



## Chen GU

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### Employment

#### Tsinghua University

- Associate Professor
- Assistant Professor

Beijing, China

June 2024 – present

October 2021 – May 2024

#### Massachusetts Institute of Technology

- Postdoctoral Associate

Cambridge, MA

October 2016 – May 2021

### Education

#### Massachusetts Institute of Technology

- **Ph.D. in Geophysics**, Department of Earth, Atmospheric and Planetary Sciences  
**Thesis title:** Source mechanisms and ground motions of earthquakes in multiscales: microseismicity to macroseismicity  
**Co-advisors:** Professors M. Nafi Toksöz and J. Brian Evans

Cambridge, MA

September 2016

#### Nanjing University

- **B.S.**, School of Earth Sciences and Engineering

Nanjing, China

June 2010

### Research interests

- AI applications to geoscience problems
- Uncertainty quantifications of inverse problems
- Source mechanism, stress triggering, and hazard analysis of earthquakes
- Dynamics of fractures, bridging microseismicity and geomechanics

### Grants

- Co-Principal Investigator, E0810-52238011, “Research on earthquake disaster chain effects and disaster resilience of dense urban building clusters”, 01/2023-12/2027
- Principal Investigator, D0404-4227040186, “Earthquake rupture quantification based on Bayesian multi-model inference”, 01/2023-12/2026
- Co-Principal Investigator, 2022YFC3003602, “Hazard scenario construction for super cities due to significant earthquakes”, 11/2022-10/2025
- Principal Investigator, XSEDE-EAR190010, “Deep learning applied to induced seismicity location in the Groningen gas field in the Netherlands – What do we need for safe AI?”, 02/18/2019-02/17/2021, awarded resources 5,000.0 GPU hours and 50,000.0 SUs (estimated value \$4,479.50).



## Publications

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16. S. Brown, W.L. Rodi, **C. Gu**, M. Fehler, J. Faulds, C.M. Smith, & S. Treitel, 2023, Bayesian Neural Networks for Geothermal Resource Assessment: Prediction with Uncertainty. arXiv preprint arXiv:2209.15543. (Submitted to Geophysics; Under revision)
15. A. Scarinci, U.B. Waheed, **C. Gu**, R. Xiang, B.M. Dia, S. Kaka, M. Fehler, Y. Marzouk, 2023, “Robust Bayesian Moment Tensor Inversion with Optimal Transport Misfits: Layered Medium Approximations to the 3D SEG-EAGE Overthrust Velocity Model”, *Geophysical Journal International*, ggad116, doi: 10.1093/gji/ggad116
14. D. Anikiev, C. Birnie, U.B. Waheed, T. Alkhalifah, **C. Gu**, D.J. Verschuur D.J., L. Eisner, 2023, “Machine Learning in Microseismic Monitoring”, *Earth-Science Reviews*, 104371
13. C.M. Smith, J.E. Faulds, S. Brown, M. Coolbaugh, J. DeAngelo, J.M. Glen, E. Burns, D. Siler, S. Treitel, E. Mlawsky, M. Fehler, **C. Gu**, B.F. Ayling, 2023, “Exploratory Analysis of Machine Learning Techniques in the Nevada Geothermal Play Fairway Analysis”, *Geothermics*, 111, p.102693
12. **Gu, Chen**, U. Mok, Y.M. Marzouk, G.A. Prieto, F. Sheibani, J.B. Evans, B.H. Hager, 2020, “Bayesian waveform-based calibration of high-pressure acoustic emission system with ball drop measurements”, *Geophysical Journal International*, 221(1), 20-36, doi: 10.1093/gji/ggz568 (available at <https://arxiv.org/abs/1906.10098>)
11. Meng, Chunfang, **C. Gu**, B.H. Hager, 2020, “An Eshelby solution based finite element approach to heterogeneous fault zone modeling”, *Seismological Research Letters*, 91(1), 465-474, doi: 10.1785/0220190083
10. Ding, Min, J. Lin, **C. Gu**, Q.H. Huang, M. Zuber, 2019, “Variations in Martian lithospheric strength based on gravity/topography analysis”, *Journal of Geophysical Research: Planets*, 124 (11), 3095-3118, doi: 10.1029/2019JE005937
9. Herring, Thomas, **C. Gu**, M.N. Toköz, O. Büyüköztürk, J. Parol, A. Enezi, F. Al-Jeri, J. Al-Qazweeni, H. Kamal, 2019, “GPS measured response of a tall building due to a distant Mw 7.3 earthquake”, *Seismological Research Letters*, 90(1), 149 – 159, doi: 10.1785/0220180147
8. **Gu, Chen**, G.A. Prieto, A. Al-Enezi, F. Al-Jeri, J. Al-Qazweeni, H. Kamal, S. Kuleli, A. Mordret, O. Büyüköztürk, M.N. Toksöz, 2018, “Ground motion in Kuwait from regional and local earthquakes: Potential effects on tall buildings”, *Pure and Applied Geophysics*, 175(12), 4183 – 4195, doi: 10.1007/s00024-018-1943-5
7. **Gu, Chen**, Y.M. Marzouk, M.N. Toksöz, 2018, “Waveform-based Bayesian full moment tensor inversion and uncertainty determination for the induced seismicity in an oil/gas field”, *Geophysical Journal International*, 212, 1963 – 1985, doi: 10.1093/gji/ggx517
6. **Gu, Chen**, F. Al-Jeri, A. Al-Enezi, O. Büyüköztürk, M.N. Toksöz, 2017, “Source mechanism study of local earthquakes in Kuwait”, *Seismological Research Letters*, 88(6), 1465 – 1471, doi: 10.1785/0220170031



