Research Institute of Sciences and Engineering

Office of the Vice Chancellor for Research & Graduate Studies
University of Sharjah

The purpose of this circular is to highlight select research projects that are conducted by researchers in Sciences and Engineering in collaboration with the local, regional and international communities. In this circular, the following projects are highlighted:

- Solar Air Conditioning System Using Parabolic Trough Collectors
- Enhancement of the Power Output and Efficiency of Dye-sensitized Solar Cells by Investigating the Counter Electrode Construction and Natural Organic Sensitizers
- Green and Cytocompatible Gold-Lysozyme Nanoantibacterial for Combating Multidrug-Resistant Superbugs
- A Data Mining Approach for Detecting and Tracking Harmful Environmental Phenomena Using WSN
- Arabic Text Classification Using Deep Learning
- Detection of Cyberbullying in Arabic Social Media Communications
- The application of Artificial Intelligence and Engineering Mathematics on Genetic Data to Understand the Pathophysiology of Asthma
- Designing Power and Low-Noise Amplifiers Using GaN Technology for Space and Terrestrial Wireless Communication
- Improved Blockchain Infrastructure with IoT for Critical/Smart Government Applications
- Presence and Fate of Contaminants of Emerging Concern (CECs) in Sharjah Main Wastewater Treatment Plant
- Managing Manned and Unmanned Air Traffic
- Rapid Strengthening of Unreinforced Masonry Walls for Out-of-Plane Actions Using Fiber Reinforced Shotcrete

Solar Air Conditioning System Using Parabolic Trough Collectors

Project Summary:

A joint research team from the University of Sharjah (UoS), Sharjah Electricity and Water Authority (SEWA) are working on designing a solar thermal absorption cooling system with 10 tones capacity in Sharjah. The study will include (1) simulation and modeling analysis to optimize the solar cooling system; (2) set up and test the performance of the system under Sharjah weather conditions; and (3) determine the conditions to achieve and maintain cooling conditions (temperature, humidity, cleanliness and distribution) to meet the requirement of the conditioned space.

Project Significance/Outcomes:

The future energy demand in the UAE will increase due to population growth, economic activities and high consumption rates. This is not sustainable in the long term. Based on the latest estimates from the UAE Ministry of Energy, there is 9% increase annually of the demand of energy in the UAE. The UAE's energy sector is undergoing a major transformation targeting diversification of UAE's energy mix – increase the penetration of renewable (solar) and nuclear energy in the energy mix and accelerate the deployment of energy efficiency systems. The development of sustained energy efficiency strategy will help to slow the growth of energy consumption. The UAE weather is a challenge for building designer because of the high temperatures and high humidity in summer. The energy consumption in UAE buildings mainly in air conditioning accounts for about 60-70% of the total energy of the building. Therefore, designing a cooling system controlled by renewable source of energy will be an excellent solution to this problem in gulf area in general and in UAE in particular.

Parties Involved:

- University of Sharjah, UAE
- Sharjah Electricity and Water Authority, UAE

Team Members:

1. Dr. Chaouki Ghenai (PI); Coordinator of Sustainable Energy Development Research Group, Department of Sustainable & Renewable Energy Engineering, UoS
2. Dr. Tareq Salameh (Co-I); Sustainable Energy Development Research Group, Department of Sustainable & Renewable Energy Engineering, UoS
3. Prof. Abdul Kadir Hamid (Co-I); Sustainable Energy Development Research Group, Department of Electrical and Computer Engineering, UoS
4. Dr. Ahmed Hachicha (Co-I); Sustainable Energy Development Research Group, Department of Sustainable & Renewable Energy Engineering, UoS
5. Dr. Shek Rahman (Co-I); Sustainable Energy Development Research Group, Department of Sustainable & Renewable Energy Engineering, UoS
6. Dr. Oussama Rejeb (Co-I); Sustainable Energy Development Research Group, UoS

Enhancement of the Power Output and Efficiency of Dye-sensitized Solar Cells by Investigating the Counter Electrode Construction and Natural Organic Sensitizers

Project Summary:

This project investigates the correlation between optical properties of dyes, manifested in their color that changes with season on the amount of incident solar energy falling on the plant. These dyes are to be used in the third-generation solar cells that use natural dyes as sensitizers, or as known as dye-sensitized solar cells (DSSCs). The biological strategies that the plants implement to extract the required amount of energy for its essential functions without jeopardizing its living tissue can be extended to dye sensitizers in solar cells to produce the maximum energy while limiting the adverse effects of over exposure. The target plants for dye

extraction are also selected to be available in the United Arab Emirates local environment in abundance. This enables the conservation of the usual dye-producing plants that can be otherwise consumed as food (beetroot, blackberries, blueberries, spinach…etc.).. Finally, the effect of growing the plants in soil environments rich with specific nanomaterials (TiO2 and ZnO) will be studied in terms of enhancement of the compatibility of the extracted dyes with the mesoporous materials that carries them as sensitizers.

Project Significance/Outcomes:

Third generation PV solar cells have emerged in the past decade as a cheaper and more eco-friendly alternative to silicon and thin-film silicon cells. The three main types of third generation PV are: i) organic photovoltaics (OPVs), ii) dye-sensitized solar cells (DSSCs) and iii) perovskite cells. Each of these types consists of numerous components that have to operate in sync to produce the desired power output and energy conversion efficiency. For the current work, DSSCs are of particular importance, since the operational efficiency for those sensitized by natural dyes is still very low (around 2% in 2014). Thus the potential of enhancing the output of DSSCs is promising, and this can be done by optimizing one (or all) of the components of the cell; namely the photo-electrode, dye/electrolyte active materials and the counter-electrode

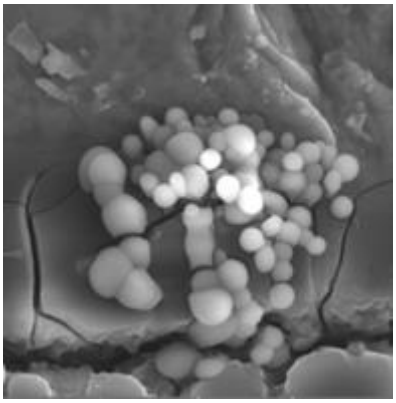
Parties Involved:

- University of Sharjah, UAE
- Sharjah Research Academy, UAE

Team Members:

1. Dr Abdul Hai Alami (PI); Coordinator of Functional Materials Research Group, Department of Sustainable and Renewable Energy Engineering, UoS
2. Prof Ali El-Keblawy (Co-I); Coordinator of Environmental & Chemical Biology Research Group, Department of Biotechnology, UoS
3. Dr. Hussain Alawadhi (Co-I); Director of Center for Advanced Materials Research (CAMR), Department of Applied Physics and Astronomy, UoS
4. Dr. Di Zhang (Co-I); Functional Materials Research Group Department of Sustainable and Renewable Energy, UoS
5. Dr Kareem Mosa (Co-I); Environmental & Chemical Biology Research Group, Department of Biotechnology, UoS

Green and Cytocompatible Gold-Lysozyme Nanoantibacterial for Combating Multidrug-Resistant Superbugs



Project Summary:

Fulfilling the synergistic principles into the design of the next generation therapeutics is a main target in the lysozyme-nanomaterials interface to reach antibiotic-free therapy. A few naturally occurring proteins such as lysozyme have been studied as antibacterial agents against pathogens. Lysozyme is known to kill bacteria by catalyzing the hydrolysis of the peptidoglycan layer of the cell wall of certain bacterial species. However, limitations in its action against only Gram-positive bacteria motivated the research to conjugate with nanomaterials to broaden its antibacterial properties against both Gram-positive and Gram-negative bacteria.

Project Significance/Outcomes:

The encouraging results of this work will catalyze the replacement of antibiotics with theranostics based on gold nanoparticles. Technological approaches can utilize our nanoplatform in which gel, cream or powder can be applied on infected wounds because of the absence of detrimental cytotoxicity to the surrounding human cells. Internal organs infection might be reached by our drug targeting system, with minor or no hemolysis to blood cells.

