

Alison E. Malcolm

Associate Professor of Geophysics
NSERC Chevron Industrial Research Chair in Reservoir Characterization
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Education

- PhD in Geophysics, with a Mathematics minor, at the Colorado School of Mines with the Center for Wave Phenomena, advisor Prof. M.V. de Hoop, co-advisor Prof. J. A. Scales, May 2005.
- Bachelor of Science in Geophysics (honours), University of British Columbia, May 2000.

Awards

- One of the 2012 recipients of the **J. Clarence Karcher Award**, given in recognition of significant contributions to the science and technology of exploration geophysics by a young geophysicist of outstanding abilities.
- American Geophysical Union (AGU) outstanding student paper award, at the AGU annual meeting, 2004.
- Society of Exploration Geophysicists (SEG) award of merit for student paper competition at the SEG annual meeting, 2003.

Research Interests

My research focuses on understanding subsurface fractures and fluids, specifically:

- Studying how best to image the subsurface and how best to exploit small but coherent signals in the data.
- Understanding how accurate our images and parameter estimates are.
- Imaging the distribution of the Earth's nonlinear wave properties to distinguish fluid types and fracture orientations and densities remotely.

Professional Experience

- Currently an associate professor in the Earth Sciences Department at Memorial University of Newfoundland (MUN), since July 2014.

- 2008-2014: Assistant professor in the Earth, Atmospheric and Planetary Sciences Department at MIT, beginning 2008.
- 2006-2007: Postdoctoral researcher in the Earth Sciences Department at Utrecht University.
- 2005-2006: Postdoctoral fellow at the Institute for Mathematics and its Applications, at the University of Minnesota, participating in the annual program on imaging.
- 2000-2005: PhD Student, Center for Wave Phenomena, Colorado School of Mines.

Publications

In Preparation Publications

These are publications that should be submitted within 2016.

- *F. Massin, and A. Malcolm, A better analysis of earthquake source mechanism using shift and stack approach with body-wavelet, in preparation for the Bulletin of the Seismological Association of America*
- *B. Willemsen, and A. Malcolm, An efficient coupled acoustic-elastic local solver applied to phase inversion, in preparation for Geophysics*

Submitted Publications

- *A. Shabelansky, A. Malcolm, and M. Fehler Converted-Phase Seismic Imaging: Amplitude-Balancing Source-Independent Imaging Conditions submitted to Geophysics.*

Refereed Publications

- *J. TenCate, A. Malcolm, X. Feng, and M. Fehler The effect of crack orientation on the nonlinear interaction of a P wave with an S wave, Geophysical Research Letters, **43**, 6146-6153, (2016).*
- *B. Willemsen, A. Malcolm, and W. Lewis A numerically exact local solver applied to salt boundary inversion in seismic full waveform inversion, Geophysical Journal International, **204**, 1703-1720, (2016).*
- *A. Richardson, and A. Malcolm Separating a wavefield by propagation direction, Geophysics, **81**, T117-T129, (2016).*
- *D. Yang, F. Liu, S. Morton, A. Malcolm & M. Fehler Time-lapse Full Waveform Inversion with Ocean Bottom Cable Data: Application on Valhall Field, Geophysics **81**, R225-R235, (2016).*
- *O. V. Poliannikov and A. Malcolm The effect of velocity uncertainty on migrated reflectors: Improvements from relative depth imaging, Geophysics, **81** S21-S29, (2016).*
- *D. Yang, M. Meadows, P. Inderwiesen, J. Landa, A. Malcolm and M. Fehler Double Difference Waveform Inversion: Feasibility and Robustness Study with Pressure Data Geophysics, **80**, M129-M141, (2015).*

