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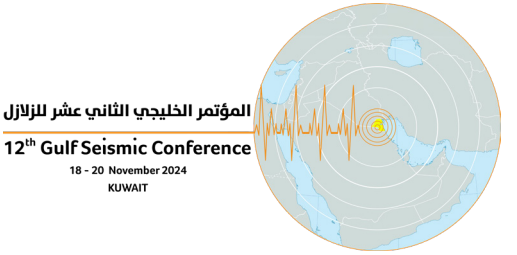
Conference Program



المؤتمر الخليجي الثاني عشر للزلازل

12th Gulf Seismic Conference

18 - 20 November 2024

KUWAIT

K.G.S. Geosciences Society

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Conference Program

Day One: Monday/November, 18th, 2024

Opening Ceremony

Time	Program
10:00 - 12:00	Opening Ceremony

Technical Sessions

Session # 1 (Seismic Networks) Chair: Issa Al-Hussain

Time	Paper code	Presenter	Title
13:40 - 14:00	P1-1	Andrea Chiang	International Cooperation in Seismic Monitoring Across the Arabian Peninsula
14:00 - 14:20	P1-2	Rémy Bossu	Performance of the Earthquake Network (Simo Detector), the First Smartphone-Based Earthquake early warning system
14:20 - 14:40	P1-3	Yousuf Al-Shijbi	Development of the Oman Seismological Network
14:40 - 15:00	P1-4	Haydar Al-Shukri	Recent Updates to the Mesopotamian Seismic Network (MPSN) in Iraq

15:00-15:20: Coffee break

Session # 2 (Seismicity and Seismotectonic) Chair: Abdullah Al-Amri

Time	Paper code	Presenter	Title
15:20 - 15:40	P2-5	Tariq Mansoob	Seismicity Study of Recent Earthquake Activity in Hail Region, Northcentral of Saudi Arabia: Indication of Regional Tectonic
15:40 - 16:00	P2-6	Mansour Al-Otaibi	Monitoring Recent Seismic Activity in the Gulf of Aqaba Region, Northwestern Saudi Arabia
16:00 - 16:20	P2-7	EL Fellah Younes	Seismicity and Seismotectonic Activity in Morocco: an Updated Review
16:20 - 16:40	P2-8	Abdullah Al-Amri	Seismogenic Sources of Makkah Region, Western Saudi Arabia
16:40 - 17:00	P2-9	Talal Alatwi	Earthquake Activity in the Jazan Region, Southwest of Saudi Arabia
17:00 - 17:20	P2-10	Hamada Saadalla	Induced and Triggered Earthquakes; Case Studies From Water and Oil Reservoirs

Day Two: Tuesday/November, 19th, 2024

Session # 3 (Emergency Plans for Seismic Response and Disaster Management Workshop)

Chair: Abdullah Al-Enezi

Time	Paper code	Presenter	Title
9:00 - 9:15	P3-11	Rashed Al-Mari GCC Emergency Management Center	GCC Cooperation Plan for Emergency Response and Preparedness
9:15 - 9:30	P3-12	Brigadier-General Nabeel Alshatti General Department of Civil Defense	Planning and Management of Governmental Response to Crises, Emergencies and Disasters in the State of Kuwait
9:30 - 9:45	P3-13	Colonel/ Dr. Meshari Alfaras Kuwait Fire Force	Earthquake disaster managment
9:45 - 10:00	P3-14	Nasser Al-Beheri Kuwait Oil company	Earthquake Emergency Preparedness and Response, Lessons Learned from the Oil and Gas Industry
10:00 – 10:15	P3-15	Hasan Kamal Municipal Council	Seismic Consideration for Resilient Infrastructure Systems in Kuwait

10:15-10:35 Coffee break

Session # 4 (Earthquake-Resilient and Structural Health Monitoring) Chair: Mauricio Ciudad Real

Time	Paper code	Presenter	Title
10:35 - 10:55	P4-16	Asli Kurtulus	Earthquake-Resilient Civil Environment from Individual Systems to Regional-Scale Assessments
10:55 - 11:15	P4-17	Mathias Franke	Management Infrastructure Platforms for Bridges, Dams, and Industrial Facilities – From Monitoring to Actionable Information
11:15 - 11:35	P4-18	Derek Skolnik	Seismic Structural Health Monitoring and Preventing Unnecessary Loss and Disruption in the Gulf Region
11:35 – 11:55	P4-19	Frank Vernon	EEWS For the Gulf region, Capabilities and Requirements.
11:55 – 12:15	P4-20	Kamal Abou Eleinein	Dubai Smart Seismic Network
12:15 – 12:30	Discussion		

12:30-14:00: Lunch

Session # 5 (Recent Seismic Activity in the Arabian Plate) Chair: Ahmed Hosny

Time	Paper code	Presenter	Title
14:00 - 14:20	P5-21	Mohamad Abdul-Wahed	Present-Day Stress Assessment in Northwestern Arabian Plate
14:20 - 14:40	P5-22	Amir Abolghasem	Unified GNSS Application on the Arabian Plate: A Case Study of Oman
14:40 - 15:00	P5-23	Ahmed Hosny	Moho Undulations and High Poisson's Ratio Beneath Volcanic Areas, West of Saudi Arabia: Indication of Asymmetric Lithospheric Uplift
15:00 - 15:20	P5-24	Hanan Mahdi	Using a 1-D Radially Symmetric Coda Envelope Model For Robust Moment Magnitude (Mw) Estimation In Iraq's Tectonically Diverse Zones
15:20 - 15:40	P5-25	Mohammad Al-Ketheri	Rock Fall Following Al-Baha Earthquake, August 2023, Southern Saudi Arabia

Hamra tour and dinner

Day Three: Wednesday/November, 20th, 2024

Session # 6 (Earthquake Source Parameters and Rupture Process) Chair: Youssef Timoulali

Time	Paper code	Presenter	Title
9:00 - 9:20	P6-26	Youssef Timoulali	The September 08, 2023 High Atlas Earthquake (Morocco): Seismic Image of the Source Zone
9:20 - 9:40	P6-27	Hamoud Beldjoudi	Reassessing the Rupture Process of the 2003 Boumerdes-Zemmouri Earthquake (Mw 6.8, Northern Algeria) Using Teleseismic, Strong Motion, InSAR, GPS, and Coastal Uplift Data
9:40 - 10:00	P6-28	Ahmad Hakouk	6th of Feb 2023 Earthquake Effects on Slope Stability Analyses Along the East Anatolian Fault Zone
10:00 - 10:20	P6-29	Wathiq Abdulnaby	Update of the Earthquake Catalog of Iraq: 1900-2021

