Mohamed Abdelmeguid

California Institute of Technology, Graduate Aerospace Laboratories
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Current Appointment

California Institute of Technology 12/2022 - Present
Postdoctoral Scholar, Graduate Aerospace Laboratories
Supervisor: Ares J. Rosakis

Education

University of Illinois at Urbana-Champaign 01/2018 - 12/2022
Ph.D. Civil and Environmental Engineering
Advisor: Prof. Ahmed Elbanna
Committee: Prof. Philippe H. Geubelle, Prof. Ares Rosakis, and Prof. Jinhui Yan
Thesis Title: "Physics-based Modeling of Earthquake Cycles and Tsunamis in Strike-slip Fault Zones"

University of Illinois at Urbana-Champaign 08/2016 - 12/2017
M.Sc. Civil and Environmental Engineering
Advisor: Prof. Ahmed Elbanna
Thesis Title: "Ruga Mechanics of Composite Media with Soft Inclusions"

The British University in Egypt 09/2008 - 06/2013
B.Sc. Mechanical Engineering

Between 10/2013 - 12/2014 I served in mandatory military service in Egypt.

Research Interests

Multi-scale Modeling and Simulation; Laboratory Earthquakes; Wave Propagation in Solids; Structural Analysis.

Awards and Honors

Academic Achievement Scholarship, The British University in Egypt 2008 - 2013
Conference Travel Award, University of Illinois at Urbana–Champaign 2018 & 2019

Journal Publications

Google Scholar: Mohamed Abdelmeguid - GS ResearchGate: Mohamed Abdelmeguid - RG

J.11 **M. Abdelmeguid**, A. Elbanna, A. Rosakis (2024). "Ground Motion Characteristics of Subshear and Supershear Ruptures in the Presence of Sediment Layers". *Geophysical Journal International*, Volume 240, Issue 2, February 2025, Pages 967–987, https://doi.org/10.1093/gji/ggae422

J.10 **M. Abdelmeguid**, M. S. Mia, A. Elbanna (2024). "On the interplay between distributed bulk plasticity and local fault slip in evolving fault zone complexity". *Geophysical Research Letters*, 51(14), e2023GL108060.

J.9 M. S. Mia, **M. Abdelmeguid**, M., R. A. Harris, A. E. Elbanna (2024). "Rupture Jumping and Seismic Complexity in Models of Earthquake Cycles for Fault Stepovers with Off-Fault Plasticity". *Bulletin of the Seismological Society of America*, 114(3), 1466-1480.

J.8 **M. Abdelmeguid**, C. Zhao, E. Yalcinkaya, G. Gazetas, A. Elbanna, A. Rosakis (2023). "Dynamics of episodic supershear in the 2023 M7.8 Kahramanmaraş/Pazarcik earthquake, revealed by near-field records and computational modeling", *Commun Earth Environ* 4, 456. https://doi.org/10.1038/s43247-023-01131-7

J.7 Md Shumon Mia, **M. Abdelmeguid**, A. Elbanna (2023). "The Spectrum of Fault Slip in Elastoplastic Fault Zones", *Earth and Planetary Sciences*, 619. https://doi.org/10.1016/j.epsl.2023.118310

J.6 Brittany Angela Erickson, Junle Jiang, Valere Lambert, **Mohamed Abdelmeguid** et al. (2023). "Incorporating Full Elastodynamic Effects and Dipping Fault Geometries in Community Code Verification Exercises for Simulations of Earthquake Sequences and Aseismic Slip (SEAS)", *Bulletin of the Seismological Society of America*. doi: https://doi.org/10.1785/0120220066

J.5 **M. Abdelmeguid**, A. Elbanna (2023). "Modeling Sequences of Earthquakes and Aseismic Slip (SEAS) in Elasto-Plastic Fault Zones With a Hybrid Finite Element Spectral Boundary Integral Scheme", *Journal of Geophysical Research: Solid Earth*, 127, e2022JB024548. https://doi.org/10.1029/2022JB024548

J.4 M. S. Mia, **M. Abdelmeguid**, A. Elbanna (2022). "Spatio-Temporal Clustering of Seismicity Enabled by Off-Fault Plasticity", *Geophysical Research Letters*, 49, e2021GL097601. doi: 10.1029/2021GL097601

J.3 **M. Abdelmeguid**, A. Elbanna (2021). "Sequences of seismic and aseismic slip on bimaterial faults show dominant rupture asymmetry and potential for elevated seismic hazard", *Journal of Earth and Planetary Sciences*.