5. Jiang, Mo, **C. Gu**, R.D. Braatz, 2017, “Analysis of focused indirect ultrasound via high-speed spatially localized pressure sensing and its consequences on nucleation”, *Chemical Engineering and Processing: Process Intensification*, 117, 186 – 194, doi: 10.1016/j.cep.2017.04.008
4. Poli, Piero, G.A. Prieto, C. Yu, M. Florez, H. Agurto-Detzel, T.D. Mikesell, **C. Gu**, V. Dionicio, P. Pedraza, 2016, “Complex rupture of the M 6.3 2015 March 10 Bucaramanga earthquake: evidence of strong weakening process”, *Geophysical Journal International*, 205, 988 – 994, doi: 10.1093/gji/ggw065
3. Jiang, Mo, **C. Gu**, R.D. Braatz, 2015, “Understanding temperature-induced primary nucleation in dual impinging jet mixers”, *Chemical Engineering and Processing: Process Intensification*, 97, 187 – 194, doi: 10.1016/j.cep.2015.06.013
2. Ye, Yu, **C. Gu**, S.H. Shim, Y. Meng, V. Prakapenka, 2014, “The postspinel boundary in pyrolytic compositions determined in the laser-heated diamond anvil cell”, *Geophysical Research Letters*, 41, 3833 - 3841, doi: 10.1002/2014GL060060
1. **Gu, Chen**, K. Catalli, B. Grocholski, L. Gao, E. Alp, P. Chow, Y. Xiao, H. Cynn, W.J. Evans, S.H. Shim, 2012, “Electronic structure of iron in magnesium silicate glasses at high pressure”, *Geophysical Research Letters*, 39 (24), L24304, doi: 10.1029/2012GL053950

### **Reviewed Expanded Abstracts**

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7. **Gu, Chen**, Y.M. Marzouk, M.N. Toksöz. 2019, “Bayesian deep learning and uncertainty quantification applied to induced seismicity locations at the Groningen gas field in the Netherlands – What do we need for safe AI?”, *SEG Technical Program Expanded Abstracts*, 2548-2553, doi:10.1190/segam2019-3216455.1
6. **Gu, Chen**, O. Büyüköztürk, M.N. Toksöz. 2018, “Deep learning applied to induced-seismicity location in the Groningen gas field in the Netherlands”, *SEG Technical Program Expanded Abstracts*, 3067-3071, doi: 10.1190/segam2018-2998357.1
5. **Gu, Chen**, S. Mighani, G.A. Prieto, D. Harwath, B.J. Evans, and M.N. Toksöz, 2017, “Hearing what fractures say – A combination of seismic and speech recognition methods”, *SEG Technical Program Expanded Abstracts*, 3846-3851, doi: 10.1190/segam2017-17791885.1
4. **Gu, Chen**, Y.M. Marzouk, M.N. Toksöz, 2017, “Bayesian moment tensor inversion and uncertainty quantification for induced seismicity – uncertainties from both the location and velocity model”, *SEG Technical Program Expanded Abstracts*, 2784-2790, doi: 10.1190/segam2017-17777808.1
3. **Gu, Chen**, Y.M. Marzouk, M.N. Toksöz, 2016, “Waveform-based Bayesian full moment tensor inversion and uncertainty quantification of the induced seismicity using a surface network in an oil/gas field in Oman”, *SEG Technical Program Expanded Abstracts*, 5048-5054, doi: 10.1190/segam2016-13850323.1
2. **Gu, Chen**, M.N. Toksöz, 2015, “Moment tensor inversion of induced seismicity under different station configurations in oil/gas fields”, *SEG Technical Program Expanded Abstracts*, 4861-4865. doi: 10.1190/segam2015-5867512.1



1. Zhu, Zhenya, X. Liu, C. Gu, M.N. Toksöz, 2013, “Experimental studies of the acoustic wave field near a borehole”, *SEG Technical Program Expanded Abstracts*, 514-518. doi: 10.1190/segam2013-0682.16.