10:20-10:40: Coffee break

Session # 7 (Seismic Hazard, Risk and Mitigation) Chair: Jafarali Parol

Time	Paper code	Presenter	Title
10:40 - 11:00	P7-30	Abd el-aziz Khairy	Earthquake Risk Assessment for Kuwait City, Kuwait
11:00 - 11:20	P7-31	Mohamed Ezzelarab	Development of Seismic Hazard Maps for Al-Madinah Region, Saudi Arabia.
11:20 - 11:40	P7-32	Abdullah Ansari	Seismic Performance and Fragility Assessment of Circular Tunnels in Sultanate of Oman: Post-Seismic Functionality of Al-Sharqiyah Expressway Tunnel-2 (AST2)
11:40 - 12:00	P7-33	Dana Al-Enezi	Liquefaction Studies in Kuwait

12:00-13:20: Lunch

Session # 8 (Ground motion and Site Effect Parameters) Chair: Abd el-aziz Khairy

Time	Paper code	presenter	Paper Title
13:20 - 13:40	P8-34	Khalifa AL-Jabri	Effect of Structural Irregularities on Seismic Performance of Buildings
13:40 - 14:00	P8-35	Jafarali Parol	Implementation of Stochastic Subspace Identification Algorithm for Operational Model Analysis of Al-Hamra Tower
14:00 – 14:20	P8-36	Adel Muhammed	Site Specific Characterization of Oman Strong Motion Network (OSMN) Station Sultante of Oman
14:20 – 14:40	P8-37	Badr Alameri	Ground Motion Parameters for Recorded Earthquakes by UAE Strong Motion Network
14:40 – 15:00	P8-38	Farah Al-Jeri	Kuwait National Earthquake Acceleration Network (KNEAN)

15:00-15:20 Coffee break

Closing Ceremony

15:20– 16:20	Recommendation and Closing Ceremony

International Cooperation in Seismic Monitoring across the Arabian Peninsula

Andrea Chiang[1], Issa El-Hussain[2], Yasir Al-Rawahi[2], Haydar Al-Shukri[3], Hanan Mahdi[3], Abdullah Al-Amri[4], István Bondár[5]

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[2]*Earthquake Monitoring Center, Sultan Qaboos University, Muscat, Oman*
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[5]*Seismic Location Services, Lagos, Portugal*

Abstract

Increasing urban development combined with damage from recent earthquakes highlights the need for resilient infrastructure and better understanding of seismic hazards and risks. Over the past several decades, the expansion of national seismic networks, seismic arrays, and data collection in the Middle East have improved seismic monitoring and contributed to emergency preparedness and response. Lawrence Livermore National Laboratory, through the US Department of Energy's Seismic Cooperation Program (SCP), supports joint research and high-quality data collection in collaboration with international partners in the Middle East. Beginning in 2012 and 2015 respectively, Saudi Arabia and Oman operated and maintained two nine-element, small-aperture arrays, QWAR and HQAR, to enhance the scientific research capacity of low signal-to-ratio events. In 2014, US and Iraqi seismologists and engineers established the Mesopotamian Seismic Network, a permeant broadband network aimed at further improving national capabilities for earthquake monitoring. Data collected from seismic arrays and national networks were used to determine earthquake source mechanisms and magnitudes, record local seismicity, reduce uncertainties in earthquake locations, advance understanding of subsurface velocity and attenuation structures in the region, and provide new insights into the mitigation and assessment of seismic hazards.

Performance of the Earthquake Network (Simo Detector), the First Smartphone-Based Earthquake Early Warning System

Francesco Finazzi[1]), Rémy Bossu[2], Fabrice Cotton[3], Robert Steed[2], Laure Fallou[2]
[1]*University of Bergamo*
[2]*EMSC*
[3]*GFZ*

Abstract

The Earthquake Network (EQN) smartphone application, also known as Sismo Detector, is the first operational smartphone-based system for early warning of earthquake. It was launched years before the gradual roll-out of the Google Earthquake Alert, which started in 2021. The EQN has a large user base in Central and South America and was the only system to provide early warning during the dramatic M 7.8 Kahramanmaraş-Pazarcik (Turkey) earthquake in 2023.

The purpose of this presentation is threefold. First, we will present the functionality of the app. Next, we will discuss its performance using examples from South America as well as the M 7.8 earthquake in Turkey. Finally, we will examine the reaction of users to the warning: did they understand the meaning of the warning, and how did they behave?

The example of a large magnitude earthquake, such as the M 7.8 event, is significant because, in such cases, the point source approximation is no longer valid, making the warning strategy challenging. Nevertheless, users located 50 km or more from the epicenter—the initiation of the rupture—benefited from a warning time of several tens of seconds before the strong motion reached their location, which is sufficient time to take protective measures. We will present the actual performance of the system as well as the reactions of its users to the warning.

Development of the Oman Seismological Network

Yousuf Al Shijbi [1], Issa El Hussain[1], Ahmed Deif [1]
[1] Earthquake Monitoring Center, Sultan Qaboos University, Muscat, Sultanate of Oman

Abstract

The Oman Seismological Network (OSN), managed by the Earthquake Monitoring Center (EMC) at Sultan Qaboos University (SQU), has been operational since July 2001. This network monitors, analyzes, and reports on earthquakes continuously to relevant national authorities. The OSN consists of 26 broadband seismographic stations that transmit continuous recording of ground motion via satellite to EMC building at SQU.

The EMC initiated a substantial project to establish the Oman Strong Motion Network (OSMN). This network will consist of 100 stations to strategically placed to cover the urban regions within Oman, taking into account densely populated areas, infrastructures, locations of active faults, and geologic and site conditions. The monitoring instruments are installed in free-field sites or short structures in the urban regions. Upon completion, the OSMN will provide a better understanding of the actual impacts of the seismic source on the seismic hazards. This improved understanding will help planners and engineers improve infrastructure codes and earthquake-resistant design, and the shakemap reports for a quick evaluation of the earthquake effects and shaking extension, thereby providing a clue on the potential of damage immediately after the earthquake occurs.

The EMC collaborates scientifically with major regional and international agencies dealing with earthquakes and their hazards, facilitating knowledge transfer, joint research, and improvements in network operations and responses. Data collected to date indicate the presence of a relatively moderate earthquake hazard in the north and low in middle and south of the Sultanate. The EMC has implemented a number of research projects in collaboration with private and public sectors, including, but not limited to: seismic and tsunami hazard assessment, soil investigation, seismic microzoning, and local site effects. This will be invaluable for developing disaster risk plans and ensuring sustainable and resilient structural construction in Oman.