- O.V. Poliannikov, M. Prange, H. Djikpesse, **A. E. Malcolm** and M. Fehler, *Bayesian inversion of pressure diffusivity from microseismicity*, *Geophysics* **80** M45-M52, (2015).
- D. Yang, X. Shang, **A. Malcolm**, M. Fehler, H. Baek, *Image Registration Guided Wavefield Tomography for Shear Wave Velocity Model Building*, *Geophysics* **80** U35-U46, (2015).
- A. H. Shabelansky, **A. Malcolm**, M. Fehler, X. Shang & W. Rodi *Source-Independent Full Wavefield Converted-Phase Elastic Migration Velocity Analysis*, *Geophysical Journal International* **200**(2) 952-966 (2015).
- T. D. Mikesell, **A. Malcolm**, D. Yang & M. M. Haney *A comparison of methods to estimate seismic phase delays: Numerical examples for coda wave interferometry*, *Geophysical Journal International* **202**(1) 347-360 (2015).
- A. Shabelansky, **A. Malcolm**, and M. Fehler, *Monitoring viscosity changes from time-lapse seismic attenuation: case study from a heavy oil reservoir*, *Geophysical Prospecting*, 0.111/1365-2478.12229 (2015).
- T. Gallot, **A. Malcolm**, T. Szabo, S. Brown, D. Burns, and M. Fehler, *Characterizing the nonlinear interaction of S- and P-waves in a rock sample*, *Journal of Applied Physics* **117**, 034902 (2015).
- D. Yang, **A. Malcolm**, M. Fehler, *Using image warping for time-lapse image domain wavefield tomography*, *Geophysics* **79** (3), WA141-WA151, (2014).
- O. V. Poliannikov, M. Prange, **A. E. Malcolm**, and H. Djikpesse, *Joint location of microseismic events in the presence of velocity uncertainty*, *Geophysics* **76** KS51-KS60, (2014).
- D. Yang, **A. Malcolm**, M. Fehler, L. Huang, *Time-lapse walkaway vertical seismic profile monitoring for CO₂ injection at the SACROC enhanced oil recovery field: A case study*, *Geophysics*, **79**(2), B51-B61, (2014).
- **A. Malcolm** and D. P. Nicholls*, *Operator Expansions and Constrained Quadratic Optimization for Interface Reconstruction: Impenetrable Acoustic Media*, *Wave Motion*, **51**, 23-40, (2014).
- O. Poliannikov, M. Prange, **A. Malcolm** and H. Djikpesse, *A unified Bayesian framework for relative microseismic location*, *Geophysical Journal International*, **194**(2), 557-571, (2013).
- G. Melo, **A. Malcolm**, K. van Wijk and D. Mikesell *Using SVD for improved interferometric Greens function Retrieval*, *Geophysical Journal International* **194** (3), 1596-1612, (2013).
- A. Shabelansky, **A. Malcolm** and M. Fehler *Data-Driven Estimation of the Sensitivity of Target-Oriented Time-Lapse Seismic Imaging to Source Geometry*, *Geophysics* **78**(2), R47-R58, (2013).
- O. Poliannikov, **A. Malcolm**, H. Djikpesse and M. Prange, *Interferometric hydrofracture microseism localization using neighboring fracture* *Geophysics*, **76** WC27, (2011).
- **A. E. Malcolm** and D. P. Nicholls*, *A Boundary Perturbation Method for Recovering Interface Shapes in Layered Media*, *Inverse Problems* **27** 095009, (2011).

- **A. E. Malcolm**, and J. Trampert, *Tomographic Errors from Wavefront Healing: more than just a fast bias*, *Geophysical Journal International* **185**, (1), p 385402, (2011).
- **A. E. Malcolm**, and D. P. Nicholls*, *A Field Expansions Method for Scattering by Periodic Layered Media*, *The Journal of the Acoustical Society of America*, **129** (4) p 1783, (2011).
- **A. E. Malcolm**, M. V. de Hoop, and B. Ursin, *Recursive Imaging with Multiply-Scattered Waves Using Partial Image Regularization: A North Sea Case Study*, *Geophysics*, **76** 33-42, (2011).
- **A. E. Malcolm**, B. Ursin and M. V. de Hoop, *Seismic imaging and illumination with internal multiples*, *Geophysical Journal International*, **176**, p 847-864, (2009).
- **A. E. Malcolm**, F. Reitich, J. Yang, J. F. Greenleaf and M. Fatemi, *Ultrasound Vibro-Acoustography: A numerical model*, *Ultrasonics*, **48**, p 553-558, (2008).
- **A. E. Malcolm** and B. Guzina, *On the Topological Sensitivity of Transient Acoustic Fields*, *Wave Motion*, **45**, p 821-34, (2008).
- **A. E. Malcolm**, M. V. de Hoop and H. Calandra, *Identification of Image Artifacts due to Internal Multiples*, *Geophysics*, **72**, S123, (2007).
- **A. E. Malcolm**, F. Reitich, J. Yang, J. F. Greenleaf and M. Fatemi, *A Complete Computational Model of Ultrasound Vibro-Acoustography*, *Proceedings of 2006 American Society of Mechanical Engineers (ASME) International congress and exhibition Paper no. IMECE2006-16385 pp. 65-71* (2006).
- **A. E. Malcolm** and M. V. de Hoop, *A Method for Inverse Scattering Based on the Generalized Bremmer Coupling Series*, *Inverse Problems*, **21**, (2005)
- **A. E. Malcolm**, M. V. de Hoop and J. H. Le Rousseau, *The Applicability of DMO/AMO in the Presence of Caustics*, *Geophysics*, **70**, (2005).
- **A. E. Malcolm**, J. A. Scales and B. A. van Tiggelen, *Extracting the Green Function from Diffuse, Equipartitioned Waves*, *Phys. Rev. E*, **70**, (2004).
- M. V. de Hoop, **A. E. Malcolm** and J. H. Le Rousseau, *Seismic Data Continuation in the Single Scattering Approximation: A Framework for Dip and Azimuth Moveout*, *Can. Appl. Math. Q.*, **10**, (2003).
- J. A. Scales and **A. E. Malcolm**, *Laser Characterization of Ultrasonic Wave Propagation in Random Media*, *Phys. Rev. E*, **67**, (2003).