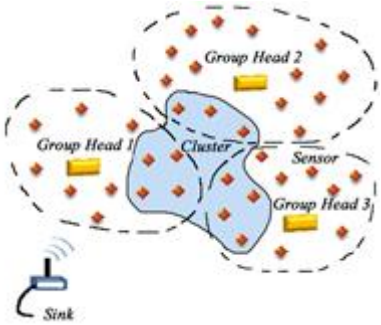
Parties Involved:

- University of Sharjah, UAE
- Delaware State University, USA
- Environmental Protection Agency, USA
- INHA University, South Korea

Team Members:

1. Dr. Ahmed A. Mohamed (PI); Coordinator of the Organometallic Chemistry Research Group, Department of Chemistry, UoS
2. Dr. Ahmed AlMahdi (Co-I); Organometallic Chemistry Research Group, Department of Chemistry, UoS
3. Dr. Bizuneh Workie (Co-I); Delaware State University, USA
4. Dr. Endalkachew Sahle-Demessie (Co-I); Environmental Protection Agency, USA
5. Dr. Changseok Han (Co-I); INHA University, South Korea

A Data Mining Approach for Detecting and Tracking Harmful Environmental Phenomena Using WSN



Project Summary:

Oil spills and air pollutions are of great risks on the local environment. UAE is one of the world largest exporters of oil and natural gas. Therefore, risks of oil spills in the Arabian Gulf are high. In this project, we propose a data mining approach for detecting and tracking oil spills and air pollutions, which are referred to as phenomena in the rest of this document, in a wireless sensor network environment (WSN). Moreover, we are interested in building algorithm for detecting possible correlations between the detected phenomena, i.e., phenomena that depend on each other. For instance, oil spills and fish populations are two different phenomena measured by different transducers. However, as the concentration of the oil increases in the seawater, fish populations decrease. The objective is to use fully distributed approach to avoid the

bottlenecks and to maximize the lifetime of the sensor network. The distributed approach is implemented on the top of a hierarchal topology, which organizes the sensors into groups.

Project Significance/Outcomes:

Harmful phenomena such as oil spills in the Gulf region causes serious damages to marine life and tourism industry. Our objective is to build a fully distributed system that uses wireless sensor networks for early detection and close tracking of oil spills and pollution clouds to help mitigate their harmful results.

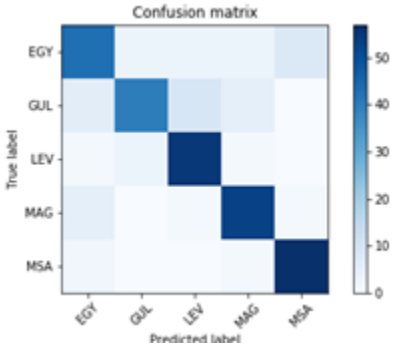
Parties Involved:

- University of Sharjah, UAE
- Sharjah Municipality, UAE

Team Members:

1. Prof. Zaher Al Aghbari (PI), Coordinator of the Big Data Mining & Multimedia Research Group, Department of Computer Science, UoS
2. Prof. Ibrahim Kamel (Co-I); Information and Network Security Research Group, Department Computer Engineering, UoS
3. MSc. Students and Research Assistants, UoS

Arabic Text Classification Using Deep Learning



Project Summary:

Text classification is the process of gathering documents into classes and categories based on their contents. This process is becoming more important due to the huge textual information available online. The main problem in text classification is how to improve the classification accuracy. This research work is aiming at teaching machines the ability to classify modern standard Arabic text into a specific category (label) or multi-categories, if possible. The project utilizes the power of Machine Learning by using state-of-the-art Deep Learning Algorithms to enhance the training capabilities of the machine, producing high accuracy models. The process of text categorization follows two steps; the first step consists on selecting some key features from all the features available from the text and the second step applies classification algorithms on those chosen features. Such classifier can be implemented either a single-label or a multi-label system. For single label, the model is trained on a dataset that is tagged by explicitly only one category, and the model needs to learn to identify it, or identify more than one, if applicable. In the multi label case, each input document is tagged with multiple categories, and the classifier is expected to report all possible tags. Deep learning algorithms reported solid performance in other field such as the image processing and pattern recognition. We experiment with a variety of DL algorithms to perform text categorization. With some hyper-parameter tuning of the neural networks used, we can achieve excellent results on multiple benchmarks.