Keywords: Earthquake Monitoring Center, strong motion network, Oman

Recent Updates to the Mesopotamian Seismic Network (MPSN) in Iraq

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[2]Department of Geology, College of Science, University of Baghdad, Baghdad, Iraq
[3]Seismological Laboratory of University of Basrah, Basrah, Iraq
[4]Lawrence Livermore National Laboratory, Livermore, USA

Abstract

The Mesopotamian Seismic Network (MPSN) in Iraq was established in 2014 to improve seismic monitoring capabilities in the region. Continuous earthquake monitoring relies on real-time access to high-quality data and sustainable network operations and maintenance. Recognizing this need, recent efforts have been focused on upgrading the network with state-of-the-art recording equipment and data acquisition systems. The equipment upgrades included sensor replacements for seven of the fourteen seismic stations that form the network, including Karbala (KAR2), Kut (KUT1), Diyala (DYL1), Baghdad (BGD1), Amara (AMR2), Basra (BSR2), and Kirkuk (KIR1). Six of these stations are also equipped with co-located accelerometers as part an ongoing effort to collect strong motion data for seismic hazard studies. In addition, two new stations Anbar (ANB2), near the Iraqi-Syrian border, and Samawa (SAM2) were established to improve network coverage. Utilizing the SeisComP data acquisition and processing system has improved real-time data relay to international collaborators and EarthScope Data Management Center. These upgrades to the network will contribute to more precise earthquake locations, earthquake hazard research, and graduate education. Planned future upgrades include replacement of the Duhok (DHK1) and Sulaymaniyah (SLY1) stations as well as addition of a new station in the mountainous area of Erbil.

Seismicity study of recent earthquake activity in Hail region, Northcentral of Saudi Arabia: indication of regional tectonic

Tariq Mansoub[1], Ahmed Hosny[1], Lotfy Samy[1], Abdulah Mousa[1], Khaled Yousef[1], and Turki Sehli[1]
[1]National Program for earthquakes and volcanoes, Geohazard Center, Saudi Geological Survey (SGS)

Abstract

Seismic activity in Hail Region, northcentral Saudi Arabia, has been recorded along the southwestern borders of Khaybar and Ithnain volcanic fields (Harrats), the northeastern border with Harrat Hutaymah, and the area between the Governorate of Hail and west of Harrat Hutaymah. The magnitude of these events ranges from small to moderate (less than 1.0 up to 3.6) with no large events recorded. The occurrence of these seismic activities may be attributed to the activity of the faults of the Najd System passing through the region and/or what is parallel to it, the activity of molten lava beneath Harrat Hutaymah, or to human activities, such as excessive groundwater withdrawal in the region, causing small seismic activity within shallow depths, not exceeding one kilometer within the sedimentary cover.

Recently, June 28, 2024, at noon, a small earthquake occurred southeast of Hail with local magnitude of ML 3.6 at a depth of 6.8 km. It was felt by people of those villages surrounding the earthquake within a circular distance of 30~40 km diameter. According to the seismic intensity report and the questionnaire conducted by a technical team of the Geohazard center (SGS), there were no damages due to the weak seismic magnitude of this earthquake.

To identify the reasons behind the occurrence of this event: (a) focal mechanism study was conducted by computing moment tensors, which showed that the earthquake occurred with a strike slip movement trending in a northwest-southeast direction on one of the faults located in the region; (b) the frequency content analysis of the waveform of the event reported high frequency content reaching 10 Hz or higher; c) there was no recording of an earthquake swarm beneath the neighboring Harrat Hutaymah in May or

June 2024; and d) the event occurred at a depth of ~ 7 km and with a seismic magnitude exceeding 3.0, which rules out the possibility that excessive withdrawal of groundwater from the area is the reason for the occurrence of this earthquake, as the thickness of sedimentary cover is around 600 m. Thus, we conclude that the recent earthquake of Hail occurred due to regional stresses affecting the region, such as those originating from the Red Sea to the west and the Gulf of Aqaba to the northwest. These stresses reactivated existing faults in the percambrian rocks, such as the Najd fault system or its parallels, which was confirmed by the results of the aeromagnetic survey in the region.

Monitoring Recent Seismic Activity in the Gulf of Aqaba Region, Northwestern Saudi Arabia

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Abstract

The northern Red Sea region is generally considered a seismically active region, including the Gulf of Aqaba, the Gulf of Suez, and the area where the two gulfs meet in the far north of the Red Sea. However, the Gulf of Aqaba is considered the most seismically active of these regions in terms of the number of earthquakes and seismic magnitude. The Saudi National Seismic Monitoring Network (SNSN) always records seismic activities along the Gulf of Aqaba, indicating the continuity of its activity concentrated on the main and secondary faults with different directions in the Gulf. The main faults take a north-northeast and south-southwest trending direction, while the secondary faults take a north-northwest-south-southeast direction.

In addition, other faults that take a north-south and east-west direction are identified based on the recorded seismicity in Gulf. The seismic activities generally occur at shallow depths and follow three patterns: foreshocks preceding the main event, the main event, and the following aftershocks. Sometimes it occurs in the form of a main event followed by seismic activity in the form of an earthquake swarm or vice versa.

Over the past four decades, the Gulf of Aqaba has experienced earthquakes of varying magnitudes in the form of recurring seismic swarms. For example, seismic activities occurred in 1983, 1990, and 1993 were followed by the occurrence of the large and well-known earthquake on November 22, 1995. This earthquake had a local magnitude of 7.3 degrees, which caused severe damage and impacts to the infrastructures on both banks of the Gulf. Additionally, earthquake swarms occurred during the years 1999, 2014, and 2016, with a maximum magnitude of 5.2 degrees. This pattern may indicate the possibility of a repeat occurrence

of such seismic activity in the Gulf, which necessitating continuous monitoring. This can be done by establishing additional monitoring stations on the eastern bank of the Gulf and exchanging seismic data in real-time with the Egyptian side on the western bank.

Seismicity And Seismotectonic Activity in Morrocco: An Updated Review

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Abstract
This study examines the seismicity of Morocco, focusing on the devastating earthquake that struck the country on September 8, 2023. With a magnitude of 6.8 Mw and its epicentre in the High Atlas region, this event highlights the urgent need for enhanced seismic risk management and preparedness in the country. In this study, we reveal the source characterization with the complex rupture processes and significant aftershock activity of this event. The main seismic zones include the Rif, Middle Atlas, and High Atlas regions, where the interaction of tectonic plates generates substantial stress. This earthquake resulted in considerable casualties and extensive infrastructural damage, particularly in Marrakech and the surrounding areas, making it one of the most destructive earthquakes in Morocco's recent history. This work reviews the seismic monitoring and research initiatives undertaken by Moroccan institutions, notably the Scientific Institute. These efforts encompass the deployment of advanced seismic networks and the implementation of comprehensive research programs aimed at enhancing the understanding of regional seismicity and developing effective mitigation strategies. Finally, we discuss the preparedness and resilience measures put in place to mitigate the impacts of future earthquakes, such as improving building codes, public education and awareness, and emergency response planning. Proactive seismic risk management is crucial to minimizing human and material losses and ensuring the safety and well-being of populations in at-risk areas.

Keywords: Seismicity, seismotectonic, monitoring, risk management, Morocco

Seismogenic Sources of Makkah Region, Western Saudi Arabia

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Abstract

Makkah region has been suffering from moderate to destructive earthquakes. These earthquakes are oriented along major faults or clustered in certain spots. Moreover, these earthquakes have annual recurrence periods, so the identification of these seismogenic source zones is crucial for mapping the most hazardous localities, which should be avoided in the future urban planning.

