Poster Abstracts

Poster #1

The Memristor: Modeling Directions and Application Circuits
Sherif Abuelenin, Port-Said University, Egypt

Memristor (short for memory resistor) is a two-terminal nanoscale device that is considered to be the fourth passive circuit element. The existence of memristors was theorized in the 1970's, and considered 'missing' since then. Real memristors were only fabricated in the last decade, based on the observation that memristance property arises naturally in nanoscale systems. As the name implies, they are resistors with memory, i.e. the value of the resistance is not fixed, but changes with the history of the current passing through the device. The device keeps the last value unchanged when current stops passing. They open the way to novel circuit designs and applications. Examples are resistive nanoelectronic computer memory, alternative (including multi-valued) computer logic and even new computer architectures. The ability to store multiple bits in a single memristor is a key feature for high-capacity memory. Memristor memory is estimated to be commercially available in the next few years. Recently, other memristive syatems were introduced, e.g. memcapacitors and meminductors. This resulted in the introduction of the memcomputing paradigm. Manufactured memristors are nanodevices, their characteristics differ from ideal ones due to their physical limitations. Therefore, accurate modeling of real memristors is required to enable better understanding of their operation and better analysis of their circuits.

This poster presents work on memristors including utilizing different modeling methodologies of memristive characteristics and introducing new memristor circuits. The team proposed a fuzzy model to enable simpler understanding of how real memristors behave. The team also introduced an accurate simulation model of memristors, and utilized it in different RAM designs. The poster reviews this work in the areas of modeling memristors and utilizing them in new circuit designs; this includes new improvements on the modeling process, and discusses some newly introduced memristor applications.

Poster #2

Statistical Signal Processing for Geophysics
Shuchin Aeron, Tufts University, United States

There is a growing need to handle and process the vast amount of data that is currently being collected from the Oil and Gas (O&G) fields. Further, advanced processing methods are necessary to address unreliable and uncertain sources of information and anomalies. This poster highlights how recent advances in using sparse and low rank signal and system decompositions can be exploited to meet the demands for large-scale and reliable information processing for geophysical applications. In particular, the team considered problems in (a) Ultrasonic imaging; (b) Borehole acoustic Logging While Drilling (LWD); (c) Machine learning for geophysics; (d) Microseismic source localization and (d) Interpolation of pre-stack seismic data. For all of these applications it is shown it is effective to use the knowledge of the physics of the system to impose structural constraints in signal estimation for enhancing the state of the art. Based on these results, the poster will outline future directions in use of statistical signal processing and machine learning methods for advancing petroleum resource exploration and production.

Poster #3

Wireless Nano Sensor Networks Communication challenges
Nadine Akkari, King Abdulaziz University, Saudi Arabia

Nanonetworks will boost the applications of nanotechnology in many fields of our society, ranging from healthcare to homeland security and environmental protection. However, there are many challenges in enabling the communication in nanonetworks. Although there have been many studies on the performance of wireless communications protocols for all sorts of wireless communication networks, these are not valid for nanonetworks.

Wireless nano devices communicating in the Terahertz band can achieve high transmission bit rates at the cost of short communication distance due to the Terahertz band peculiarities. Despite their promising applications, a new communication scheme for wireless nano devices applications is to be developed to allow nano devices to communicate efficiently in the allocated Terahertz band. High speed Wireless Nano Sensor Networks challenges in the Terahertz band could be overcome by considering the effect of distance-based transmissions and Critical Packet Transmission ratio (CTR) on the communication scheme and channel access. Since classical MAC protocols cannot be used given the peculiarities of the Terahertz band, different Medium Access Control (MAC) protocols were designed for an energy-efficient communication among wireless nano devices.

In this context, an overview of the so-far developed MAC protocols will be presented and analysed in addition to the design guidelines and requirements of an energy-aware MAC protocol for WNSN.
The related performance metrics such as node consumed energy, collision probability, and channel access are discussed and analyzed in addition to the network lifetime and throughput.
Finally, current research trends for WNSN and future directions will be highlighted.