Project Significance/Outcomes:

There are multiple models available for the English Language, but models for Arabic are scarce. Therefore, our objective is to bring the Arabic

Language up-to-date with the rest of the languages, highlighting more on its importance. This will allow us to set a "benchmark" for Arabic Language, that all new researches in the Arabic field will be able to use as a metric of evaluation, in order to verify how good their models are. Currently, such versatile benchmark does not exist.

Parties Involved:

- University of Sharjah, UAE

Team Members:

1. Prof. Ashraf Elnagar (PI); Coordinator Machine Language and Arabic Language Processing (ML & ALP) Research Group, Department Computer Science, UoS
2. Eng. Ridhwan Al Debsi; Research Assistant, UoS
3. Mr. Omar Einea; Graduate Research Assistant, UoS

Detection of Cyberbullying in Arabic Social Media Communications

Project Summary:

The popularity of social networks, such as Facebook, Twitter and Instagram, has dramatically increased during the last years, especially with the exponential growth in smartphones and mobile devices. This, in turn, has opened the door to numerous cyber threats specifically targeting users of social networks. Cyberbullying is an example of such threat impacting children, teenagers and young adults. The effects of this threat are so severe and damaging that could lead to suicide, as reported by the news in several cases. Unfortunately, this threat is also becoming a significant issue in the UAE, especially with the wide adoption of Internet technologies and social media by UAE's population, mainly by the young generation. In this context, this research project aims to design and implement a framework for the detection and characterization of cyberbullying activities in online social networks using Arabic language. More precisely, we aim to identify relevant features and behaviors that characterize a cyberbullying threat and the involved users and design classifiers and algorithms to detect such threats.

Project Significance/Outcomes:

The proposed research has an outstanding potential to bring immediate social benefits to the Community. The proposed project aims to make UAE schools a safer place for children and youth. The resulting cyberbullying filter could be used, for example, by UAE schools and universities to reduce the amount of cyberbullying and mitigate its effects. Another important impact is raising awareness about cyberbullying among university students and school children.

Parties Involved:

- University of Sharjah, UAE
- Ministry of Education, UAE

Team Members:

1. Prof. Ibrahim Kamel (PI); Coordinator of the Information and Network Security Research Group, Department of Electrical and Computer Engineering, UoS

2. Prof. Zaher Al Aghbari (Co-I), Coordinator of the Big Data Mining & Multimedia Research Group, Department of Computer Science, UoS

3. Dr. Djedjiga Mouheb (Co-I); Information and Network Security Research Group, Department of Computer Science, UoS

Improved Blockchain Infrastructure with IoT for Critical/Smart Government Applications

Project Summary:

A joint research team from the University of Sharjah (UOS), and American University of Sharjah (AUS), with support from Dubai Electronic Security Center (DESC), worked on investigating the security and privacy issues of Internet of things (IoT) and Blockchain technology, and introducing blockchain-based architecture for IoT that delivers lightweight and decentralized security and privacy.

Project Significance/Outcomes:

The main contribution of this research project is to introduce blockchain-based architecture for IoT that delivers decentralized security and privacy. The architecture retains the benefits of blockchain while overcoming the aforementioned challenges in adopting blockchain into IoT. The goals of this project are well-aligned with Dubai's cyber security objectives, as the proposed infrastructure is an innovative solution in the field of IoT security, and it will enhance the IoT security and privacy while ensuring availability and reliability of the IoT ecosystems.