The existence of microearthquakes inland suggests that there is a significant level of tectonic activity away from the axial trough of the Red Sea. Seismogenic source zones have been defined based on the major tectonic trends: distribution of earthquake epicenters, seismicity rate (a & b- values) and fault plane solution of major earthquakes. It is concluded that Makkah region is affected by the outlined five seismogenic source zones. Three of these zones aligned with the main Red Sea axial trough (southwestern Jeddah, western Jeddah, and northwestern Jeddah zones), while the other two zones are located inland (Thewal-Rabegh and JeddahMakkah zones). These inland zones correlated well with the main trends of major tectonics, reflecting the reactivation of tectonic movements along these fault trends.

The Red Sea zones align with the main path of the axial trough. The range of b-value in these identified zones is 0.65 to 1.03 through these identified zones. Area characterized by higher b-values could indicate a relative low stress regime resulting from the stress release by the earthquakes. Meanwhile the areas of lower b-values can be considered as an evidence of a relatively higher stress regime associated with a dominantly extensional stress. Based on aforementioned, the region is suffering from different stress level accumulations, which in turn, cause earthquakes with different magnitudes. Accordingly, deployment of local seismograph network throughout Makkah region is highly recommended. These results will significantly support seismic hazard assessment and risk mitigation of the region.

Earthquake Activity in the Jazan Region, Southwest of Saudi Arabia

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Abstract

Earthquakes in the Kingdom of Saudi Arabia generally occur due to the activity of the complex tectonic boundaries surrounding the Arabian Plate. These boundaries are divergent in the Red Sea region and the Gulf of Aden from the western and southern direction, while convergent (collisional) where the Arabian Plate moves to the east towards the Eurasian Plate, forming a broad orogenic zone along the Zagros Mountains in northern Iran and Makran in the south. The plate's movement to the north and northeast results in the development of a collision zone, building the Taurus Mountains, southeastern Turkey. Additionally, left lateral transform boundaries dominate the northwest of the Arabian Plate, represented by the Dead Sea transform fault extending to the Gulf of Aqaba. The activity of these tectonic boundaries results in the accumulation of the tectonic stresses affecting the Earth's crust of the Arabian Plate, leading to the common and recurrent reactivation of the faults along the plate margin, causing seismic activity.

The Saudi National Seismic Network (SNSN) has been monitoring earthquakes in the Jazan region since 2007. The number of seismic activities during this period has ranged from low to high, with the highest number occurring in specific years. For instance, in 2014, the number of earthquakes reached about 159, with the largest local magnitude of ML= 4.59.

The occurrence of the seismic activity in the Jazan region is attributed to the impact of regional tectonic stresses surrounding the region. These stresses result from the tensional movement along the Red Sea Rift, leading to the redistribution of these stresses on the faults, parallel or perpendicular on the Red Sea Rift, in the Earth's crust in the Jazan region. This leads to the occurrence of earthquake activity with local magnitude ranges from small to moderate, without reaching large magnitudes.

Induced and Triggered Earthquakes: Case Studies from Water and Oil Reservoirs

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Abstract

The current research is concerned with earthquakes triggered / induced by various human activities such as hydrocarbon production in Dahshour region in the northeastern Egypt, quarry blasts and reservoir impoundments in southwestern Egypt, and oil extraction in the Arab Gulf region. The current study describes the nature and characteristics of different cases of induced/triggered seismicity in various regions in and around the target area. Understanding the conditions and nature of the earthquakes related to various human activities and energy technologies development is necessary to mitigate their hazardous and environmental impacts. In the present work, several modern seismic methods, such as earthquakes location, full waveform moment tensor decomposition, and source spectra analysis, have been used to discriminate between different types of seismicity of different origins. Our findings revealed that most induced/triggered events have a higher percentage of non-double-couple components compared to pure natural earthquakes, with focal depth less than 10 km. The source spectra characteristics of the quarry blast events calculated in the current study have significantly lower corner frequencies than natural and induced/triggered earthquakes in and around the area investigated. Understanding the nature and scale of induced seismicity related to energy technologies, especially in oil and gas production fields, can help mitigate the risks and hazards resulting from oil and gas field seismicity. It is essential to conduct seismic source characterization and discrimination for different earthquakes areas based on the assessment of the potential for future natural and induced earthquakes.

Keywords: Induced/triggered earthquakes, discrimination processes, environmental hazard

Dubai Smart Seismic Network

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Abstract

In April 2006, Dubai Municipality established the broadband seismological network in Dubai Emirate, United Arab Emirates (UAE). This network was the first seismic network in UAE to observe local and regional seismic activity that may affect Dubai and the surrounding areas. The network exchanges real-time data with the National Center of Meteorology and Seismology in Abu Dhabi, the Earthquake Monitoring Center in Oman, and the Kuwait National Seismic Network, and imports in real-time data from few Global Seismic Network stations, which increases the aperture of the network. The earthquake information system sends SMS and emails alerts within few seconds to government organizations (i.e., Dubai Police and Civil Defense) in case of any earthquake felt in the region.

In April 2012, Dubai Municipality installed additional five free-field strong motion stations inside the urban area to estimate and publish real-time ShakeMaps for the public and decision makers. In June 2013, an independent backup server was installed at Jebel Ali Data Center, Dubai Municipality, to acquire and analyze earthquake data in case of any emergency at the main center in the main building of Dubai Municipality.

From 2015 to 2022, four smart structural health monitoring systems were installed on four strategic buildings (i.e., DWTC Rashid Tower, Burj Khalifa, Dubai Police Forensic Building, and Dubai Municipality). These systems are supported by a smart application (DB-SAFE) to enhance the emergency response plan during earthquake shaking inside these buildings. This smart application is also available to the public, providing information on all local and regional earthquakes information and safety awareness, faster than the international data centers. The best feature of these systems is the real-time and automatic evaluation of the felt earthquake and strong wind impact on the high-rise equipped towers, especially Burj Khalifa.

The recorded local seismic activity from 2006 to 2024 indicates low seismic activity within the eastern part of UAE and active tectonics in the relatively aseismic northern Oman Mountains region.