### **Invited seminars**

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12. Colloquium, Department of Earth and Atmospheric Sciences, Indiana University (01/2020)
11. Machine Learning Geophysics, School of Geosciences, University of Aberdeen (12/2019)
10. Seismolab Seminar, Department of Earth Sciences, University College London (06/2019)
9. Seismology Seminar, Department of Earth Sciences, Oxford University (05/2019)
8. Petroleum Geoscience & Engineering Seminar, Department of Earth Science and Engineering, Imperial College London (05/2019)
7. Geodynamics Seminar, Lamont-Doherty Earth Observatory, Columbia University (02/2019)
6. Geophysics Seminar, Institute of Theoretical and Applied Geophysics, School of Earth and Space Sciences, Peking University (01/2019)
5. SUSTech Global Scientist Forum, Department of Earth and Space Sciences, Southern University of Science and Technology (01/2019)
4. Tectonics & Seismology Seminar, Department of Earth, Planetary, and Space Sciences, University of California, Los Angeles (10/2018)
3. Berkeley Seismological Laboratory, Department of Earth and Planetary Science, University of California, Berkeley (10/2018)
2. Solid Earth Physics Seminar, Department of Earth and Planetary Sciences and School of Engineering and Applied Sciences, Harvard University (11/2017)
1. Solid Earth Brown Bag Seminar, Department of Geosciences, Princeton University (09/2017)

### **Research at MIT**

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2019 – 2021

- Developing new statistical approaches to inverse problems in seismology and in coupled flow-geomechanical modeling focused on characterization of subsurface reservoirs containing petroleum, geothermal fluids, and injected CO<sub>2</sub>  
Advisors: Professor Youssef M. Marzouk and Dr. Michael Fehler

2013 – 2019

- Hydrofracture Mechanism Study – Bridging microseismicity and geomechanics
- Ground motion modeling and structural monitoring of tall buildings for performance-based engineering
- Bayesian uncertainty quantifications of source mechanism inversions of induced seismicity  
Advisors: Professors M. Nafi Toksöz, J. Brian Evans, Germán A. Prieto, and Youssef M. Marzouk



2012 – 2013

- Studies of acoustic full wave propagation in scaled borehole model  
Advisors: Dr. Zhenya Zhu and Professor M. Nafi Toksöz

2010 – 2012

- Spin and Valence State of Iron in Magnesium Silicate Glasses at high pressures
- Seismic Imaging of Upper Mantle Transition Zone beneath NW Pacific and Easter  
Advisors: Professors Sang-Heon Dan Shim and Prof. Robert van der Hilst

### Internship

06/2014-08/2014

ConocoPhillips

- Source characterization of acoustic emissions due to hydraulic fracturing in large block shale samples
- Single-well microseismic monitoring of field hydraulic fracturing

### Teaching experience

Inverse Problem Theory and Applications	Fall 2022
Mathematical Modeling and Data Analysis at Tsinghua University	Summer 2022
Engineering and Computer Graphics at Tsinghua University	Summer 2022
Invited lectures in “Introduction to Seismology” at MIT	Spring 2017
Mentor at the NHERI SimCenter Programming Bootcamp	12/2020 and 01/2021
Invited lectures in “Common Tools for Data Science” at Macau University of Science and Technology	03/2021

### Awards and Honors

Nafi Toksöz Fellowship	09/2014-05/2015
Aramco Fellowship	06/2013-08/2013
MIT Shrock Fellowship	09/2010-05/2011
COPRESS Annual Meeting Graduate Student Travel Fellowship	2011
People’s Scholarship of Nanjing University	2008
National Scholarship Award of the People’s Republic of China	2007

### Selected Conference Abstracts

#### **Oral presentations**

- Meng, Chunfang, **C. Gu**, B.H. Hager, 2019, Towards multi-scale fault/fracture system modeling. Numerical Modeling of Earthquake Motions Workshop, Smolenice Castle near Bratislava, Slovakia
- Gu, Chen**, Y.M. Marzouk, M.N. Toksöz, 2019, Deep learning applied to induced seismicity location in the Groningen gas field in the Netherlands – What do we need for safe AI? 2nd Machine Learning in Solid Earth Geoscience conference, Santa Fe, NM, USA