Parties Involved:

- University of Sharjah, UAE
- American University of Sharjah, UAE
- Dubai Electronic Security Center, UAE

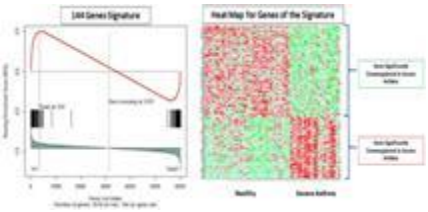
Team Members:

1. Dr. Qassim Nasir (PI); Co-coordinator of the Open UAE Research and Development Research Group, Department of Electrical and Computer Engineering, UoS

2. Dr. Manar Abu Talib (Co-I); Co-coordinator of the Open UAE Research and Development Research Group, Department of Computer Science, UoS

3. Dr. Ali Bou Nassif (Co-I); Open UAE Research and Development Research Group, Department of Electrical and Computer Engineering, UoS

The application of Artificial Intelligence and Engineering Mathematics on Genetic Data to Understand the Pathophysiology of Asthma



Project Summary:

A joint research team from the University of Sharjah (UoS), Sharjah Research Academy (SRA) and Rashid Hospital in Dubai (RHD), worked on applying engineering mathematics principles to shed light on the pathophysiological mechanism of Asthma. The team is currently working on applying the mathematical models to multi-OMIC (Genomics, Transcriptomics and Epigenetics) data derived from asthmatic biological tissue including primary cell lines, clinical biopsies, blood and saliva. The data from those will be used to construct a molecular circuitry map that can help to explain the pathophysiology of Asthma using signal theory, feedback control and fluid mechanics principles. This approach will shed light on the pathophysiology of asthma identifying key diagnostic and therapeutic biomarkers involved in the process.

Project Significance/Outcomes:

Asthma is a chronic complex disease, usually characterized by chronic airway inflammation. Recently, asthma is shown to be heterogeneous disease consisting of multiple different phenotypes. Asthma is difficult to predict, diagnose accurately and treat. The approach adapted in this project will shed light on the pathophysiology of asthma and in the process of doing so, identifying key diagnostic, predictive and therapeutic biomarkers involved in the initiation and progression of Asthma. This has immense help to patients mainly through diagnosing what stage of Asthma they are currently, predicting what stage they will progress or regress in future and identifying the appropriate therapeutic strategy for the patient. The data from this can be used in Asthma prevention.

In addition, the mathematical modelling and bioinformatics methodology can be applied to other chronic complex diseases prevalent in the middle east and worldwide such as cancer and diabetes.

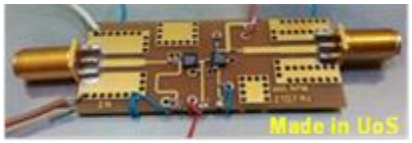
Parties Involved:

- University of Sharjah, UAE
- Sharjah Research Academy, UAE
- Rashid Hospital Dubai, UAE

Team Members:

1. Dr Rifat Hamoudi (PI); Coordinator of Bioinformatics & Functional Genomics Research Group, Department of Clinical Sciences, College of Medicine, University of Sharjah
2. Prof. Qutayba Hamid (Co-I); Coordinator of the Tissue Injury and Repair Research Group, Department of Clinical Sciences, College of Medicine, University of Sharjah
3. Prof. Mufid Al-Samarai (Co-I); Sharjah Research Academy
4. Dr. Bassam Mahboub (Co-I); Rashid Hospital Dubai & University of Sharjah
5. Prof Azzam Magazachi; Coordinator of Immuno-Oncology group, Department of Clinical Sciences, College of Medicine, University of Sharjah

Designing Power and Low-Noise Amplifiers Using GaN Technology for Space and Terrestrial Wireless Communication



Project Summary:

This is a collaborative project between research team from the University of Sharjah (UoS), University of Calgary in Canada and University of Messina in Italy. This project targets the development of new techniques for designing power and low-noise amplifiers using GaN technology. The quality of the circuit design depends on the reliability of the device model that can bring important insight into GaN devices' workings and enable the designers to take full advantage of the technology. Thus, in the first stage of the project a mm-wave noise small-signal model for GaN HEMT will be developed and implemented in CAD software. The model will be used for designing and implantation of high frequency low-noise amplifiers. In the second stage, the model will be upgraded to large-signal one to include thermal and electrical dynamic behaviors. The large-signal model will be used later for designing and implantation of high efficiency power amplifiers.

