IUCRC - Benefits to Industry

How do industrial partners benefit from GMG?

Bringing industry experts together with Caltech engineers and earth scientists will enable technology and science breakthroughs.

Industrial partners will have the following benefits:

- Influencing the research as members of the Industrial Advisory Board
- In-depth access to state-of-the-art research at Caltech in geomechanics and geohazards of high relevance to industry
- Possibility of targeted one-on-one collaborations Facilitating training and future recruitment of Caltech students
- Networking among Center members with similar /complementary goals
- 10% indirect cost, NSF guidance and funding of administrative costs

How to Join

A business can join the GMG Research Center as an Industrial Member. Each Industrial Member is entitled to a representative on the Industrial Advisory Board (IAB) that decides which projects will be funded from the pooled annual dues. Industrial Members have non-exclusive royalty-free access to research conducted by GMG.

For further information about the Center or memberships, please contact Dr. Jean-Philippe Avouac, Director of the Geomechanics and Mitigation of Geohazards Industry/University Cooperative Research Center at avouac@caltech.edu or GMG_Center@caltech.edu

Facilities

California Institute of Technology
Pasadena California

Caltech is a world-renowned science and engineering institute that marshals some of the world's brightest minds and most innovative tools to address fundamental scientific questions and pressing societal challenges. GMG leverages faculty members from the Division of Geology and Planetary Sciences and from the Division of Engineering and Applied Science.

Contact Information

Academic Leadership Team

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NSF Factsheet on GMG
http://www.iucrc.org/center/center-geomechanics-and-mitigation-geohazards

Caltech

NSF

Geomechanics and Mitigation of Geohazards

A NSF Industry-University Cooperative Research Center

Engineering and Applied Science
mce

Center Overview, Mission, and Rationale

The Center for Geomechanics and Mitigation of Geohazards (GMG) aims to advance the understanding of geomaterials failure in the presence of fluids for industry applications and geohazard mitigation. It leverages cutting edge modeling, computing, geophysical, and remote-sensing research to better understand how geomaterials fail when subjected to hydromechanical effects (e.g. fluid pumping in or out of the subsurface or slope instabilities induced by ground shaking or rainfall). Applications include safe and economic operations for carbon dioxide (C02) storage, oil and gas extraction and production, geothermal heat production, monitoring and resilience of infrastructure, and hazard assessment.

Natural hazards such as earthquakes and landslides threaten the safety and economic stability of urban centers, the structural integrity and smooth operation of their interconnected infrastructure systems. These events and the growth and prosperity of fossil-fuel dependent economies depend on:

- Extracting oil and gas and geothermal resources effectively and efficiently
- Diminishing the impact that energy production and consumption has on the climate through CO2 sequestration, utilization, and storage
- Mitigating the risk posed by natural hazards such as earthquakes and landslides to the infrastructure systems that, in part, transmit and distribute energy resources to the public

To carry out its research, GMG gathers industry and government stakeholders, and scientists and engineers with diverse expertise spanning geophysics, geology, remote sensing, computational mechanics, fracture mechanics, and applied mathematics.

GMG

Geomechanics and Mitigation of Geohazards

www.gmg.sites.caltech.edu

Research Focus Areas

- Microseismic monitoring with deep learning
- Application of distributed acoustic sensing to monitor microseismicity and subsurface property changes
- Interaction between fluids and failure of rock faults in shear
- Stable/unstable fault slip induced by fluid flow
- Resiliency of infrastructure systems

Recent Advances

- Advanced imaging/monitoring techniques in seismology (AI, Fiber optics, MEMS sensors)
- Ground deformation measurement (GPS; radar and optical remote sensing from satellite an UAV)
- Numerical modeling, laboratory and in situ experiments on coupling between fracture mechanics, damage, and fluid flow
- Improved methods for earthquake forecasting

Capabilities and Facilities

From field data, experiments, and physical models to hazard assessment and mitigation

1. ***Modeling of geomaterials:*** multiscale rheology, hydro-fracturing, damage, rupture, earthquake sequences, landslides, liquefaction, site effects.
2. ***Unique experiments:*** laboratory earthquakes, fluid injection, hydrofracturing, debris flow plume.
3. ***Advanced algorithms:*** data analysis tools, network design, high-performance computing
4. ***Innovative imaging and data:*** So Cal Seismic Network, Community Seismic Network, GPS and InSAR, structured and dense arrays, geology
5. ***Hazard assessment and mitigation:*** physics-based approaches, early warning, structural health monitoring, distributed networks

GMG Core Faculty

Domniki Asimaki
Professor of Mechanical and Civil Engineering
Ground deformation and failure, geotechnical infrastructure systems, underground structures

Jean-Philippe Avouac
Earle C. Anthony Professor of Geology and Mechanical and Civil Engineering
Seismic imaging, ground motions, physics of earthquakes and landslides, inverse methods.

Robert W. Clayton
Professor of Geophysics
Exploration and crustal geophysics, imaging with dense arrays, inverse methods

Xiaojing (Ruby) Fu
Assistant Profesor of Mechanical and Civil Engineering
Carbon Sequestration

Allen L. Husker
Research Professor of Geophysics

Nadia Lapusta
Lawrence A. Hanson, Jr., Professor of Mechanical Engineering and Geophysics
Earthquake source mechanics, fracture and faulting in geomaterials, interaction with fluids

Ares J. Rosakis
Theodore von Karman Professor of Aeronautics and Mechanical Engineering
Laboratory earthquakes, fracture and faulting in the presence of fluids

Zachary E. Ross
Assistant Professor of Geophysics
Earthquake seismology, machine learning, fault zone imaging, and advanced monitoring techniques

Zhongwen Zhan
Assistant Professor of Geophysics
Seismic imaging of earth structure and earthquake rupture processes