16. **Gu, Chen**, M.N. Toksöz, F. Al-Jeri, A. Al-Enezi, O. Büyüköztürk, 2019, Ground motion in Kuwait from regional and local earthquakes and impacts on infrastructures. Gulf Conference on Sustainable Built Environment, Kuwait City, Kuwait
15. **Gu, Chen**, M.N. Toksöz, Y.M. Marzouk, S. Mighani, J.B. Evans, 2018, Deep learning applied to induced seismicity – Earthquake detection, location and forecasting. Annual Founding Members Meeting, MIT Earth Resources Laboratory, Cambridge, MA, USA
14. **Gu, Chen**, G.A. Prieto, A. Al-Enezi, F. Al-Jeri, J. Al-Qazweeni, H. Kamal, S. Kuleli, A. Mordret, O. Büyüköztürk, M.N. Toksöz, 2018, Ground motion in Kuwait from regional and local earthquakes: potential effects on tall buildings. Annual Meeting, Seismological Society of America, Miami, FL, USA
13. Herring, Thomas, **Gu, Chen**, M.N. Toksöz, J. Parol, A. Al-Enezi, F. Al-Jeri, J. Al-Qazweeni, H. Kamal, O. Büyüköztürk, 2018, GPS measurements of large oscillations of a tall building due to a magnitude 7.3 Earthquake. Annual Meeting, Seismological Society of America, Miami, FL, USA
12. **Gu, Chen**, S. Mighani, G.A. Prieto, U. Mok, J.B. Evans, B. Hager, M.N. Toksöz, 2017, An observation of repeating events at local asperities during a laboratory stick-slip experiment of a saw-cut cylindrical lucite sample. Annual Meeting, AGU, New Orleans, LA, USA
11. **Gu, Chen**, S. Mighani, G.A. Prieto, D. Harwath, B.J. Evans, M.N. Toksöz, 2017, Hearing what fractures say – a combination of seismic and speech recognition methods. Annual Meeting, Society of Exploration Geophysicists, Houston, TX, USA
10. **Gu, Chen**, Y.M. Marzouk, M.N. Toksöz, 2017, Bayesian moment tensor inversion and uncertainty quantification for induced seismicity – uncertainties from both the location and velocity model. Annual Meeting, Society of Exploration Geophysicists, Houston, TX, USA
9. **Gu, Chen**, F. Al-Jeri, A. Al-Enezi, G.A. Prieto, Y.M. Marzouk, U. Mok, J.B. Evans, M.N. Toksöz, 2017, Source mechanism inversion for micro- and pico-seismicities in field and laboratory scales. ERC-REALISM (Reproducing Earthquakes in the Laboratory: Imaging, Speed and Mineralogy) kick-off meeting, ENS, Paris, France
8. **Gu, Chen**, Y.M. Marzouk, M.N. Toksöz, 2016, Waveform-based Bayesian full moment tensor inversion and uncertainty determination for the induced seismicity in an oil/gas field. Annual Meeting, Society of Exploration Geophysicists, Dallas, TX, USA
7. **Gu, Chen**, M. Ding, F. Al-Jeri, G. A. Prieto, S. Kuleli, A. Mordret, A. Al-Enezi, O. Büyüköztürk, M.N. Toksöz, 2015, Source mechanism, stress triggering, and hazard analysis of induced seismicity in oil/gas fields in Oman and Kuwait. Annual Meeting, AGU, San Francisco, CA, USA
6. **Gu, Chen**, M.N. Toksöz, 2015, Moment tensor inversion of induced seismicity under different station configurations in oil/gas fields. Annual Meeting, Society of Exploration Geophysicists, New Orleans, LA, USA
5. **Gu, Chen**, M.N. Toksöz, 2015, Uncertainty quantification of full moment tensor inversion analysis for induced seismicity in oil/gas fields. Annual Founding Members Meeting, MIT Earth Resources Laboratory, Cambridge, MA, USA



4. **Gu, Chen**, M.N. Toksöz, F. Al-Jeri, A. Al-Enezi, 2015, Full-waveform moment tensor inversion and source mechanism of induced earthquakes in oil/gas fields. 9th Gulf Seismic Forum, Kuwait.
3. **Gu, Chen**, M.N. Toksöz, G.A. Prieto, A. Mordret, A. Al-Enezi, F. Al-Jeri, 2015, Surface waves from regional earthquakes: primary seismic hazard to tall buildings in Kuwait. 9th Gulf Seismic Forum, Kuwait
2. Ye, Yu, **C. Gu**, S.H. Shim, V. Prakapenka, Y. Meng, 2014, In situ measurements of the post-spinel and post-garnet phase boundaries in Pyrolyte at 17-32 GPa and 1500-2400 K. Annual Meeting, AGU, San Francisco, CA, USA
1. **Gu, Chen**, M.N. Toksöz, 2014, Constrained and unconstrained waveform-based full moment tensor inversion. Annual Founding Members Meeting, MIT Earth Resources Laboratory, Cambridge, MA, USA