Project Significance/Outcomes:

The scientific aspects of this research include the use of a new technology in device and microwave circuit design and fabrication, which form the infrastructure of mobile communication, satellite and radar systems. A new advanced designs has been simulated using advanced CAD softwares and the final design has been fabricated and tested. The results of this research have been published in outstanding Journals and Conferences.

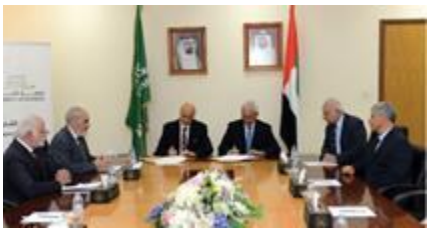
Parties Involved:

- University of Sharjah, UAE
- University of Calgary, Canada
- University of Messina, Italy

Team Members:

1. Dr. Anwar Jarndal (PI); Mixed Analogue-Digital Smart Electronic Circuits & Systems Research Group Department of Electrical and Computer Engineering, UoS
2. Prof. Fadhel Ghannouchi (Co-I); University of Calgary, Canada
3. Dr. Mohamed Helaoui (Co-I); University of Calgary, Canada
4. Prof. Giovanni Crupi (Co-I); University of Messina, Italy
5. Prof. Alina Caddemi (Co-I); University of Messina, Italy
6. Eng. Amer Bassal, UoS
7. Eng. Ahmed Hussein UoS

Presence and Fate of Contaminants of Emerging Concern (CECs) in Sharjah Main Wastewater Treatment Plant



Project Summary:

A joint research team from the University of Sharjah (UoS), Sharjah Research Academy (SRA) and the Desert Research Institute (DRI) in USA, with support from Sharjah Municipality (SM), worked on assessing the Presence and Fate of Contaminants of Emerging Concern (CECs) in Sharjah Main Wastewater Treatment Plant (SWWTP). The CECs include pharmaceuticals, personal health products, hormones and a variety of other trace contaminants. The researchers managed to develop highly sensitive analytical techniques and identified many CECs in the influent and effluent of the SWWTP over a one-year period. The team is working on assessing potential impacts of such contaminants on human health and the environment in addition to methods for their removal.

Project Significance/Outcomes:

The presence of CECs in treated wastewater intended for discharge in the environment or for reuse can adversely impact human health and the environment. Therefore, concerned authorities need scientific data to help control the spread of CECs and reduce the risk associated with them. The research team has produced a number of scientific publications based on the results and currently the outcomes are being presented to the concerned authorities for consideration.

Parties Involved:

- University of Sharjah, UAE
- Sharjah Research Academy, UAE
- Sharjah Municipality, UAE
- Desert Research Institute, USA

Team Members:

- Prof. Abdallah Shanableh (PI); Director of the Research Institute of Sciences & Engineering, Department of Civil and Environmental Engineering, UoS
- Prof. Mufid Al-Samarai (Co-I); Sharjah Research Academy
- Dr. Mohamed Harb Semreen (Co-I); Drug Design and Discovery Research Group, Department of Medicinal Chemistry, UoS
- Dr. Lucy Semerjian (Co-I); Department of Environmental Health Sciences, UoS
- Dr. Kumud Acharya (Co-I); Desert Research Institute, USA
- Dr. Xuelian Bai (Co-I); Desert Research Institute, USA

Managing Manned and Unmanned Air Traffic

Project Summary:

Managing manned aviation will involve the use of sensors, such as heart rate sensors and eye tracking glasses for measuring stress and fatigue levels. These measurements will then be used for building neural network models to predict stress levels of the air traffic controllers. These stress levels will be used as input for optimization models designed to balance workload and the configuration of airspace sectors.

In the second part of this project, an operational concept for unmanned aerial traffic will be developed for the UAE. The developed operational concept will be used to define optimal routes for specific drone applications and it will be visualized using drone simulator.

Project Significance/Outcomes:

For the manned aviation:

1. Collecting measurements from operators to estimate stress levels and connect them to workloads using artificial intelligence to better balance the workload.
2. Building stochastic models that consider weather aspects and fairness in flight schedules.

For the unmanned aviation:

3. Developing an operational concept to operate UAVs and visualizing this concept
4. Building and optimizing the UAV routing under contingency scenarios.

