

**Dr. Evan Schankee Um**

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I am an electromagnetic (EM) geophysicist with a computational emphasis. I utilize EM wave propagation and diffusion to investigate geological structures, energy reserves and fluid distribution within the Earth from the near-surface scale to the deep mantle. To rigorously interrogate the Earth, my research is not limited to a single EM method but jointly utilizes multiple EM methods. I often employ both EM and seismic methods in a joint inversion framework to improve the consistency and reduce the ambiguity in geophysical analysis. Analysis and interpretation of seismic and EM fields that propagate/diffuse through the Earth are not only geophysically complex but also numerically intensive. Thus, I develop accurate, fast and scalable algorithms for simulating and interpreting geophysical responses to complex geology. The algorithms are employed to better understand the physics of EM and seismic field interaction with complex geology. My modeling and inversion algorithms provide solutions to a range of marine geophysical problems including offshore fault and tectonic zones, volcanic and geothermal investigations, monitoring of geological storages, imaging of deep crust and mantle structures and energy exploration.

**Education:**

- 2006 – 2011 Ph.D. Geophysics, Stanford University, CA, USA  
The title of Ph.D. dissertation: 3-D finite-element time-domain modeling of the marine controlled-source electromagnetic method (Advisor: Drs. Jerry M. Harris and David Alumbaugh)
- 2003 – 2005 M.S. Geological Engineering (Interdisciplinary Program between Geology, Geophysics and Civil and Environmental Engineering), University of Wisconsin-Madison, USA  
The title of M.S. thesis: On the physics of galvanic source electromagnetic methods (Advisor: Dr. David L. Alumbaugh)
- 1994 – 1998 B.S. Earth and Environmental Sciences (Geology), Korea University, Seoul.

**Research Positions:**

- 2017 – Present Scientist, Geophysics Department, Earth and Environmental Sciences, Lawrence Berkeley National Lab, CA, USA
- 2014 – 2016 Postdoctoral Fellow, Geophysics Department, Earth and Environmental Sciences, Lawrence Berkeley National Lab, CA, USA (advisor: Dr. Gregory A. Newman).
- 2006 – 2011 Research & Teaching Assistant, Graduate Fellow, Geophysics Department, Stanford University, CA.
- 2003 – 2005 Research Assistant, Geological Engineering, Univ. of Wisconsin-Madison.

**Work Experiences:**

- 2010 Computational Geophysics Consultant, Saudi Aramco, Saudi Arabia
- 2005 – 2006 Geophysics Intern, Physics, Modeling and Inversion Group, Schlumberger-ElectroMagnetic Instruments, Berkeley, CA

## **Research Experiences:**

1. Large-scale electromagnetic-seismic joint imaging for marine subsalt exploration.
2. Analysis of complex bathymetry effects on ocean bottom electromagnetic receivers.
3. Electromagnetic monitoring of offshore and onshore geological storage.
4. Borehole-to-surface/seafloor electromagnetic imaging of energy reservoirs, fractures and fault systems.
5. Electromagnetic imaging of ultra-deep localized energy resources, hazardous wastes, hydraulic fractures with a steel casing as a virtual vertical electric source.
6. Seismic full waveform inversion in the Laplace-Fourier domain.
7. Multi-scale multi-geophysical imaging of geothermal systems.
8. Parallel finite-element electromagnetic imaging algorithms in heterogeneous (CPU+GPU) computing environments
9. Parallel finite-element geophysical modeling algorithms in a multi-grid framework.

## **Teaching Experiences:**

1. Co-advising graduate students with Professor J. Kim (Petroleum Engineering, Texas A&M University) for multi-geophysical approaches for characterizing fracture propagation and fluid flow in hydro-fracturing operations.
2. Co-advising graduate students with Professor H. Fu in Center for Earth System Science, Tsinghua University (China) for parallel electromagnetic geophysical modeling since 2013.
3. TA, Geological Engineering (Instructor: Professor Tom Holtzer, class size: about 25), 2010, Department of Geological and Environmental Sciences and Civil & Environmental Engineering at Stanford University
4. TA, Exploring Earth Sciences with MATLAB (Instructor: Professor Tapan Mukerji, class size: about 40), 2009, Department of Geophysics, Earth & Environmental Sciences and Earth Resource Engineering at Stanford University.

## **Honors and Awards:**

1. Recipient, Stanford Graduate Fellowship, 2008-2011.
2. Inaugural Recipient, Computational Geosciences Fellowship, Stanford University, 2008.
3. Recipient, ConocoPhillips Fellowship, Stanford University, 2007.
4. Recipient, Littlefield Fellowship, Stanford University, 2006.
5. Recipient, Award for Excellence, College of Sciences, Korea University, 1997.
6. Recipient, Undergraduate Scholarship, Korea University, 1994-1997.