Papers in Professional Magazines

These are reviewed, but the magazine is not an official journal.

- **A. E. Malcolm**, B. Willemsen, *Using a Local Solver for 4D Full Waveform Inversion*, Invited submission in *The Leading Edge*.

- G. Ely, **A. E. Malcolm**, O. Poliannikov, D. Nicholls, *Assessing Seismic Images with Velocity Uncertainty*, Invited submission in The Leading Edge.
- O. Poliannikov, **A. E. Malcolm**, M. Prange, *The Impact of Velocity Uncertainty on Microseismic Event Location*, Invited submission in The Leading Edge.
- O. Poliannikov, **A. E. Malcolm**, M. Prange, *The Impact of Velocity Uncertainty on Microseismic Event Location*, To appear in The Leading Edge.
- O. Poliannikov, **A. E. Malcolm**, M. Prange, H. Djikpesse, *Checking up on the neighbors: Quantifying uncertainty in relative event location*, The Leading Edge, **31**(12) 1490-1494, (2012).
- G. Melo and **A. Malcolm** *Microquake seismic interferometry with SVD enhanced Greens function recovery* The Leading Edge **30** (5) p 556, (2011).
- O. Poliannikov, **A. Malcolm**, H. Djikpesse and M. Prange, *How can we use one fracture to locate another?* The Leading Edge **30** (5) p 551, (2011).

Book Chapter

- **A. E. Malcolm**, F. Reitich, J. Yang, J. F. Greenleaf and M. Fatemi, *Numerical Modeling for Assessment and Design of Ultrasound Vibroacoustography Systems in Biomedical Applications of Vibration and Acoustics in Imaging and Characterisations* editors: M. Fatemi, A. Al-Jumaily and A. Alizad.

Theses Written

- PhD Thesis: *Data Regularization for Data Continuation and Internal Multiples*, advisor M.V. de Hoop.
- B.Sc. Honors Thesis: *Algorithm Development for the Fast Computation of the Fourier Transform of Unequally Sampled Data with Applications to Seismic and Sediment Core Data*, advisor T. J. Ulrych.

Theses Supervised

- Alan Richardson *Seismic imaging using internal multiples and overturned waves*, Ph.D., MIT, 2015.
- Andrey Shabelansky, *Theory and Application of Source Independent Full Wavefield Elastic Converted Phase Seismic Imaging and Velocity Analysis*, Ph.D., MIT, 2014 (co-supervised with Michael Fehler).
- Di Yang, *Full Wavefield Inversion Methods for Monitoring Time-Lapse Subsurface Velocity Changes*, Ph.D., MIT, 2014 (co-supervised with Michael Fehler).
- G. Melo, *Using relative traveltimes: SVD-enhanced seismic interferometry and microseismic location uncertainty*, Ph.D., MIT, 2014.
- C. Hess, *Geologic Interpretations of Seismic Scattering and Attenuation for the Cianten Caldera and Surrounding Area*, M.Sc., MIT, 2013.
- H. Omer *Enhancing reservoir characterization through improved imaging and production management*, M.Eng., MIT, 2013.