Poster #4

Continuous-Time Model Predictive Control Applications to Grid-Connected PV Systems
Ahmed Al-Durra, The Petroleum Institute, United Arab Emirates

This work presents a robust, continuous, nonlinear model predictive control (MPC) for grid-connected photovoltaic (PV) inverter systems. The objective of the proposed approach is to control the power exchange between the grid and photovoltaic system, while achieving the unity power factor. As the continuous nonlinear MPC cannot completely remove the steady-state error in the presence of disturbances, the nonlinear disturbance observer-based control is adopted to estimate the offset caused by parametric uncertainties and external perturbation. The stability of the closed-loop system under both nonlinear predictive control and disturbance observer is ensured by the convergence of output-tracking error to the origin. The proposed control strategy is verified using a laboratory scale complete PV test bed system consisting of a photovoltaic emulator, boost converter, and grid-tied inverter. High performance with respect to DC link voltage tracking, grid current control, disturbance rejection, and unity power factor operation will be demonstrated.

Poster #5

Basin Modeling of the Potential Sourced Sargelu Formation within Zagros Fold Belt, North Iraq

Emad Al-Sarraj, Al-Nahrain University, Iraq

Many approaches have been attempted to determine the potentiality of the Sargelu Formation. All the geochemical studies by various indications refer to this formation as being one of the most important source rocks and its economic horizon shows that it has the potential to generate the most oil and gas in Iraq. Accordingly, basin modeling will declare the scope of its potential and will demonstrate a comprehensive view by utilizing all previous and current data to create a new version of basin modeling. This study explores northern iraq, including the oldest oil exploratory wells which produce the majority of oil and gas in Iraq, and diffes from previous attempts through its use of rock samples (core and cuttings) extracted from Butmah-15, Jabal Kand -1, Qara chuq -1, and the Ajil oil exploratory wells rather than estimations.

One dimensional , petroleum – system modeling of key wells was developed using the Integrated Exploration System (IES) PetroMod software to evaluate burial- thermal history, source rock maturity, and the timing and extent of petroleum generation. Interpreted well logs served as input to the models. The oil generation potential of the sulfur rich Sargelu source rocks was simulated using closed – system Type IIs kerogen kinetics. Model results indicate that throughout northern Iraq, generation and expulsion of oil from the Sargelu began and ended in the late Miocene period.

At present,the model indicates that Jurassic source rocks may have generated and between 70 and 100% of their total oil, and the majority of Jurassic source rocks in Iraq have reached or exceeded peak oil generation. Most rocks have completed oil generation and expulsion except Jabal Kand-1 , which is quite unlike the other wells and is still generating today.

Poster #6

Brain Computer Interfaces and Human Behavior Understanding

Rami Alazrai, German Jordanian Univeristy, Jordan

Human Centered Computing (HCC) is a research field that aims at bridging the gap between the various disciplines involved with the design and implementation of computing systems that support people's daily life activities. This presentation shall address the team's research in two applications related to the HCC field, namely, brain-computer interface (BCI) and human behavior understanding.

On the one hand, brain computer interfacing is an emerging field of research that has gained attention in the biomedical community. BCI systems aim at providing an alternative non-muscular communication pathway to assist people suffering from various neurological impairments and/or motor disabilities to interact with their surroundings. In this vein, the team has been conducting research in collaboration with both the Royal Medical Services and King Hussein Cancer Center in order to achieve the following objectives:

1. Understanding the relationship between the motor imagery and daily life tasks of the human hands via investigating methodologies that can discriminate between EEG associated with wrist and finger movements for more reliable hand movement classification.
2. Developing a BCI framework for controlling prosthetic hands that can serve people with amputated hands.
3. Analyzing muscles' electromyography (EMG) signals to continuously decoding wrist and fingers movements.

4. Developing EEG-based BCI systems to investigate the relationships between EEG and pain levels and how EEG can be used as a reliable tool for detecting, measuring and diagnosing pain levels in cancer patients.

On the other hand, in human behavior understanding, the team is investigating methodologies for recognizing human emotions, single human daily life activities, elderly fall prediction and detection, and human-human interactions by utilizing different types of non-verbal human behavioral signals such as facial expressions, body postures, actions and interactions as video input signals.

