Yunyue (Elita) Li

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PARTICULARS

EDUCATION

Stanford University — Stanford, CA
Ph. D. in Geophysics — *Sep 2008 - Jul 2014 (expected)*

Stanford University — Stanford, CA
M. S. in Geophysics — *Sep 2008 - Sep 2010*

China University of Petroleum, Beijing — Beijing, China
B. S. in Information and Computational Science — *Sep 2004 - Jul 2008*
Outstanding undergrad thesis

RESEARCH INTERESTS

- **Seismic imaging and inversion**: Wave-equation inversion-based methods for structural imaging and model building
- **Data integration**: Integration of surface seismic data with geological and rock physics information; Joint inversion of multiple datasets
- **Seismic monitoring**: Seismic exploration and monitoring for unconventional resources

DISSERTATION

Title: " Wave-equation migration velocity analysis for anisotropic models with rock physics constraints"
Advisor: Prof. Biondo Biondi

My thesis develops an image-space wave-equation tomography framework for anisotropic model building, with interfaces to include geological and rock physics information into the surface seismic inversion. This methodology produces models that are consistent and meaningful with all the available information.

ACADEMIC HONORS

- Centennial Teaching Assistant Award, 2012, Stanford University
- Best oral presentation award, 2012, SUM/SEG 12 Student Conference in Beijing, China
- The Robert G. Kirby Fellowship, 2008, Stanford University
- Michael L. Haider Fellowship in Earth Sciences, 2008, Stanford University
- Outstanding undergraduate thesis, Jul. 2008, China
- Mathematical Contest in Modeling, Jan. 2007, Honorable Mention, US
- Undergraduate Mathematical Contest in Modeling, Sep. 2006, Second Prize, China
- 22nd National Physics Championship, Dec. 2005, Third Prize, China
- First class scholarship for undergraduate students, 2004 - 2008, China

WORK EXPERIENCE

- **Research intern, Shell Global Solutions International, Netherlands.** June 2012 - Sep. 2012. Mentor: Renè-Èdouard Plessix. Worked on waveform acoustic impedance inversion with spectral shaping. Designed a spectral shaping filter according to the frequency response of the gradient of the FWI misfit functional with the reflection data. Improved the convergence as well as the inversion result of the waveform impedance inversion on both synthetic and field datasets.
- **Research intern, Shell International Exploration & Production Company, USA.** June 2011 - Sep. 2011. Mentor: Peng Shen. Worked on migration velocity analysis using RTM in VTI media. Extended the isotropic RTM-based WEMVA workflow to anisotropic media. The framework included more realistic physical models and inverted for anisotropic parameters according to the focusing in the subsurface-offset domain common image gathers. Improved the definition of the anisotropy on a synthetic 2-D dataset.
- **Research intern, Schlumberger, USA.** June 2010 - Sep. 2010. Mentor: Dave Nichols. Worked on rock physics constrained tomography. Designed preconditioning operator using deterministic and stochastic rock physics modeling results to better constrain the anisotropic tomography. Achieved improved stability and better defined anisotropic parameters on a synthetic VSP dataset.

RESEARCH EXPERIENCE

- **Automatic picking by simulated annealing**, (Sep 2008 - June 2009): An ideal velocity model is both geologically significant and geophysically smooth. Velocity picking can be phrased as a nonlinear optimization problem with multiple contradictory objectives. We develop an automatic velocity picking technique based on the Simulated Annealing (SA) Algorithm. Accuracy and smoothness of the velocity model are used as objective functions. To improve the convergence of the algorithm, we include prior knowledge of the velocity model in the initialization and the constraints. The algorithm is adapted for this problem and demonstrated using a 2-D field example.
- **Sparse inversion with sparsity constraints**, (June 2009 - Sep 2010): When dealing with field data and geological models, neither ℓ_2 nor ℓ_1 perfectly describes the distribution of the data and model spaces. We therefore propose a hyperbolic penalty function, whose center is parabolic like ℓ_2 and whose asymptotes are like ℓ_1. A transition threshold must be chosen for regression equations of data fitting and another for model regularization. By this hyperbolic penalty function, we achieve robustness against erratic noise in the data space and sparsity in the model space.
- **Image-guided WEMVA for azimuthal anisotropy**, (Sep 2012 - Dec 2012): In multi/full-azimuth acquisition, multiple images of the same subsurface are available from multi-azimuthal data. When the Earth model is inaccurate, the images at different azimuths do not agree with each other. I propose the image-guided WEMVA methodology to take advantage of the differences in the images and to update the azimuthally anisotropic model. This method directly tackles the differences in anisotropic parameters among different azimuths. The numerical test results show that the image-guided WEMVA method is robust with respect to the velocity error and yields meaningful updates for anisotropic parameters.
- **Rock physics modeling for seismic anisotropy**, (Jan 2013 - Sep 2013): Rock physics models provide useful tools to describe shale (and other) anisotropy. When inverting surface seismic data for anisotropy, rock physics information contains important constraints. Therefore, I study two rock physics models for shale anisotropy: lamination model and inclusion model. Sand (quartz) is modeled as lamination material in the former case and as inclusion material in the latter case. Stochastic modeling results from the combined distributions from these two models are used to constrain the surface seismic inversion.
- **WEMVA for anisotropic models with rock physics constraints**, (Sep 2009 - present): This is the thesis project of my Ph.D. research. I extend the wave equation migration velocity analysis methodology to anisotropic media. I choose to use wavefield (wave path) as the carrier of the model updates because it better describes the wave phenomenon. I choose to perform the optimization in the image space to avoid the cycle-skipping problem of the data-space methods and to utilize the reflection events for the deeper subsurface. However, surface seismic data cannot fully constrain the multi-parameter inversion problem. Ambiguities exist among the anisotropic parameters and the velocity model. Therefore, I propose a preconditioning operator to include the geological and rock physics information. The geological prior information defines the spatial correlation of the model parameters; whereas the rock physics prior information defines the inter-parameter correlation of the model parameters. The geological information can be obtained by a preliminary migration of the data. The rock physics information can be modeled by deterministic and stochastic shale (or other) anisotropic modeling. After the proposed preconditioning, we can better constrain the anisotropic-parameter space and untangle the ambiguities among the anisotropic Earth parameters. This work also utilizes the