Expanded Abstracts

- B. Willemsen, **A. Malcolm**, *Coupling a Local Elastic Solver to a Background Acoustic Model to Estimate Phase Variation*, SEG Expanded Abstracts, (2016).
- F. Massin, **A. Malcolm**, *A better automatic body-wave picker with broad applicability*, SEG Expanded Abstracts, (2016).
- **A. Malcolm**, J. TenCate, M. Fehler, *The role of cracks in the nonlinear interaction of a P-wave with an S-wave*, SEG Expanded Abstracts, (2016).
- O. Poliannikov M. Fehler and **A. Malcolm** *Error bounds on diffusive flow models from noisy micro-seismic data*, SEG Expanded Abstracts, (2015).
- B. Willemsen, W. Lewis and **A. Malcolm** *Toward target-oriented FWI: An exact local wave solver applied to salt boundary inversion*, SEG Expanded Abstracts (2015).
- G. Ely, **A. Malcolm** and D. Nicholls *Combining Global Optimization and Boundary Integral Methods to Robustly Estimate Subsurface Velocity Models*, SEG Expanded Abstracts (2015).
- A. Richardson and **A. Malcolm** *Separating a Wavefield by Propagation Direction*, SEG Expanded Abstracts (2015). **This paper was ranked as one of the top 31 of over 1000 papers presented at the meeting.**
- A. Shabelansky, **A. Malcolm** and M. Fehler *The Sensitivity of Converted-Phase Extended Images to P- and S-Wavespeed Variations*, SEG Expanded Abstracts (2015).
- B. Willemsen and **A. Malcolm** *Regularizing Velocity Differences in Time-Lapse FWI Using Gradient Mismatch Information*, SEG Expanded Abstracts (2015).
- A. Shabelansky, **A. Malcolm**, M. Fehler, X. Shang and W. Rodi *Converted-phase Seismic Imaging-Amplitude-balancing Source-independent Imaging Conditions* EAGE Expanded Abstracts, (2015).
- T. Gallot, **A. Malcolm**, D. Burns, S. Brown, M. Fehler, T. Szabo, *Nonlinear interaction of seismic waves in the lab: A potential tool for characterizing pore structure and fluids*, SEG Expanded Abstracts 33, (2014).
- O. Poliannikov, **A. Malcolm**, M. Fehler, M. Prange, H. Djikpesse, *Propagation of uncertainty from effective-diffusion flow to microseismicity* SEG Expanded Abstracts 33, (2014).
- O. Poliannikov, **A. Malcolm**, *Effect of velocity uncertainty on migrated reflectors*, SEG Expanded Abstracts 33, (2014).
- A. Richardson, **A. Malcolm** *Illumination compensation using Poynting vectors, with special treatment for multiples*, SEG Expanded Abstracts 33, (2014).
- A. Shabelansky, **A. Malcolm**, M. Fehler, W. Rodi, *Migration-based seismic trace interpolation of sparse converted phase micro-seismic data*, SEG Expanded Abstracts 33, (2014).

- D. Yang, X. Shang, **A. Malcolm**, M. Fehler, *Image registration guided wavefield tomography for shear wave velocity model building*, SEG Expanded Abstracts 33, (2014).
- D. Yang, **A. Malcolm**, M. Fehler, *Time-lapse Full Waveform Inversion and Uncertainty Analysis with Different Survey Geometries*, 76th EAGE Conference and Exhibition (2014).
- G. Melo, **A. Malcolm**, T. Gallot, *Seismic interferometry for sparse data: SVD-enhanced Green's function estimation*, IEEE 5th International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP), p 276-279 (2013).
- O. Poliannikov, **A. Malcolm**, M. Prange, H. Djikpesse, *Joint microseismic event location with uncertain velocity*, SEG Expanded Abstracts 32, (2013).
- G. Melo, **A. Malcolm**, O. Poliannikov, M. Fehler, *Analysis of location uncertainty for a microearthquake cluster: A case study*, SEG Expanded Abstracts 32, (2013).
- A. Richardson, **A. Malcolm**, *Reverse time migration in the presence of known sharp interfaces*, SEG Expanded Abstracts 32, (2013).
- D. Yang, M. Fehler, **A. Malcolm**, F. Liu, S. Morton, *Double-difference waveform inversion of 4D ocean bottom cable data: Application to Valhall, North Sea*, SEG Expanded Abstracts 32, (2013).
- A. Shabelansky, **A. Malcolm**, M. Fehler, X. Shang, W. Rodi, *Converted phase elastic migration velocity analysis*, SEG Expanded Abstracts 32, (2013).
- D. Yang, **A. Malcolm**, M. Fehler, *Using image warping for time-lapse image domain wavefield tomography*, SEG Expanded Abstracts 32, (2013).
- O. V. Poliannikov, M. Prange, **A. Malcolm**, and H. Djikpesse *A unified framework for relative source localization using correlograms*, SEG Expanded Abstracts 31, (2012).
- A. Shabelansky, **A. Malcolm**, M. Fehler and S. Bakku, *Seismic imaging of hydraulically-stimulated fractures: A numerical study of the effect of the source Mechanism*, SEG Expanded Abstracts 31, (2012).
- D. Yang, Y. Zheng, M. Fehler and **A. Malcolm**, *Target-oriented time-lapse waveform inversion using virtual survey*, SEG Expanded Abstracts 31, (2012).
- A. Shabelansky, **A. Malcolm** and M. Fehler, *Monitoring Seismic Attenuation Changes Using a 4D Relative Spectrum Method in Athabasca Heavy Oil Reservoir, Canada*, EAGE Expanded Abstracts, (2012).
- D. Yang, M. Fehler, **A. Malcolm**, and L. Huang, *Carbon sequestration monitoring with acoustic double-difference waveform inversion: A case study on SACROC walkaway VSP data*, SEG Expanded Abstracts 30, 4273 (2011).
- O. V. Poliannikov, **A. Malcolm**, H. Djikpesse, and M. Prange, *Interferometric microseism localization using neighboring fracture*, SEG Expanded Abstracts 30, 4263 (2011).