Parties Involved:

- University of Sharjah, UAE
- Department of Civil Aviation in Sharjah, UAE
- Dubai Air Navigation Services, UAE
- Dubai Aviation Engineering Projects, UAE.
- Linkoping University, Sweden
- Swedish Civil Aviation Administration, Sweden
- SAAB Group, Sweden

Team Members:

1. Dr. Ali Cheaitou (PI); Sustainable Engineering Asset Management Research Group, Department of Industrial Engineering & Engineering Management, UoS
2. Dr. Imad Alsyouf (Co-I); Coordinator of Sustainable Engineering Asset Management Research Group, Department of Industrial Engineering & Engineering Management, UoS

3. Dr. Hamdi Bashir (Co-I); Sustainable Engineering Asset Management Research Group, Department of Industrial Engineering & Engineering Management, UoS

4. Eng. Sadeque Hamdan (Co-I); Research Assistant, UoS

5. Eng. Anwar Hamdan (Co-I); Graduate Research Assistant, UoS

6. Ms. Noura Mohamed Al Suwaidi (Co-I); Department of Civil Aviation in Sharjah (DCA), UAE

7. Mr. Aleksandar Pavlovic (Co-I); Dubai Air Navigation Services, UAE

8. Dr. Zain Tahboub (Co-I); Dubai Aviation Engineering Projects, UAE

9. Dr.Jonas Lundberg (Co-I); Linkoping University, Sweden

10. Dr.Magnus Bång (Co-I); Linkoping University, Sweden

11. Dr.Tobias Granberg (Co-I); Linkoping University, Sweden

12. Mr. Billy Josefsson (Co-I); Swedish Civil Aviation Administration (LFV), Sweden

Rapid Strengthening of Unreinforced Masonry Walls for Out-of-Plane Actions Using Fiber Reinforced Shotcrete

Project Summary:

Unreinforced masonry elements are primarily designed to withstand in-plane compression loads with little consideration of the forces generated in accidental events such as earthquake and impact loads. In the occurrence of such events, the unreinforced masonry elements experience in-plane and/or out-of-plane horizontal loads, which they are not designed for, and thus, they will not be able to withstand these additional forces. Further, significant efforts have been devoted in recent years to develop effective methods of enhancing the out-of-plane resistance of URM walls driven by the need to develop impact & blast-resistant designs & retrofits for buildings. The objective of this research project is to develop a rapid method of strengthening URM walls by the use of fiber reinforced shotcrete (FRS) with and without steel reinforcement and investigate experimentally the performance of strengthened URM walls subjected to out-of-plane static loading as well as projectile impact and air blast.

Project Significance/Outcomes:

The outcomes of this project have a direct impact on the way structures are strengthened in the region. The project impact is significant to the community as it also provides data that can be utilized for other shotcrete applications particularly for tunneling and underground construction needed for fast transportation systems such as the metro and substations.

The UAE and the gulf region is undergoing a rapid development in this direction and the project is expected to have a direct impact with this regard. The research team has produced a number of Scopus Indexed conference publications based on the results and currently are working on scientific journal papers.

Parties Involved:

- University of Sharjah, UAE
- Emirates Stone Company, UAE
- GCP Applied Technologies, UAE
- Gulf Rock Tunneling, UAE

Team Members:

1. Prof. Salah Altoubat (PI); Coordinator of Sustainable Construction Materials and Structural System Research Group, Department of Civil and Environmental Engineering UoS
2. Prof. Mohamed Maalej (Co-I); Sustainable Construction Materials and Structural Systems Research Group, Department of Civil and Environmental Engineering, UoS
3. Dr. Moussa Leblouba (Co-I); Sustainable Construction Materials and Structural Systems Research Group, Department of Civil and Environmental Engineering, UoS
4. Eng. Abdul Saboor Karzad (RA); Sustainable Construction Materials and Structural Systems Research Group, Department of Civil and Environmental Engineering, UoS
5. Dr. Pierre Estephane (Co-I); GCP Applied Technologies, UAE
6. Eng. Chris (Co-I); Gulf Rock Tunneling Company, UAE

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