## **Research Grants:**

1. Worked with senior scientists at Berkeley Lab, wrote electromagnetic research components for Department of Energy research proposals and secured funds since 2011.
2. Recipient, Early Career Development Grant (\$100,000) from Berkeley Lab, 2012-13.
3. Co-PI with Professor Haohuan Fu (Center for Earth System Science, Tsinghua Univ., Beijing, China) for grants (\$300,000) from National Natural Science Foundation of China (NSFC): High-Performance Finite-Element Electromagnetic Earth Modeling (2014-16).

### Journal and Scientific Community Services:

1. Special Editor for *Geophysics* since 2011.
2. Committee Member for *Technical Programs for SEG Annual Meeting* since 2011
3. Reviewer for *Geophysics*, *Geophysical Prospecting*, *Geophysical Journal International*, *IEEE Trans. on Geoscience and Remote Sensing*, *Computers and Geosciences*, *Surveys in Geophysics*, and many others.
4. Secretary, Bay Area Geophysical Society (BAGS) since 2017
5. Committee Member for *the 6<sup>th</sup> International Symposium on Three-Dimensional Electromagnetics*, Berkeley, CA, USA. 2017.

### Articles and Book Chapters under Review (\* corresponding author):

1. \***Evan Um**, J. Kim and H. Fu, New advances in 3D borehole-to-surface/seafloor electromagnetic modeling and imaging in the presence of steel-cased wells, submitted to *Geophysical Journal International* (2016) and currently under review.
2. \***Evan Um**, J. Kim and S. Kim, A feasibility study on a casing-top electric source method for detecting and imaging hydraulically active fractured zones: 3D finite element modeling approach, submitted to *Geophysical Journal International* (2016) and currently under review.
3. Jihoon Kim and **Evan Um**, 2017, Framework of integrated flow-geomechanics-geophysics simulation for planar hydraulic fracture propagation (Chapter 4), *Hydraulic Fracturing Modeling*, ISBN: 0128129980, Elsevier.

### Journal Publications (\*corresponding author):

1. Baek, S., S. Kim, J. Kwon and **Evan Um**, 2017, Ground penetrating radar for fracture mapping in underground hazardous waste disposal sites: A case study from an underground research tunnel, South Korea, *Journal of Applied Geophysics*, **141**, 24-33.
2. \***Evan Um**, S. Kim and H. Fu, 2017, A tetrahedral mesh generation approach for 3D marine controlled-source electromagnetic modeling, *Computers and Geosciences*, **100**, 1-9.
3. \***Evan Um**, Michael Commer, Gregory Newman and Michael Hoversten, 2015, Finite element modeling of transient electromagnetic fields near steel-cased wells, *Geophysical Journal International*, **202**, 901-913.
4. Haohuan Fu, Yingqiao Wang, \***Evan Um**, Jiarui Fang, Tengpeng Wei and Guangwen Yang, 2015, A Parallel Finite-Element Time-Domain Method for Transient Electromagnetic Simulation, *Geophysics*, **80**, E213-E224.
5. Michael Commer, Michael Hoversten and **Evan Um**, 2015, Transient-electromagnetic FDTD earth modeling over steel infrastructure, *Geophysics*, **80**, E147-E162.
6. \***Evan Um**, Michael Commer, Gregory A. Newman, 2014, A strategy for coupled 3D imaging of large-scale seismic and electromagnetic data sets: application to subsalt imaging, *Geophysics*, **79**, ID1-13.
7. \***Evan Um**, Michael Commer, Gregory A. Newman, 2013, Efficient pre-conditioned iterative solution strategies for the electromagnetic diffusion in the Earth: finite-element frequency-domain approach, *Geophysical Journal International*, **193**, 1460-1473.
8. \***Evan Um**, David Alumbaugh, Jerry Harris and Jiuping Chen, 2012, Numerical modeling analysis of short-offset electric-field measurements with a vertical electric dipole source in complex offshore environments, *Geophysics*, **77**, E329-341.

9. \***Evan Um**, Jerry Harris and David Alumbaugh, 2012, An iterative finite-element time-domain method for simulating electromagnetic diffusion in 3D Earth, *Geophysical Journal International*, **190**, 871-886.
10. \***Evan Um**, Michael Commer and Gregory Newman, 2012, Iterative finite-difference solution analysis of acoustic wave equation in the Laplace-Fourier domain, *Geophysics*, **77**, T29-T36.
11. \***Evan Um**, Jerry Harris and David Alumbaugh, 2010, Three-dimensional time-domain simulation of electromagnetic diffusion phenomena: a finite-element electric-field approach, *Geophysics*, **75**, no. 4, F115-F126.
12. \***Evan Um** and David Alumbaugh, 2007, On the physics of the marine controlled source electromagnetic method, *Geophysics*, **72**, no. 2, WA13-WA26.