- A. H. Shabelansky, **A. Malcolm**, and M. Fehler, *Visibility analysis using reverse time wave sensitivity for time-lapse target-oriented imaging*, SEG Expanded Abstracts 30, 4155 (2011).
- G. Melo and **A. Malcolm**, *SVD enhanced seismic interferometry for traveltime estimates between microquakes*, SEG Expanded Abstracts 30, 1608 (2011).
- O. V. Poliannikov and **A. Malcolm** *Detecting medium changes from coda by interferometry*, SEG Expanded Abstracts 29, 4227 (2010).
- G. Melo, **A. Malcolm**, D. Mikesell and K. van Wijk, *Using SVD for improved interferometric Green's function recovery*, SEG Expanded Abstracts 29, 3986 (2010).
- **A. Malcolm** and M. de Hoop, *Interferometric imaging of multiples in an RTM approach*, SEG Expanded Abstracts 29, 3327 (2010).
- **A. Malcolm**, M. de Hoop and B. Ursin *Subsalt Imaging with Internal Multiples*, SEG Expanded Abstracts 27, 2461 (2008).
- **A. Malcolm**, M. de Hoop and H. Calandra *Estimating imaging artifacts caused by internal multiples*, SEG Expanded Abstracts 24, 2111 (2005).
- **A. Malcolm**, and M. de Hoop, *Data continuation in the presence of caustics: A synthetic data example*, SEG Expanded Abstracts 23, 2060 (2004).
- **A. Malcolm** and M. de Hoop, *Inverse multiple scattering in the downward-continuation approach*, SEG Expanded Abstracts 23, 1293 (2004).
- **A. Malcolm** and J. Scales, *Non-contacting ultrasonics for visualizing and exploiting multiple scattering*, SEG Expanded Abstracts 22, 1672 (2003).
This paper received an award of merit in the student paper competition.
- **A. Malcolm**, M. de Hoop, and J. Le Rousseau, *DMO/AMO in the presence of caustics*, SEG Expanded Abstracts 21, 2265 (2002).

Selected Recent and Upcoming Presentations

- **Invited: A. Malcolm**, *What do we really know? Uncertainty in Reservoir Monitoring* I have been invited to repeat this presentation and *The Role of Cracks in the Nonlinear Elasticity of Rocks*, at The University of Western Ontario in September 2016.
- **A. Malcolm**, J. TenCate, *Correlating Crack Orientation with Nonlinearity*, International Conference on Nonlinearity in Earth Materials, July 2016, Lake Tahoe CA.
- **Invited: A. Malcolm**, F. Massin, O. Poliannikov & G. Melo, *Uncertainty in Microseismic Event Location*, Seismix Annual Meeting, May 2016, Aviemore Scotland.
- **A. Malcolm**, D. Yang, G. Ely, M. Fehler, *Uncertainty Quantification in 4D Seismic*, SIAM Meeting on Uncertainty Quantification, April 2016, Lausanne, Switzerland.