Present-Day Stress Assessment in Northwestern Arabian Plate

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Abstract

Syria is located in the northwestern part of the Arabian plate. It is bounded to the west by the northern section of the Dead Sea Fault System (DSFS), which intersects the Eastern Anatolian Fault System (EAFS), both of which comprise the northern border of the Arabian plate. The DSFS is an important tectonic feature that accommodates the relative sinistral motion between the African and Arabian plates (Reilinger and McClusky, 2011). This system has been regarded as an active plate boundary since the late Cenozoic to the present-day (Barazangi et al., 1993). The recent instrumental seismicity reveals that northwestern Arabia has relatively high levels of seismic activity, in addition to the long history of earthquakes (Abdul-Wahed and Asfahani, 2018). The previous works on the focal mechanisms of the past events in Syria attest the left-lateral pattern of active deformation with a minor component of normal faulting. The main purpose of this work is to evaluate the tectonic regime and the present-day stress in northwestern Arabia by calculating the focal mechanism of the strongest events, and creating the stress map using the derived maximum horizontal stress (S_{Hmax}). A dataset of fault-plane solutions was obtained for 48 events, each having at least 5 P-wave polarities. The tectonic regime for most of these events is extensional, producing normal mechanisms consistent with the local configurations of the seismogenic faults in the region. Strike-slip mechanisms are more scarce and restricted to certain areas, such as the northern extension of the Dead Sea fault system. The results of the current study reveal the spatial variations in the orientation of maximum horizontal stress (S_{Hmax}) across the northwestern Arabia region. These variations highlight the role of main geometrically complex shear zones in shaping the present-day stress pattern of this region.

Despite the relatively small magnitude of the studied events, these results provide a picture of the local stress deviations currently occuring along the local active faults.

Keywords: Fault plane solutions, tectonic regime, Syria, Arabian plate.

Unified GNSS Application on the Arabian Plate: A Case Study of Oman

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The Arabian plate is surrounded by diverse active boundaries. Although several recent publications have addressed localized deformation mechanisms to some extent, the present-day deformations of the boundaries and intra-plate patterns have not been comprehensively studied.
Over the past decade, most GCC countries have established national GNSS networks consisting of a few hundred sites that continuously collect precise data. These networks primarily serve as reference networks for positioning and mapping projects at the national level. The integration of these networks along with the IGS (International GNSS Service) sites equips us with a power tool to precisely quantify the rigid motion and internal deformations of the Arabian plate.
The strain rate field, derived from GNSS observations, is currently used to study Earth's surface deformations. We suggest an alternative approach: establishing a regional reference frame for the Arabian plate that integrates the plate's rigid motion within a global frame, such as ITRF20. The residual deformations in this new frame directly represent intra-plate deformations. Such a reference frame will have wide applications in international positioning and mapping projects.
The National Survey Authority (NSA) of the Sultanate of Oman, which runs the country wide reference GNSS network, established a continuously operating network of 47 sites across the country in 2016, providing a precise tool to study internal deformations.
Ludwig – Maximilians – Universität in Munich (LMU) and the NSA applied this method to realize a new reference frame for the Sultanate and studied the kinematics of the Oman CORS network. The established frame revealed internal motions ranging from fractions of a millimeter to few millimeters per year. The distribution of vertical motions in the vicinity of the oil fields and in the mountains is noticeable. A GCC-wide collaboration can extend this work to realize a unified reference frame for the Arabian plate and study both internal deformations and plate boundary deformations.

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Moho Undulations and High Poisson's Ratio beneath Volcanic Areas, West of Saudi Arabia: Indication of Asymmetric Lithospheric Uplift

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Abstract

By utilizing teleseismic data, the P-wave receiver functions (RFs) have been computed for 20 broadband seismic station deployed in Harrat Khaybar and Ithnayn, in the Arabian Shield area, western Saudi Arabia. The RFs are modeled to investigate the crustal structure, by determining crustal thickness, mean crustal Vp/Vs ratio, and the Poisson's ratio. No previous studies have provided information on crustal structure using seismological data for several parts of Harrat Khyber, making this study a valuable new source of information. Results revealed that the crustal thicknesses range from 30 to 37 km, indicating an undulated Moho interface and asymmetric mantle uplift beneath the study area. The asymmetry could relate to a simple shear extension under the study area or to the preexisting lateral variations of crustal thickness. The observed Vp/Vs values ranging from 1.71 to 1.82 seem to have a direct relationship with the crustal thickness (i.e., crust of smaller depth corresponds to high Vp/Vs). The high Poisson's ratios throughout some areas beneath Khayber and Ithnayn area (~ 0.30) indicate that the crust is more mafic in composition than a typical continental crust, probably referring to intrusion of mafic dikes into the lower crust. In contrast to previous studies, the results of this study revealed that some areas of Harrat Khaybar and Ithnayn have high Vp/Vs ratios with respect to the rest of the Arabian shield; however, this finding is consistent with the results of other previous studies.

Using a 1-D Radially Symmetric Coda Envelope Model For Robust Moment Magnitude (M_w) Estimation In Iraq's Tectonically Diverse Zones

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Abstract

Robust estimation of moment magnitude (M_w) can be challenging for Iraq due to the strong lateral heterogeneity across its diverse tectonic zones. We aim to improve moment magnitude estimation by investigating the reliability of using a 1-D coda envelope model in diverse tectonic zones of different lateral effects, offering a way forward for reliable estimates of M_w for small events difficult to waveform model. Iraq comprises two main tectonic zones: 1) The Outer Platform, consisting of the northwestern Zagros Fold-Thrust Belt and the Mesopotamian Foredeep, and 2) The Inner Arabian Platform overlain by the Iraqi desert. A simple 1-D coda envelope model was used because coda waves have a low sensitivity to the source and path heterogeneity. Three separate coda calibrations were conducted in order to investigate the robustness of a single 1-D calibration to fit the country: whole-region calibration, Zagros calibration, and Mesopotamia calibration. In the whole-region calibration, we used stations from both the Zagros and Mesopotamia zones. In the two other calibration models, we used only stations located in those particular zones. Ground truth (GT) reference spectra derived from the coda spectral ratio method were used to constrain high-frequency site terms. There were no drastic difference when comparing the moment magnitudes calculated from the waveform modeling and the three calibration models. The results show that the 1-D coda envelope model is a reliable method even for a region with diverse tectonic zones. Hence, we recommend using the whole-region calibration model for moment magnitude estimation, as it provides more complete path coverage and avoids biases introduced by path correction failures. The proposed calibration is a fundamental step in updating the comprehensive earthquake catalog and probabilistic seismic hazard assessments for Iraq.

Rock Fall Following Al-Baha Earthquake, August 2023, Southern Saudi Arabia

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Abstract

Rock falls occur in regions of the Kingdom of Saudi Arabia mainly due to rainfall, especially in areas exposed to intensive rainfall over steep, tectonically complex terrains. However, there are other reason that can trigger rock falls. Earthquake activity near rugged mountainous areas can cause rocks to fall, particularly in regions where rocks are naturally prone to falling due to the presence of cracks and sharp inclination angles.

In August 2022, on a Wednesday morning, a landslide occurred with some rocks falling from the highest mountains in the Al-Baha region, southern Saudi Arabia. This landslide coincided with the occurrence of an earthquake southwest of the city of Al-Baha, with a local magnitude ML of 3.6 degrees on the Richter scale, and within a depth of approximately 4 km. This collapse occurred north of the epicenter of the earthquake at approximately 19 km away, indicating the influence of seismic waves, particularly the shear waves with influential horizontal polarization and propagation. These waves likely travelled through areas of weakness, causing disturbances that led to the sliding of rock. This was due to the low friction angle and cohesion of the rock masses, as well as the presence of multiple rock joints and various weathering factors.