J.2 A. Elbanna, **M. Abdelmeguid**, X. Ma, F. Amlani, H. S. Bhat, C. Synolakis, A. J. Rosakis (2021). "Anatomy of Strike Slip Fault Tsunami-genesis", *Proceedings of the National Academy of Sciences*, May 2021, 118 (19) e2025632118. doi: 10.1073/pnas.2025632118

J.1 **M. Abdelmeguid**, X. Ma, A. Elbanna (2019). "A Novel Hybrid Finite Element-Spectral Boundary Integral Scheme for Modeling Earthquake Cycles: Application to Rate and State Faults with Low-Velocity Zones", *Journal of Geophysical Research: Solid Earth*, 124, 12854– 12881. doi: 10.1029/2019JB018036

Manuscripts Under Review

R.2 S. E. Godínez, **M. Abdelmeguid**, J. I. Restrepo, A. Rosakis. "Do Earthquake-Induced Rotational Ground Motions Matter on Building Safety? A Case Study From the Pazarcik Mw7.8 Mega-Earthquake", 2024, *submitted to Bulletin of the Seismological Society of America.*

R.1 A. Rosakis, **M. Abdelmeguid**, A. Elbanna. "Evidence of Early Supershear Transition in the Feb 6th 2023 Mw 7.8 Kahramanmaras Turkey Earthquake From Near-Field Records", 2023, *submitted to Nature Geoscience.* Preprint: https://doi.org/10.31223/X5W95G

Manuscripts In Preparation

M.5 N. Tainpakdipat, C. Zhao, **M. Abdelmeguid**, A. Elbanna (2025). "Modeling Dynamic Rupture Propagation of Faults Using Fourier Neural Operators".

M.4 **M. Abdelmeguid**, G. Lavrentiadis, A. Rosakis, D. Asimaki (2025). "Near-field ground motion variability associated with the rupture speed: A numerical study".

M.3 **M. Abdelmeguid**, Nadia Lapusta. "Dilatancy Effects can Stabilize Seismicity on Rough Faults".

M.2 **M. Abdelmeguid**, Attilio Lattanzi, Ares Rosakis. "Experimental Investigation on the Role of Fault Branches on Frictional Sliding".

M.1 Md Shumon Mia, **M. Abdelmeguid**, A. Elbanna. "Coevolution of Fault Zones and Earthquakes in a Multi-Cycle Simulation of Fault Networks".

Proceedings, Presentation and Posters

Conference Proceedings

Mohamed E. Abdel-Meguid used in earlier publications

C.2 Ahmed E. El-Etriby, **Mohamed E. Abdel-Meguid**, Tarek M. Hatem, Yehia A. Bahei-El-Din. "A multiscale-based approach for composite materials with embedded PZT filaments for energy harvesting". Proc. SPIE 9058, Behavior and Mechanics of Multifunctional Materials and Composites 2014, 90581K (20 March 2014); doi: 10.1117/12.2051830

C.1 Khalid M. Shalan, **Mohamed E. Abdel-Meguid**, Tarek M. Hatem, Yehia A. Bahei-El-Din. "Multiscale Model And Experimental Study Of Damage In Piezoelectric Fiber-Based Composite". EWSHM - 7th European Workshop on Structural Health Monitoring, IFFSTTAR, Inria, Universite de Nantes, Jul 2014, Nantes, France. hal-01022979

Presentations

P.5 **M. Abdelmeguid**, Mia, M., & Elbanna, A. E. (2022, 09). "Modeling co-evolution of slip and fault zones in a Sequence of Earthquakes and Aseismic Slip (SEAS) model with off-fault plasticity". Oral Presentation at 2022 SCEC Annual Meeting. SCEC Contribution 12495.

P.4 A. Elbanna, **M. Abdelmeguid**, X. Ma, F. Amlani, H. S. Bhat, C. Synolakis, A. J. Rosakis (2021). "Anatomy of Strike Slip Fault Tsunami-genesis". Oral Presentation at Seismological Society of America Annual Meeting.

P.3 **M. Abdelmeguid**, A. Elbanna (2021). "An Efficient Numerical Algorithm for Modeling of Seismic Cycles: Effect of Low Velocity Zones". Oral Presentation at 16th U.S. National Congress on Computational Mechanics.

P.2 **M. Abdelmeguid**, X. Ma, A. Elbanna (2019). "A Novel Hybrid Numerical Finite Element-Spectral Boundary Integral Scheme For Modeling Earthquake Cycles". Engineering Mechanics Institute Conference.