- **A. Malcolm**, J. TenCate, M. Fehler, *The Role of Cracks in the Nonlinear Elasticity of Rocks*, Colloquium presentation given in the Department of Physics at MUN (March 2016) and in the Institute for Geophysics at ETH Zurich, Switzerland (April, 2016).
- **Invited: A. Malcolm**, *What do we really know? Uncertainty in Reservoir Monitoring*, Given at Acadia University, The University of New Brunswick and St Francis Xavier University as part of the Atlantic Geoscience Society Travelling Speaker Series, November 2015.
- **Invited: A. Malcolm**, D. Yang, M. Fehler, *Uncertainty Quantification in Reservoir Monitoring with 4D Seismic Data and Induced Seismicity*, Newfoundland Energy West Symposium, September 2015, Cornerbrooke, NL.
- **A. Malcolm**, J. TenCate, X. Feng, M. Fehler, *Assessing Crack Orientation with S/P wave interactions*, International Conference on Nonlinearity in Earth Materials, July 2015, Bruges, Belgium.
- **A. Malcolm**, A. Shabelansky, A. Richardson, M. Fehler *Seismic Imaging with a Single Wavefield*, Workshop on Computational and Mathematical Challenges in Inverse Problems, April 2015, Ann Arbor, MI.
- T. Gallot, **A. Malcolm**, T. Szabo, D. Burns, S. Brown, M. Fehler, *Nonlinear Interaction of Seismic Waves in the Lab: A Potential Tool for Characterizing Pore Structure and Fluids*, SEG Annual Meeting, November 2014, Denver CO.
- **A. Malcolm** & A. Richardson, *Algorithms for Seismic Imaging with Multiply Scattered Waves*, Society for Industrial and Applied Mathematics (SIAM) Computational Science and Engineering Meeting, February 2013, Boston, MA.
- **Invited: Plenary talk:**, *Targetted Seismic Imaging*, SIAM Imaging Sciences Meeting, May 2012 Philadelphia PA.
- **Invited Plenary talk:**, *Seismic Inversion with Multiply-Scattered Waves*, Applied Inverse Problems Meeting, May 2011, College Station TX.
- **A. Malcolm**, F. Reitich, M. Fatemi, and J. Greenleaf, *Multi-Scale Surface Integral Methods for Ultrasound Vibro-Acoustography*, International Congress on Industrial and Applied Math, July 2011, Vancouver, BC.
- **A. Malcolm** and O. Poliannikov *Time-reversal determination of acoustic scattering properties*, BIRS workshop on Tomography and Transport, May 2010, Banff AB.
- **A. Malcolm**, M. de Hoop and B. Ursin, *Imaging with Multiply Scattered Waves: Removing Artifacts*, SIAM Imaging Science Meeting, April 2010, Chicago, IL.
- **A. Malcolm**, M. de Hoop, *Multiple Scattering and Subsalt Imaging*, Princeton Solid Earth Seminar, Fall 2009, Princeton, NJ.
- **A. Malcolm**, M. de Hoop, *Imaging with Multiply Scattered Waves*, Tufts Department of Mathematics Colloquium, and RPI Inverse Problems Seminar, Spring 2008, Boston, MA, and Troy, NY.

- **A. Malcolm**, F. Reitich, J. Yang, J. Greenleaf and M. Fatemi, *Mathematical and Numerical Modeling of Ultrasound Vibro-Acoustography*, Presented at the 2009 Applied Inverse Problems Meeting, July 2009, Vienna, Austria.
- **A. Malcolm** and J. Trampert, *Wavefront Healing and the Failure of Ray Theory*, Presented at the AGU annual meeting, December 2008, San Francisco, CA.
- **Invited: A. Malcolm**, F. Reitich, M. Fatemi and J. Greenleaf, *Ultrasound vibro-acoustography*, BIRS 2008 Inverse Problems Workshop, May 2008, Banff AB.
- **A. Malcolm**, M. de Hoop, B. Ursin, *Multiples: From artifact prediction to image reconstruction via illumination*, Presented at the AGU annual meeting, December 2007, San Francisco, CA.
- **A. Malcolm**, B. Guzina, *Acoustic Obstacle Reconstruction with the Time Domain Topological Derivative*, Presented at the COMPDYN meeting June 2007, Crete, Greece.
- **A. Malcolm**, M. de Hoop, B. Ursin, *Exploiting Multiple Scattering for Improved Seismic Image Illumination: A Series Approach*, SIAM Annual Meeting, May 2007, San Diego, CA.
- **A. Malcolm**, M. de Hoop, B. Ursin, *A Series Approach to Multiple Scattering*, Presented at the Canadian Applied and Industrial Mathematics Society Annual Meeting, May 2007, Banff, AB.
- **A. Malcolm**, F. Reitich*, J. Yang, J. Greenleaf and M. Fatemi, *A Complete Numerical Model of Ultrasound Vibro-Acoustography*, Invited presentation at the International Conference on Ultrasound, 2007, Chicago IL.
- **A. Malcolm**, M. de Hoop, *Amplitude Corrections for Estimating Imaging Artifacts from Multiples*, Contributed presentation to the 2006 Pacific Institute for the Mathematical Sciences Geophysical Inversion Workshop, July 2006, Calgary, AB.
- **A. Malcolm**, F. Reitich, J. Yang, J. Greenleaf and M. Fatemi, *Virtual Ultrasound Vibro-Acoustography*, Poster presentation at the Imaging Communication and Disorder summer school, June 2006, Cargèse France.
- **A. Malcolm**, with F. Reitich, J. Yang, J. Greenleaf and M. Fatemi, *Virtual Ultrasound Vibro-Acoustography*, Contributed presentation at the SIAM Conference on Imaging Science, May 2006, Minneapolis, MN.
- **A. Malcolm**, M. de Hoop, H. Calandra *Estimating Imaging Artifacts Caused by Leading-Order Internal Multiples*, Poster presentation at the Institute for Mathematics and its Applications workshop on "Imaging from Wave Propagation", Fall 2005, Minneapolis, MN.
- **Invited: A. Malcolm**, J. A. Scales and B. A. van Tiggelen, *The Transition to Equipartitioning and its Relation to Scattering Strength*, Invited presentation at the annual meeting of the Acoustical Society of America, May 2005, Vancouver, BC.
- **A. Malcolm**, M. de Hoop *Inverse Multiple Scattering*, Poster presentation at the annual meeting of the American Geophysical Union, December 2004, San Francisco, CA.
This paper won an outstanding student paper award.