The collapse is considered a plane failure type. Additionally, the surface of failure is inclined at an angle of more than 60 degrees. The rock blocks fell in the deep part of Wadi Al-Manjoor, from a height of about 1,200 m above sea level. This led to the huge falling rock blocks collapsing and forming a dense cloud of dust because of this impact. The mass of these falling rock blocks was estimated at about 800 tons at least.

In future, further studies are needed to avoid any damage to facilities or infrastructure due to this phenomenon, including in urban zones. These studies should focus on determining the locations of the critical zones around the epicenters of the earthquake, especially areas around waters dam.

The September 08, 2023, High Atlas Earthquake (Morocco): Seismic Image of the Source Zone

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Abstract
The earthquake that occurred on September 08, 2023, with M_w 6.8, linked to an ENE – WSW trending and NNW dipping thrust faulting mechanism (Harvard CMT), is the most destructive earthquake event in Morocco in the past decade. This earthquake took place in the Al Haouz region, located in the western part of the High Atlas domain. According to active tectonics and GPS data, the Atlas Mountains are known as slowly deforming mountain belts where the seismic activity is poorly understood. To better understand what caused and triggered the large earthquake, we studies the P and S arrivals at 19 seismic stations in the region to create a high-resolution 3D velocity structures within the seismic zone and the western section of the High Atlas. The results reveal that the mainshock hypocenter is located at a depth of 15 km within fractured rock formations characterized by a low P velocity zone. This low-velocity zone extends from 10 to 45 km depth. Interestingly, the aftershock relocations using double difference methods provide sharper seismicity distribution of the fault rupture geometry, which agrees well with tomographic images of the earthquake zone. The earthquake tomography and analysis of seismic wave velocities provide new insights into the detailed imaging of deep active geological structures in the seismic zone and High Atlas range.

Keywords: High-Atlas earthquake, thrust faulting, seismic waves, tomography, seismic velocity

Reassessing the Rupture Process of the 2003 Boumerdes-Zemmouri Earthquake (Mw 6.8, Northern Algeria) Using Teleseismic, Strong Motion, InSAR, GPS, and Coastal Uplift Data

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Abstract

In this work, we determined the coseismic slip distribution of the Boumerdes-Zemmouri earthquake (Mw 6.8, 2003) by inverting a comprehensive set of data, including teleseismic seismograms, strong motion seismograms, coastal uplift, global positioning system (GPS), and Interferometric Synthetic Aperture Radar (InSAR). We suggest a best-fitting model of coseismic slip distribution on two segments: the first segment oriented at N70° and the second segment located at the west of the first one and oriented at N100°. The slip distribution shows two slip patches on the N70° segment containing the hypocenter. The eastern patch is shallower, located between 0 and 9 km depth, with a maximum slip of 2.30 m. The western slip-patch on this same segment is deeper, between 4 and 12 km depth, with a slip that reaches a maximum value of 2.70 m at the center. The N100° segment also displays two slip patches, a small one in the east of the segment, which is between 4 and 8 km depth, and a larger one in the western part of the segment, between 0 and 10 km depth. Both patches associated with the N100° segment show a maximum slip between 1.10 and 1.40 m.

6th of Feb 2023 Earthquake Effects on Slope Stability Analyses along the East Anatolian Fault Zone

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The disastrous earthquake that struck Turkey and Syria on February 6, 2023, at 04:17 (local time) had a magnitude of 7.7 M_w (AFAD), with the epicenter located in Pazarcik-Kahramanmaras and a focal depth of 8.6 km. The following day, at 13:24, another 7.6 M_w earthquake (AFAD) occurred in Elbistan-Kahramanmaras, with a focal depth of 7 km. This was followed by over 30,000 aftershocks in the subsequent three months. This event resulted in more than 63,000 human casualties in both countries and severely impacted 14 million individuals. Additionally, significant infrastructure damage, billions of dollars in economic losses, huge slope failures, and catastrophic mass movements posed significant geohazard challenges.

The motivation behind this study was to address the event with a novel approach by combining geotechnical engineering, seismology, and remote sensing. Unmanned aerial photogrammetry, LiDAR, and neural network processing were utilized to comprehensively understand the relationship between strong ground motion properties and slope failure mechanisms in seismically active regions.

Note: The arrows denote the deduced direction of the initial rupture of the Kahramanmaraş Pazarcık earthquake. The figure displays an acceleration record obtained from station 2712, located near Nurdağı. Figure 2. The seismotectonic map displays inferred rupture planes and aftershocks (AFAD) and the Harvard global centroid moment tensor solutions for significant earthquakes. Source: Cetin and Ilgaç (2023).

Keywords: Earthquake, slope stability, seismology, neural network, 6th Feb EQ.

Update of the Earthquake Catalog of Iraq: 1900–2021

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Abstract

The first comprehensive earthquake catalog for Iraq based on moment magnitude (Mw) was compiled by Onur et al. (2017). This catalog spanned from 1900 until the end of 2009, covering the regions between 26°–40° N latitudes and 36°–51° E longitudes. It included more than 18,000 earthquakes, of which roughly 4,000 are of Mw 4.0 or larger. This catalog was used in a probabilistic seismic hazard assessment (PSHA) for Iraq by Abdulnaby et al. (2020). Recently, we have updated the earthquake catalog of Iraq by adding earthquakes recorded during the past 12 years. Additionally, we have directly calculated Mw for about 2000 earthquakes using the Coda Calibration Technique. The reviewed earthquake bulletin of the International Seismological Center (ISC) and seismological data from the Mesopotamian Seismological Network (MPSN) in Iraq were used in this effort. The aim was to increase the number of direct moment magnitude measurements in the earthquake catalog. In cases where the moment magnitude of an earthquake is not directly calculated, other magnitude scales are converted to moment magnitude using relations compatible with the local catalog. The updated earthquake catalog now covers the period from 1900 to the end of 2021 and includes more than 36,000 earthquakes, with approximately 6,200 of them having a moment magnitude of 4.0 or larger. This revised catalog will be utilized to update the PSHA for Iraq.

Earthquake Risk Assessment for Kuwait City, Kuwait

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Abstract

Estimating the expected losses from a seismic disaster, whether economic or human, is considered one of the most important priorities for urban development in countries, especially those with continually expanding urban areas, high-rise buildings, and skyscraper construction. Kuwait, especially its capital, Kuwait City, exemplifies this type of urban area. Therefore, it was necessary to conduct an earthquake risk assessment study in Kuwait due to its geographical location, which places it near the most important global seismic belt, the Zagros Seismic Belt, as well as its proximity to local seismic sources.