### Conference and Technical Presentations:

1. Jihoon Kim and **Evan Um**, 2017, Joint analysis of integrated flow, geomechanics and geophysics in geological CO<sub>2</sub> sequestration, 18<sup>th</sup> US-Korea Conference on Science, Technology and Entrepreneurship (UKC), Washington D.C.
2. Jihoon Kim and **Evan Um**, 2017, Computation and Joint Analysis of Coupled Flow, Geomechanics and Geophysics in Reservoir Engineering, *Society of Industrial and Applied Mathematics Conferences for Computational Sciences and Engineering*, Atlanta, GA.
3. **Evan Um**, E. Martinez, J. Kim, Application of Electromagnetic Geophysical Methods for Detecting Hydraulically-Active Fractured Zones, 50<sup>th</sup> U.S. Rock Mechanics Geomechanics Symposium, Houston, Texas, 2016.
4. **Evan Um** and J. Kim, Numerical Modeling Study of Surface Electromagnetic Monitoring of CO<sub>2</sub> Storage with Use of Steel Casing, 2015, June, *Engineering Mechanics Institute Conference*, Stanford, CA.
5. Sena, A., D. Colombo, E. Curiel, **Evan Um** and J. Harris, Efficient 3D Finite Element CSEM Modeling with Unstructured Tetrahedral Meshes Using a Parallel Direct Solver, *EAGE Meeting*, 2014.
6. Jihoon Kim, **Evan Um** and George Moridis, 2014, Fracture propagation, fluid flow, and geomechanics of water-based hydraulic fracturing in shale gas systems and electromagnetic geophysical monitoring of fluid migration, *SPE Hydraulic Fracturing Technology Conference*.
7. **Evan Um**, Michael Commer and Gregory Newman, A framework for coupled inversion of large-scale seismic and electromagnetic data: application to subsalt imaging, *AGU Meeting*, 2013.
8. Gregory Newman, **Evan Um** and Michael Commer, 2013, A framework for three-dimensional coupled seismic-electromagnetic inversion, 5<sup>th</sup> International Symposium on Three-Dimensional Electromagnetics, Sapporo, Japan.
9. **Evan Um**, Michael Commer and Gregory Newman, Coupled electromagnetic-seismic imaging, Workshop Integration of Seismic and EM, 82<sup>th</sup> *SEG meeting*, 2012.
10. Yingqiao Wang, Tengpeng Wei, Haohuan Fu, and **Evan Um**, A Parallel Finite-Element Solution of Transient Electromagnetic Diffusion Equation, 82<sup>th</sup> *SEG meeting*, 2012
11. **Evan Um** and Gregory Newman, Fluid imaging of enhanced geothermal systems, *Geothermal Technology Program*, 2012.
12. **Evan Um**, David Alumbaugh and Jerry Harris, Lorenz-gauge finite-element solution for transient CSEM modeling, 2010, 80<sup>th</sup> *SEG meeting*, Denver, Expanded Abstracts.

13. **Evan Um**, Jerry Harris and David Alumbaugh, 2009, A finite element algorithm for 3-D transient electromagnetic modeling, *79<sup>th</sup> SEG meeting*, Houston, Expanded Abstracts.
14. **Evan Um** and Jerry Harris, 2009, Finite-Element Numerical Simulation of Transient Electromagnetic Diffusion in the Earth, *International Association for Mathematical Geosciences Annual Conference*.
15. **Evan Um** and Jerry Harris, 2008, Sensitivity study of time-domain controlled-source electromagnetic method for detecting geological CO<sub>2</sub> sequestration, *Global Climate and Energy Project Research Symposium*.
16. **Evan Um** and Jerry Harris, 2007, A feasibility study of the controlled-source electromagnetic method for monitoring CO<sub>2</sub> storage in coals, *Global Climate and Energy Project Research Symposium*.
17. **Evan Um** and David Alumbaugh, 2005, On the physics of the marine-time-domain controlled source electromagnetic method for detecting hydrocarbon reservoir, *75<sup>th</sup> SEG meeting*, Houston, Expanded Abstracts.
18. **Evan Um** and David Alumbaugh, 2004, On the physics of seabed logging (SBL) over 3-D hydrocarbon reservoirs, *74<sup>th</sup> SEG meeting*, Denver, Expanded Abstracts.