- **A. Malcolm**, J. A. Scales and B. A. van Tiggelen, *Estimating Scattering Strength from the Transition to Equipartitioning*, Poster presentation at the annual meeting of the American Geophysical Union, December 2004, San Francisco, CA.

Research Grants

- *Multiwave Imaging of the Subsurface to Improve Spatial Resolution*, Weatherford, co-PI M. Fehler (2011-2014).
- *Interferometric Imaging of Subduction Zones*, NSF, (2011-2012).
- *Collaborative Research: A field expansion method for acoustic scattering from topography: extensions to elasticity and the inverse problem*, NSF, co-PIs A. Malcolm & D. Nicholls, (2011-2014).
- *Risk Assessment and Advance Warning for Landslides in Brazil*, Geoscientists Without Borders, (2011-2013), an interdisciplinary multi-PI humanitarian project led by my student G. Melo.
- *Arterial Properties from Stimulated Acoustical Emission*, NIH, PI J. F. Greenleaf, Co-Is M. Fatemi, C. Pislaru, S. Chen, X. Zhang, M. Urban, M. Joyner, L. Lerman, F. Reitich, A. Malcolm, W. Aquino, (2009-14).
- *Monitoring and modeling fluid flow in a developing enhanced geothermal setting (EGS) reservoir.*, DOE, PI M. Fehler, Co-PIs A. Malcolm, L. House, (2008-12).
- *Imaging with Multiply Scattered waves*, Total, PI A. Malcolm (2010-14).
- *Steam Chamber Imaging*, Total, Co-PIs A. Malcolm and M. Fehler (2010-12).
- *Real-Time Fracture Imaging*, ConocoPhillips, (2011-12).
- *Subsurface Change Detection for CO₂ Sequestration*, MIT Energy Initiative Seed Funds, Co-PIs A. Malcolm and M. Fehler (2010-11).

Teaching Experience

Courses Taught

- “Earth Systems”, introductory undergraduate level, 2016.
- “Wave Equation Modeling, Processing and Inversion Algorithms”, graduate level, 2016.
- “Seismic and Potential Field Methods in Geophysics” undergraduate level, 2015, 2016.
- “Introduction to Seismology” introductory graduate level, 2012, 2013.
- “Applications of Continuum Mechanics to Earth, Atmospheric and Planetary Sciences”, sophomore/junior level, 2009, 2010.
- “Scattering in the Earth”, graduate seminar, co-taught with M. Fehler, D. Burns and O. Poliannikov, 2009.
- “Advanced Seismic Imaging”, graduate level, co-taught with S. Rondenay, 2008, 2010, taught alone 2012, 2014.

- “Oral Communication”, graduate level, 2009, 2010, 2011.
At the request of several students I developed this course to help prepare students to give conference presentations.
- Guest Lecturer in: “Earth Science, Energy and the Environment”, sophomore level, 2009-2012.
I give a series of three lectures on finding and extracting oil.
- Substitute Instructor, 2002-2004 for Prof. M. V. de Hoop for “Advanced Engineering Mathematics”, (MACS348) and “Linear Algebra”, (MACS332) at the Colorado School of Mines.
- Ran a math help group for geophysics undergraduates, 2004-2005.
At the request of the department chair I met weekly to answer questions the undergraduates had relating both specifically to a mathematical geoscience course they were taking and more general math questions.
- Teaching Assistant, Spring 2001 for the Department of Geophysics summer field camp (third year undergraduate students), Colorado School of Mines with faculty instructor Prof. M. L. Batzle.

Short Courses

- Instructor at the Inverse Problems in Imaging Summer School, Kuopio, Finland, June 2012.
- *An Introduction to Seismic Imaging* Mathematical Sciences Research Institute Connections for Women Workshop, August 2010.

Advising

- Advisor to one postdoc.
- Advisor to 3 Ph.D. students, and 2 M.Sc. students.
- Advised 3 undergraduate thesis projects and one summer undergraduate project in 2014/2015.
- Advised 2 completed Ph.D. students, and 2 completed Masters students at MIT, 2008-2014.
- Co-advised 2 completed Ph.D. students at MIT.
- Freshman advisor 2008-2010.
- Advised a total of 6 undergraduates on 3 research projects over 3 years at MIT.
- Advised two postdocs and one research associate at MIT.