To conduct such a study, three inputs were incorporated: seismic hazard, exposure, vulnerability, modules, taking into account the uncertainty in the inputs. To assess the seismic hazard module, a unified earthquake catalog was compiled, a seismotectonic model of 27 seismic sources was designed, the recurrence parameters of seismicity and the strongest predictable earthquake were calculated for each source, and the unified hazard spectrums were obtained. Earthquake scenarios were generated to create a seismic hazard module. The exposure module was performed using data from the Kuwaiti Public Authority for Civil Information including coordinates of 33,066 facilities and buildings, area, height, shape, and type of buildings, the materials used in their construction, and their occupancy and replacement costs. The vulnerability module was implemented using mean damage ratio curves by selecting the most appropriate equations that describe the condition of buildings in Kuwait, the vast majority of which are modern multi-story concrete buildings.

The final results, including the economic losses of the exposures, were calculated using probabilistic metrics (predicted annual losses, loss exceedance curve, and probable maximum loss). Preliminary results showed that the annual average loss was calculated and found to be $12,793,319.52. Seismic source No. 27 to the north of Kuwait significantly contributed to the losses, while the frequent occurrence of losses from seismic source No. 15 to the east of Kuwait, in the Zagros region, posed the greatest danger to Kuwait. Seismic risk results can be used by decision-makers to create emergency response scenarios, develop risk mitigation strategies, design financial risk transfer mechanisms, plan land use and zoning, and mitigate or prevent losses through cost-benefit analysis in Kuwait City.

Keywords: Probabilistic seismic risk, seismic hazards, cost-benefit analysis, probable maximum loss, land use and zoning.

Development of Seismic Hazard Maps for Al-Madinah Region, Saudi Arabia

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Abstract
Probabilistic seismic hazard maps for Al-Madinah Region in the western part of Saudi Arabia are presented based on recent data set, which includes updated complied earthquake catalogue, reliable seismogenetic models, and carefully selected GMPEs. The seismic hazard maps are developed for three levels of exceedance probabilities in 50 years (10%, 5%, and 2%) using the logic tree approach, and they show variation in the distribution of the expected ground motions. Quantitative analysis for this variation is performed in terms of uniform hazard spectra (UHS) at three rocky sites: Al-Hinakiyah, Al-Ula, and Badr. The UHS demonstrate that the Badr rock site in the northwest part of Al-Madinah region has higher expected ground motion, with PGA values of 41.2, 62, and 102.4 cm\s^2 for return periods of 475, 975, and 2475 years, respectively. However, the values of PGA at Al-Ula rock site in northern part of the region are 30, 46.3, and 79.3 cm\ s^2 for the three return periods. The Al-Hinakiyah rock site, located at the easternmost part of the investigated region, has the lowest PGA values, which equal to 11, 14, and 19 cm\s^2. To capture the relative contribution of seismic sources to the total seismic hazard, disaggregation charts and the contribution of seismic sources to PGA seismic hazard curves were implemented. The results showed that that Hijaz seismic source contributes most significantly to the seismic hazard in the northwestern part of the region. However, in the northern part, most of seismic hazard is related to Tabuk seismic source, while in the eastern part, most of the seismic hazard is related to Hijaz seismic source and the Red Sea seismic sources. Establishing a high quality seismic network around these sources could be a crucial step in developing the earthquake early warning system and mitigating the seismic risk in the Al-Madinah Region.

Keywords: Saudi Arabia; Al-Madinah region; logic tree; uniform hazard spectra; disaggregation charts; spatial variation of seismic sources

Seismic Performance and Fragility Assessment of Circular Tunnels in Sultanate of Oman: Post-Seismic Functionality of Al-Sharqiyah Expressway Tunnel-2 (AST2)

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Abstract
Seismic events have historically caused significant damage to tunneling and underground infrastructure worldwide, leading to considerable socioeconomic impacts. This study addressed two main aspects: the seismic performance of circular tunnels in the Sultanate of Oman and their vulnerability based on typology and variations in the surrounding medium. A comparison of fragility functions, evaluated under identical seismic conditions, revealed that tunnel models with a lining thickness of 285 mm were more vulnerable. A project-specific risk matrix and functional route map were developed for the Al-Sharqiyah Expressway Tunnel-2 (AST2) to assess post-seismic functionality. The AST2C section showed a high probability of extensive damage, greatly increasing its risk category. Near the AST2C portals, substantial landslide risks due to slope instability pose significant hazards. Sections AST2A and AST2B showed potential for operability with minor retrofitting. This study offers valuable insights for professionals in seismic tunnel analysis and design, aiding in efforts for both new construction and retrofitting. It also assists government stakeholders in creating policies and guidelines for underground structures in the Sultanate of Oman.

Keywords: Sultanate of Oman. seismic. vulnerability. functionality. tunnelling, Al-Sharqiyah Expressway

Assessment and Mapping of Soil Liquefaction Hazards for Urban Areas in Kuwait

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In recent years, Kuwait has faced several significant earthquakes driven by both natural seismic activity from tectonic plate movements and artificial seismic waves resulting from oil extraction. Despite these challenges, the potential for soil liquefaction, particularly in urban areas with shallow groundwater tables, has not been investigated. This study aims to fill this gap by investigating, assessing, and creating soil liquefaction hazard maps for Kuwaiti urban areas using available soil borehole records. Soil susceptibility to liquefaction was evaluated in two stages: first, by calculating the factor of safety against soil liquefaction using the deterministic method from the National Center for Earthquake Engineering Research (NCEER) workshop, and second, by determining the liquefaction potential index (LPI) using Luna and Frost's methodology. Peak ground accelerations were computed with Cornell's equation for local and regional moment magnitudes (Mw), and these calculations were validated with ground motion models. The study resulted in five comprehensive soil liquefaction hazard maps of Kuwait, representing various earthquake scenarios through the application of geographical information systems (GIS). The findings reveal that the southern regions of Kuwait are particularly vulnerable to soil liquefaction, especially with a local earthquake moment magnitude of 5.5. These hazard maps are crucial for identifying high-risk areas and will assist decision-makers, engineers, and planners in developing construction strategies, updating building regulations, and implementing effective risk mitigation measures.

Effect of Structural Irregularities on Seismic Performance of Buildings

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Abstract
The design and performance of buildings during an earthquake depend heavily on their structural configuration and layout. Irregularities in plan and elevation are common due to architectural and service requirements. This study addresses the structural design and performance of buildings under seismic loads, considering irregularities in plan and elevations, as defined by the Oman Seismic Code. A reinforced concrete building with a total height of 30 m is considered. The study developed and used 19 different structural configurations to investigate the effect of structural irregularities in plan and elevation. All the cases are designed and analyzed using ETABS for Muscat (Zone-1) with soil class C and gravity loads. The building capacity and performance are estimated using pushover analysis, plastic hinges deformation, and capacity-demand curve. Structural irregularities were found to have a significant effect on seismic performance, particularly the base shear, performance point, and development of plastic hinges. For floor discontinuity, the centralized location of the floor opening affects the structural behavior, generating a more vulnerable structure due to the reduction of base shear capacity by 74% in the x-direction and 68% in the y-direction.