lithological inversion results (shale content, porosity and pore pressure) from the previous iteration of seismic data processing, which is a step further to close the loop from seismic data to reservoir modeling.

TEACHING EXPERIENCE

- **Teaching Assistant:** GP211: Image Estimation by Examples, Prof. Jon Claerbout, Fall 2011, Stanford University.
- **Teaching Assistant:** GP280: 3D reflection seismology, Prof. Biondi Biondo, Spring 2012, Stanford University.
- **Mentoring students:** SEP students: Yi Shen and Noha Farghal; Non-SEP students: Yu Xia, Stanford University.

SELECTED PUBLICATIONS

PAPERS

1. Yunyue Li, "Image-guided WEMVA for azimuthal anisotropy", in *SEG Expanded Abstracts*, 32, 2013.
2. Renè-Èdouard Plessix and Yunyue Li, "Waveform acoustic impedance inversion with spectral shaping", to appear in *Geophysical Journal International*, 2013.
3. Yunyue Li, Peng Shen and Colin Perkins, "VTI migration velocity analysis using RTM". *SEG Extanded Abstracts*, 31, 2012.
4. Yunyue Li, Yang Zhang and Jon Claerbout, "Hyperbolic estimation of sparse models from erratic data", *Geophysics*, 77, 2012.
5. Yunyue Li and Biondo Biondi, "Migration velocity analysis for anisotropic models", *SEG Extended Abstracts*, 30, 2011.
6. Yunyue Li, Dave Nichols, Konstantin Osypov and Ran Bachrach, "Anisotropic tomography using rock physics constraints", *EAGE 73rd Conference and Exhibition*, 2011.
7. Yunyue Li, Yang Zhang and Jon Claerbout, "Geophysical applications of a novel and robust L1 solver", *SEG Extended Abstracts*, 29, 2010.

PAPERS UNDER REVIEW

8. Yunyue Li, Biondo Biondi, Robert Clapp and Dave Nichols, "Wave equation migration velocity analysis for VTI models", *Geophysics*. 2013.

OTHER REPORTS

9. Yunyue Li, Mandy Wong and Robert Clapp, "Equivalent accuracy at a fraction of the cost: Overcoming temporal dispersion", *SEP report - 150*, Stanford University, 2013.
10. Yunyue Li, Biondi Biondo, Dave Nichols, Gary Mavko and Robert Clapp, "Stochastic rock physics modeling for seismic anisotropy with two different shale models", *SEP report - 150*, Stanford University, 2013.
11. Yunyue Li, Biondi Biondo, Dave Nichols, Gary Mavko and Robert Clapp, "Stochastic rock physics modeling for seismic anisotropy", *SEP report - 149*, Stanford University, 2012.
12. Yunyue Li, "Wave equation migration velocity analysis for VTI media using optimized implicit finite difference", *SEP report - 147*, Stanford University, 2011.
13. Yunyue Li and Mohammad Maysami, "Dix inversion constrained by L1-norm optimization", *SEP report - 139*, Stanford University, 2009.
14. Yunyue Li and Biondo Biondi, "Automatic velocity picking by simulated annealing", *SEP report - 138*, Stanford University, 2009.

SERVICE

- Reviewer (Journals) - *Geophysics, Geophysical Journal International.*
- SEG Translation Committee - *Served as member since 2008, regional liaison since 2011 and vice president since 2012.*

LANGUAGES

Proficient in English and Chinese.

REFERENCES

FROM ACADEMIA

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