Service

Department Level

- Internal reader for one Ph.D., one M.Sc. and one M. Eng thesis.
- Committee member for two M.Sc. students.
- Comprehensive exam committee member for one Ph.D. student.
- Second reader for two Honours theses.
- Graduate Matters Committee Member 2015-2016.
- Undergraduate Matters Committee Member 2014-2015.

- Department Head Review Committee Member 2015.
- Search committee member for the Applied Geophysics Search 2014-2015.
- Speaker in the SEG student chapter panel on careers, 2015.
- Active member of the Earth Resources Laboratory.
Specifically, I organize student presentations at the annual meeting, meet regularly with representatives of sponsoring companies, and informally mentor both students and postdocs interested in industrial careers.
- Faculty advisor to the MIT student chapter of the SEG.
This is a new initiative begun by the students; I am working with them to facilitate improved interactions between students and visiting company representatives.
- Co-organizer of Imaging and Computing Seminar Series at MIT beginning fall 2009 (joint EAPS and Math).
- EAPS Department Undergraduate Committee member 2009-2010.
I am still part of an ongoing process to revitalize the department's undergraduate curriculum, specifically streamlining course material and working with other departments to increase the visibility of Earth science problems and topics at MIT.
- One of four organizers of the Women in Geophysics Mentoring Program in the Geophysics Department at the Colorado School of Mines, 2003-2005.
Organized 2-3 events per semester for the female graduate students in the department to meet and interact with female geoscientists in the Denver area.

School Level

- Member of the NSERC and Vanier selection committee 2014-2016.
- External member of the Mathematics Canada Research Chair in Numerical Analysis search committee, 2014.
- Member of the MIT Council on Family and Work.
- Member of MITS (MIT International Science and Technology Initiatives) seed grant review board 2009 and 2010.
The board is responsible for reading and ranking proposals by MIT faculty and researchers for seed funds to begin projects with international collaborators.
- Geophysics student representative to the Graduate Student Association of the Colorado School of Mines, 2002-2004.
- Student representative to the Research Council of the Colorado School of Mines, 2002-2004.

Academic Community

- Associate Editor of Geophysics, 2015-2018.
- Guest Editor for IEEE Transactions on Computational Imaging special issue on Computational Imaging for Earth Sciences, 2016-2017.

- Member of the organizing committee for the Institute for Computational and Experimental Research in Mathematics Semester on Mathematical and Computational Challenges in Radar and Seismic Reconstruction, to take place at Brown University in the Fall 2017; I am the primary organizer of the Wave Propagation and Inversion in Seismic Applications Research Cluster.
- Member of the organizing committee for the 2017 “Passive Imaging and Monitoring in Wave Physics: From Seismology to Ultrasound” meeting June 5-9, 2017.
- Organizing a series of minisymposia on seismic imaging at the 2017 Waves meeting, May 15-19 2017.
- External Reviewer for the field of Earth Systems Modelling, Faculty of Earth Sciences, Geography and Astronomy and Faculty of Mathematics, University of Vienna. I will perform a review of the candidates for a new tenure-track position.
- Member of the Candidate Selection Committee for the SIAM Imaging Sciences Activity Group, 2015.
- Co-organizer of Pacific Institute for the Mathematical Sciences workshop on Full-Waveform Inversion, 2015.
- Newfoundland and Labrador representative to the Atlantic Geological Society Board.
- Secretary of the SIAM Imaging Sciences activity group, 2010/2011.
I maintained both the website and the mailing list for the group as well as working with the rest of the executive to discuss governance issues and plan the annual meeting.
- Co-organizer for the MSRI Connections for Women workshop during the 2010 MSRI semester on Inverse Problems.
This two-day workshop gave an introduction to the semester on Inverse Problems.
- Member of the NSF Numerical Analysis Panel March 9-10 2009.
- Referee for several international journals in geophysics and applied mathematics.

General Community

- Judge, Eastern NL Science and Technology Fair, April 2016.
- Led a high-school group visiting MUN in a discussion on seismology and Earth science in general, 2015.
- Spoke a group of high-school students through the Women in Science and Engineering organization, 2014.
- Spoke to the Girls’ Angle math club, Cambridge MA, 2011.
- Spoke at a science Fun Fair, Minneapolis MN, 2006.
- Taught a session at the University of Minnesota to a group of middle and high school students on triangulation and Earthquake location
- Volunteered with the US Geological Survey to man a booth of different activities for children highlighting Earthquakes, 2004-2005.
- Along with a sponsoring faculty member, organized an open house for several hundred high-school students, UBC Department of Earth and Ocean Sciences, 2000.