### Poster presentations

12. **Gu, Chen**, Y.M. Marzouk, M.N. Toksöz, 2019, Bayesian deep learning and uncertainty quantification applied to induced seismicity locations at the Groningen gas field in the Netherlands – What do we need for safe AI? Annual Meeting, Society of Exploration Geophysicists, San Antonio, TX, USA
11. **Gu, Chen**, Y.M. Marzouk, M.N. Toksöz, 2019, “Earthquake” Tracking in the Laboratory using Reinforcement Learning, Launch celebration for the MIT Stephen A. Schwarzman College of Computing, Cambridge, MA, USA
10. **Gu, Chen**, S. Mighani, G.A. Prieto, U. Mok, J.B. Evans, 2018, Slip behaviors on an artificial fault surface with engraved topography in laboratory stick-slip experiments: Insights on the roles of fault roughness in spatial and temporal seismic distribution. Annual Meeting, AGU, Washington, D.C., USA
9. **Gu, Chen**, O. Büyüköztürk, M.N. Toksöz, 2018, Deep learning applied to induced-seismicity location in the Groningen gas field in the Netherlands. Annual Meeting, Society of Exploration Geophysicists, Anaheim, CA, USA
8. **Gu, Chen**, O. Büyüköztürk, M.N. Toksöz, 2018, Deep learning applied to induced seismicity in a large gas field – Earthquake detection, location and forecasting. MIT Intelligence Quest (IQ) Launch Poster Session, Cambridge, MA, USA
7. **Gu, Chen**, G.A. Prieto, U. Mok, Y.M. Marzouk, J.B. Evans, M.N. Toksöz, 2017, Bayesian source mechanism inversion of induced seismicity in oil/gas fields and pico-seismicity (acoustic emission) in the laboratory. Annual Meeting, SCEC, Palm Spring, CA, USA
6. **Gu, Chen**, G.A. Prieto, S. Kuleli, A. Mordret, F. Al-Jeri, A. Al-Enezi, O. Büyüköztürk, M.N. Toksöz, 2016, Source mechanism inversion and ground motion modeling of induced earthquakes in Kuwait — A Bayesian approach. Annual Meeting, AGU, San Francisco, CA, USA
5. **Gu, Chen**, M.N. Toksöz, 2014, Constrained and unconstrained waveform based full moment tensor inversion under different station configurations. SEG/SPE/ARMA Injection Induced Seismicity Workshop, Calgary, AB, Canada



4. **Gu, Chen, J. Li, M.N. Toksöz**, 2013, Location and full moment tensor determination of induced seismicity in an oil/gas field. Annual Meeting, AGU, San Francisco, CA, USA
3. **Gu, Chen, J. Li, M.N. Toksöz**, 2013, Location and full moment tensor determination of induced seismicity in an oil/gas field. Applied Geoscience Conference, Houston, TX, USA
2. **Gu, Chen, K. Catalli, B. Grocholski, L. Gao, E. Alp, P. Chow, Y. Xiao, W.J. Evans, S.H. Shim**, 2011, Electronic structure of iron in magnesium silicate glasses up to 93 GPa. Annual Meeting, AGU, San Francisco, CA, USA
1. **Gu, Chen, K. Catalli, B. Grocholski, S.H. Shim, L. Gao, E. Alp**, 2011, Spin state of iron in aluminous magnesium silicate glass up to 93 GPa. Annual Meeting, COMPRESS, Richmond, VA, USA

### Department service

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2016-2017

Organizer                      Friday Informal Seminar Hour (FISH) at Earth Resource Laboratory (ERL) at MIT

2018-current

Organizer                      Friday Informal Seminar Hour (FISH) at Earth Resource Laboratory (ERL) at MIT

### Professional associations

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American Geophysical Union	2011-present
Society of Exploration Geophysicists	2013-present
Seismological Society of America	2017-present

### Leadership at MIT

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MIT Chinese Students and Scholars Association

- Founder and Director, Division of Sciences and Technology, 08/2013-06/2015
- Director, Division of Sports, 06/2012-08/2013
- Captain, Tennis Team, 09/2011- 06/2013