P.1 **M. Abdelmeguid**, X. Ma, A. Elbanna (2018). "Ruga Mechanics of Composite Media with Soft Inclusions". 18th U.S. National Congress for Theoretical and Applied Mechanics (USCTAM) Conference.

Posters

T.9 **M. Abdelmeguid**, Elbanna, A., Mia, M., & Zhao, C. (2024, 09). "On the Interplay Between Distributed Bulk Plasticity and Local Fault Slip in Evolving Fault Zone Complexity". Poster Presentation at 2024 SCEC Annual Meeting.

T.8 **M. Abdelmeguid**, A. Elbanna, A. Rosakis (2024, 09). "Ground Motion Characteristics of Subshear and Supershear Ruptures in the Presence of Sediment Layers". Poster Presentation at 2024 SCEC Annual Meeting.

T.7 **M. Abdelmeguid**, Zhao, C., Yalcinkaya, E., Gazetas, G., Elbanna, A. E., & Rosakis, A. J. (2023, 09). "Revealing the Dynamics and Episodic Supershear in the Feb 6th 2023 M7.8 Kahramanmaraş/Pazarcik Earthquake: Near-field Records and Dynamic Rupture Modeling". Poster Presentation at 2023 American Geophysical Union Meeting.

T.6 **M. Abdelmeguid**, Zhao, C., Yalcinkaya, E., Gazetas, G., Elbanna, A. E., & Rosakis, A. J. (2023, 09). "Revealing the Dynamics and Episodic Supershear in the Feb 6th 2023 M7.8 Kahramanmaraş/Pazarcik Earthquake: Near-field Records and Dynamic Rupture Modeling". Poster Presentation at 2023 SCEC Annual Meeting. SCEC Contribution 13273.

T.5 **M. Abdelmeguid**, Mia, M., & Elbanna, A. E. (2022, 09). "Modeling Sequence of Earthquakes and Aseismic Slip on Fault Step-Overs with Off-Fault Plasticity". Poster Presentation at 2022 SCEC Annual Meeting. SCEC Contribution 12458.

T.4 **M. Abdelmeguid** & Elbanna, A. E. (2021, 08). "Advanced Earthquake Cycle Simulations: Bimaterial Interfaces, LVFZ, and Nonlinear Bulk Rheology". Poster Presentation at 2021 SCEC Annual Meeting. SCEC Contribution 11514.

T.3 A. Elbanna, **M. Abdelmeguid**, X. Ma, F. Amlani, H. S. Bhat, C. Synolakis, A. J. Rosakis (2021). "Anatomy of Strike Slip Fault Tsunami-genesis". American Geophysical Union Meeting.

T.2 **M. Abdelmeguid**, X. Ma, A. Elbanna (2019). "Modeling Sequence of Earthquakes and Aseismic Slip (SEAS) in Complex Faults Zones Using a Computationally Efficient Numerical Algorithm". American Geophysical Union Fall Meeting.

T.1 **M. Abdelmeguid**, X. Ma, A. Elbanna (2019). "A Novel Hybrid Numerical Finite Element-Spectral Boundary Integral Scheme For Modeling Earthquake Cycles". Society of Engineering Science Conference.

Invited Talks

I.2 Modeling of Earthquake Cycles with High Resolution Fault Zone Physics, 09/2022, Engineering and Applied Science Forum (EASF) Young Webinar 2022. Watch on Youtube.

I.1 Modeling of Earthquake Cycles with Off-fault Plasticity, 09/2022, SCEC Annual Meeting Plenary Session on Faults Loading and Response.

Media Coverage

- Contrary-to-previous-belief-strike-slip-faults-can-generate-large-tsunamis. Caltech News 2021.
- Previously unrecognized tsunami hazard identified in coastal cities. Illinois News Bureau 2021.
- Al Jazeera News 2021 صدوع القشرة الأرضية يمكن أن تتسبب في حدوث موجات تسونامي

Teaching

American University in Sharjah, Sharjah, UAE
Department of Mechanical Engineering

- Teaching Assistant, Spring 2016
  - MCE223 Mechanics of Materials
  - MCE226L Computer Applications in Mechanical Engineering I

The British University in Egypt, Cairo, Egypt
Department of Mechanical Engineering

- Teaching Assistant, Fall 2014 - Spring 2015
  - MECH28H Heat Transfer Equipment
  - MECH02P Engineering Drawing and Descriptive
  - MECH03C Manufacturing Engineering (1)
  - MECH02P Engineering Drawing and Descriptive Geometry
  - EAXS264 Structural and Stress Analysis

Mentoring

Co-Mentor for Undergraduate Students with Prof. Ares Rosakis, Caltech

Kyrillos Bastawros, Caltech undergraduate 2023
Setting up experimental laboratory earthquakes.