Keywords: Omani Seismic Code, seismic analysis, push over analysis, reinforced concrete

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Implementation of Stochastic Subspace Identification Algorithm for Operational Modal Analysis of Al-Hamra Tower

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Affiliation?

Abstract

In the past decade, the application of structural health monitoring (SHM) has made significant advances in all branches of civil engineering and the construction industry. SHM systems provide vital information on the evolution of the structural performance of key components in various infrastructures such as bridges, buildings, and wind turbine structures. Structural performance indicators such as natural frequencies, mode shapes, displacements, and strains are measured or estimated using sensor measurements. The underlying principle of SHM is that these indicators are sensitive to structural deterioration, either continuously degrading due to aging or resulting from abruptly imposed structural damage, such as from an earthquake. The stochastic subspace identification (SSI) algorithm is one of the most reliable methods for operational modal analysis (OMA) of linear structures subjected to ambient vibrations, used to extract modal parameters. In this paper, we demonstrate the implementation of an advanced version of SSI to identify the modal parameters of the Al-Hamra Tower in Kuwait City, Kuwait. The results obtained were compared against finite element analysis results and measurements from GPS.

Site-Specific Characterization at Oman Strong Motion Network (OSMN) Stations, Sultanate of Oman

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Abstract
In 2001, the Earthquake Monitoring Center (EMC) at Sultan Qaboos University (SQU) initiated seismic monitoring in the Sultanate of Oman with 10 short-period stations. Between 2004 and 2011, this network expanded to 20 broadband seismic stations across the country. In 2021, EMC-SQU embarked on a major upgrade, adding 6 broadband stations and establishing a strong motion network comprising 100 stations. This expansion offers a valuable opportunity to analyze the effects of seismic sources, propagation paths, and local site conditions on ground motion, particularly in near-source areas. Such data are crucial for refining seismic hazard maps, building codes, and earthquake-resistant designs.
An extensive site selection survey was conducted for the new stations, adhering to standard criteria. To fully utilize the strong motion recordings, site response information is essential. Thus, site investigations at the Oman Strong Motion Network (OSMN) stations were performed, measuring noise levels, resonance frequencies (using the horizontal-to-vertical spectral ratio (HVSR) method), P-wave velocities (using shallow seismic refraction tomography (SRT)), and S-wave velocities (using multichannel analysis of surface waves (MASW)). These investigations were complemented by existing geotechnical borehole data. The results provide site classifications according to NEHRP/IBC standards, which in turn reflect the seismic hazard levels at the ground surface.

Keywords: OSMN, site characterization, noise level, HVSR, SRT, MASW

Ground Motion Parameters for Recorded Earthquakes by UAE's Strong Motion Network

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Abstract

Ground motion parameters from different sources and paths improve the ground motion prediction equations (GMPEs), enhance the understanding of earthquake mechanism, support the seismic hazard assessment studies for the region, and improve mitigation solutions. In addition to the existing network, the UAE has installed 12 strong motion stations in the urban areas on the northern part of the country over the last few years. These stations have improved the detection, monitoring, and analyses of acceleration records, thereby enhancing the ground motion database for further studies to generate new GMPEs. The two-doublet earthquakes on 14th Nov. 2021, with magnitudes M5.9 and M6.2, and 1st July 2022, with magnitudes M5.9 and M6.2, were slightly felt in the northern part of UAE without any significant effects. Based on the processed acceleration records and the ground motion analysis of these events, the closest station, SHAAM (SHM), with an epicentral distance of 135.8 km, recorded the maximum peak ground acceleration of 116.6 mm/s2 (~0.01g), peak ground velocity of 5.3 mm/s, peak ground displacement of 0.3 mm, and Modified Mercalli Intensity III. The spectral response acceleration (SA) at 0.2 second was Ss 0.08g, and at 1.0 second, it was S1 0.002g. The recorded peak ground acceleration and the spectral acceleration values are low compared to the seismic building code regulation in the UAE.

Kuwait National Earthquake Acceleration Network (KNEAN)

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Abstract

In 1997, Kuwait established a modern seismic network to record local and regional earthquakes efficiently, contributing to the study Kuwait's seismicity. Recently, with the sustainable development of urban areas and the increased construction of high-rise buildings in the State of Kuwait, the need to establish a new network to record seismic acceleration in the urban areas has become crucial. This network aims to record earthquake acceleration and create a database of ground motion acceleration data to contribute to modern studies on seismic risks in Kuwait. In 2022, the Kuwait Institute for Scientific Research (KISR) established the Kuwait National Earthquake Acceleration Network (KNEAN) in Kuwait by installing three Kinemetrics Etna-2 seismic accelerometers in different governorates of Kuwait. The number of new network stations is currently being increased to cover all areas of Kuwait and to transfer data from instruments via mobile phone lines. The recorded seismic acceleration data will be used in several research projects on seismic risks in the State of Kuwait, and a local attenuation model for seismic waves within Kuwait will be created from the data of this network.

Keywords: Seismicity, earthquake acceleration, Kuwait

Workshop title: Emergency Plans for Seismic Response and Disaster Management Workshop

Chair: Abdullah Al-Enezi

Talk Code	Presenter	Title
P3-11	Rashed Al-Mari GCC Emergency Management Center	GCC Cooperation Plan for Emergency Response and Preparedness
P3-12	Brigadier-General/ Nabeel Al-Shatti General Department of Civil Defense	Planning and Management of Governmental Response to Crises, Emergencies and Disasters in the State of Kuwait
P3-13	Colonel/ Dr. Meshari Alfaras Kuwait Fire Force	Earthquake disaster managment
P3-14	Nasser Al-Beheri Kuwait Oil company	Earthquake Emergency Preparedness and Response, Lessons Learned from the Oil and Gas Industry
P3-15	Hasan Kamal Municipal Council	Seismic Consideration for Resilient Infrastructure Systems in Kuwait

Workshop title: Earthquake-Resilient and Structural Health Monitoring

Chair: Mauricio Ciudad Real

Talk Code	Presenter	Title
P4-16	Asli Kurtulus	Earthquake-Resilient Civil Environment from Individual Systems to Regional-Scale Assessments
P4-17	Mathias Franke	Management Infrastructure Platforms for Bridges, Dams, and Industrial Facilities – From Monitoring to Actionable Information
P4-18	Derek Skolnik	Seismic Structural Health Monitoring and Preventing Unnecessary Loss and Disruption in the Gulf Region
P4-19	Frank Vernon	EEWS For the Gulf region, Capabilities and Requirements.
P4-20	Kamal Abou Eleinein	Dubai Smart Seismic Network
Discussion		


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