Benefits of second-tier membership

Second-tier membership

Preprints of publications, our newsletter, attendance to Consortium meetings

Access to

- basic support of our public-domain source code w/ proofs-of-principle implementations
- our students and other members of the SINBAD research team;
- our coordinated graduate internship program to get to know our graduate students.

Status of research group

Bas, Zhilong, Yimeng, Ali, and Marie will stay at UBC

Henryk and Diana will continue to offer support

Mathias, Philipp, Mengmeng, Shashin, Ali, and Rajiv (PDF) will move to Gatech

This meeting

Impact of Compressive Sensing on Seismic Data Acquisition & Processing — boosting the economics & time-lapse repeatability from fewer non-replicated data

- Field Case studies & Multicomponent data
- Full-azimuth processing
- Time-lapse seismic
- At scale matrix factorization

This meeting (cont'ed)

Wave-equation based Imaging, Inversion, and Uncertainty Quantification — tackling artifacts, noise, lack of convergence speed & parasitic minima

- Compressive imaging w/ multiples & source estimation
- Microseismic source collocation
- Novel formulations &
- Inversions w/ constraints

This meeting (cont'ed)

Extreme-scale matrix factorizations — making the impossible possible w/ randomized probing

- low-rank data compression & recovery w/ on-the-fly data generation
- full-subsurface image volumes from low-rank data representations
- scenario testing in radatuming
- probing of image volumes revisited

This meeting (cont'ed)

Extreme performant at-scale Wave Equation-Based Inversion — managing complexity while increasing performance

- Latest developments in Devito — a domain-specific language and compiler for stencil-based finite-difference computations
- Performance & capabilities review
- Time-domain Wave-equation based Inversion & Imaging in Julia
- The road ahead to the Cloud

2017 SINBAD Consortium meeting

Tuesday October 3, Houston, Dug, 16200 Park Row Drive, Suite 100

08:00—08:30 AM		*Registration and coffee & pastries*
08:30—09:00 AM	Felix J. Herrmann	Welcome & overview of the meeting
		Impact of Compressive Sensing on Seismic Data Acquisition & Processing — boosting the economics & time-lapse repeatability from fewer non-replicated data (Chair: Rajiv Kumar)
09:00—09:30 AM	Chuck Mosher	What Happened: How we implemented CSI with help from SINBAD
09:30—10:00 AM	Oscar Lopez	A Guide for Successful Low-Rank Matrix Recovery in Seismic Applications
10:00—10:15 AM		*Coffee Break*
10:15—10:45 AM	Ali M. Alfaraj	Reconstruction of S-waves from low-cost randomized acquisition
10:45—11:15 AM	Chengbo Li	Alternating Direction Method and its role in CSI technology
11:15—11:45 AM	Rajiv Kumar	Full-azimuth seismic data processing w/ coil acquisition
11:45—12:15 PM	Felix J. Herrmann	Highly repeatable 3D compressive full-azimuth towed-streamer time-lapse acquisition –- a numerical feasibility study at scale
12:15—12:30 AM		Discussion
12:30—01:30 PM		*Lunch*
		Extreme-scale matrix factorizations — making the impossible possible w/ randomized probing (Chair: Marie Graff)
01:30—02:15 PM	Oscar Lopez	Matrix Completion in Parallel Architectures: Julia Implementation
02:15—02:45 PM	Yiming Zhang	Massive seismic data compression & recovery w/ on-the-fly data extraction
02:45—03:15 PM	Ali Siahkoohi	Seismic data interpolation with Generative Adversarial Networks
03:15—03:30 PM		*Coffee Break*
03:30—04:00 PM	Rajiv Kumar	Multi-domain target-oriented imaging using extreme-scale matrix factorization
04:00—04:30 PM	Marie Graff	Low-rank representation of omnidirectional subsurface extended image volumes
04:30—05:00 PM		Discussion

Wednesday October 4, Houston, DUG, 16200 Park Row Drive, Suite 100

08:30—09:00 AM		*Registration and coffee & pastries*
		Wave-equation based Imaging, Inversion, and Uncertainty Quantification — tackling artifacts, noise, lack of convergence speed & parasitic minima Chair: Philipp Witte
09:00—09:30 AM	Mengmeng Yang	Imaging with multiples in shallow water
09:30—10:00 AM	Emmanouil Daskalakis	Stochastic Optimization from the perspective of dynamical systems
10:00—10:15 AM		*Coffee Break*
10:15—10:45 AM	Mathias Louboutin	Data driven Gradient Sampling for seismic inversion
10:45—11:15 AM	Zhilong Fang	PDE-free Gauss-Newton Hessian for Wavefield Reconstruction Inversion
11:15—11:45 AM	Shashin Sharan	Tracking the spatial-temporal evolution of fractures by microseismic source collocation
11:45—12:15 PM	Felix J. Herrmann	Noise robust and time-domain formulations of Wavefield Reconstruction Inversion
12:15—12:30 AM		Discussion
12:30—01:30 PM		*Lunch*
		Extreme performant at-scale Wave Equation-Based Inversion — managing complexity while increasing performance Chair: Bas Peters
01:30—02:15 PM	Bas Peters	Algorithms and Julia software for FWI with multiple constraints
02:15—03:00 PM	Philipp Witte	A large-scale framework in Julia for fast prototyping of seismic inversion algorithms
03:00—03:30 PM	Mathias Louboutin [	Latest developments in Devito]
03:30—03:45 PM		Discussion
03:45—04:15 PM		*Coffee Break*
04:15—05:15 PM		Steering committee meeting with SINBAD (Consortium members only)
06:30—08:30 PM		Dinner, Caracol Restaurant, 2200 Post Oak Blvd