Co-Mentor for Graduate Students with Prof. Ahmed Elbanna, UIUC

Pavan Ravi, UIUC PhD student 2024 - present
Parallel implementation of earthquake cycle simulation models.

Napat Tainpakdipat, UIUC PhD student 2023 - present
Implementation of scientific machine learning toward accelerating dynamic rupture modeling.

Chunhui Zhao, UIUC PhD student 2022 - present
Implementation of dynamic rupture modeling capability within MOOSE framework.

Md Shumon Mia, UIUC PhD student 2021 - 2022
Incorporating high resolution fault zone physics to study earthquake sequences.

Service

Reviewer,

- Geophysical Research Letters
- Nature Communications
- Communications Earth and Environment
- Scientific Reports
- Earth and Planetary Sciences
- Tectonophysics
- National Science Foundation
- Seismica

Proposal Preparation

M. Abdelmeguid helped write proposal, write progress reports, and executed the work

G.6 Unraveling rupture propagation history from near-fault ground motion signatures: A mechanics-informed approach utilizing 3-D rupture models with fault zone complexity
Period: 02/2024 - 01/2025
PI: Ares J. Rosakis, Co-PI: Mohamed Abdelmeguid
SCEC: $ 25,000

G.5 Physics-based Modeling of Near-Source Tsunami Hazard for Coastal Communities
Period: 02/2023 - 02/2024
PI: Ares J. Rosakis, Co-PI: Mohamed Abdelmeguid
AWS AI4S award for Computing Resources: $ 30,000

G.4 When fault ruptures form Mach cones: Fundamental research on the catastrophic consequences of the 2023 Türkyie Earthquake on the built environment
Period: 06/2024 - 06/2025
PI: Domniki Asimaki, Co-PI: Ares Rosakis
Gary Clinard Innovation Fund: $ 100,000

G.3 Investigating Properties of Small and Large Earthquakes on Geometrically Heterogeneous Faults
Period: 02/2021 - 02/2022
PI: Camilla Cattania, Co-PI: Ahmed Elbanna
Southern California Earthquake Center: $ 48,000

G.2 Modeling sequence of earthquakes and aseismic slip with off-fault damage
Period: 02/2020 - 02/2021
PI: Ahmed Elbanna
Southern California Earthquake Center: $ 25,000

G.1 Multiscale Mechanics of Fluid Infiltrated Fault Zones – An Integrated Research and Education Plan
Period: 02/2018 - 02/2022
PI: Ahmed Elbanna
National Science Foundation: $ 487,991

Pending Proposals

X.3 Combined Experimental and Numerical Study of Slow Slip and Earthquake Rupture Induced by Fluid Injection: Quantifying Healing and Testing Rate-and-State Formulations
PI: Ares Rosakis, Co-PI: Nadia Lapusta
National Science Foundation EAR: $ 500,000 - submitted 2024

X.2 Near-field ground motion variability associated with the rupture speed: A numerical idealization of the 2023 Türkyie Earthquake scenario and its effects on building archetypes
PI: Domniki Asimaki, Co-PI: Ares Rosakis
United States Geological Survey: $ 100,000 - submitted 2024

X.1 Collaborative Research: Cyber-Physical Foundations for Adaptive Learning of Fault Zone Hidden Physics
PI: Ahmed Elbanna, Co-PIs: Ares Rosakis, Yehuda Ben-Zion, George Karniadakis, Feng Liang
National Science Foundation FRES: $ 3,000,000 - submitted 2024

Other Research and Teaching experience

American University in Sharjah 12/2015 - 08/2016
Teaching Assistant
Taught several introductory mechanical engineering courses for undergraduate students.

University of Illinois at Urbana-Champaign 08/2015 - 11/2015
Visiting Researcher
Host: Prof. Ahmed Elbanna. Modeling of programable multifunctional materials using nonlinear finite element methods.

Politecnico di Torino 01/2013 - 03/2013
Undergraduate Visiting Researcher
Host: Prof. Erasmo Carerra. FEM modeling of piezoelectric material for structural health monitoring application using unified plate theory.