Poster #7

Advantages of a Deep Space Ground Station in the UAE

Muthanna AlMahmoud, UAE Space Agency, United Arab Emirates

In July 2014, H.H. Sheikh Khalifa bin Zayed Al Nahyan announced the first UAE science mission to Mars – Al Amal probe. In its efforts to diversify the space industry and enriching the capabilities of Emirati engineers and scientists, the UAE Space Agency is studying the initiative to build the first Deep Space Ground Station in the country to communicate with the probe, allowing the support for future UAE missions, conducting radio astronomy activities, as well as providing the support for international missions and collaborations. This presentation covers the unique benefits of hosting the Deep Space Ground Station in the UAE, the technology utilized, the relation to the Deep Space Network of NASA, and a summary of the activities that the UAE Ground Station will support.

Poster #8

Poverty, Stress, Enrichment, and Human Brain and Cognitive Development

Dima Amso, Brown University, United States

Executive functions (EFs) include the ability to update rules into working memory in order to plan, reason, and control one's own behavior in a goal directed way. EFs necessitate prefrontal cortex (PFC) involvement. There are ostensibly two critical periods in EF development. The first is in the transition from toddler to early childhood years and the second is in the transition from childhood to adolescence. Both periods are marked by changes in peer relations and increased independence and academic demand. This team has found that PFC development during these important transitions is highly vulnerable to the effects of environmental poverty and has shown that as EFs develop beyond childhood, for example, socioeconomic status (SES) moderates the efficiency of this development such that lower SES children show less efficient developmental change. Disruptions to this developmental course may result in pathology, poor academic achievement, and dangerous risk-taking behaviours. Stress in low SES homes may derive from malnourishment, parental emotional stress, or abuse and neglect. Enrichment varies as a function of the availability of stimulation in the home, as well as financial resources that allow exposure to variable experiences and contexts in which to implement rule-guided action, including museum visits, travel, and access to age-appropriate toys and books. One or both of these characteristics of low SES homes may be the source of the SES impact on PFC. This team is approaching this problem with a large-scale demographic data collection on participants in behavioural and neuroimaging tasks. Analytically, the team is again achieving precision in by developing, from standardized scales, detailed subscales using a principle components analysis approach and is showing that it is precisely the Cognitive Enrichment aspect that is predictive of better PFC and executive functions development, over and above any differences arising from stress in low SES homes.

Poster #9

Nanotechnology-Based Solutions for Next Generation Devices: Health, Water, Food, and Environment

Silvana Andreescu, Clarkson University, United States

Rapid progress of nanotechnology and advanced nanomaterials production offers significant opportunities for designing powerful sensing systems and devices with integrated recognition, detection and communication capabilities. These technologies are needed in a wide range of applications, especially in medical diagnostics and in the environmental and food monitoring fields. Examples include responsive materials for wearable sensing devices, flexible electronics, functional contact lenses, small sensors for monitoring brain activity, smart screens, and intelligent packaging. For example, nanostructures that have the appropriate detection sensitivity and selectivity are particularly important for the development of low cost devices for home diagnosis and point of care testing. This presentation will discuss the use of nanotechnology to construct nano-based sensing systems designed to address emerging health and environmental challenges. Examples of sensors that utilize advanced nanomaterials possessing interesting optical, catalytic and oxygen storage/release properties and application of these devices for the detection of clinically and environmentally important analytes will be presented. Recent work focusing on the development of nanoparticles based tests for point-of-care diagnosis and therapy as well as the use of implantable microbiosensors for studying biomolecular mechanisms in in vivo conditions and for exploring the brain neurological activity in the will be discussed.

Poster #10

Multiple Stellar Populations in LMC Stellar Clusters

Randa Asa'd, American University of Sharjah, United Arab Emirates

Star clusters are generally defined as groups of stars bound by gravity, born at the same time (same age) with definite chemical composition (metallicity). However, many recent studies have discussed age spread within a star cluster, which proposes multiple bursts rather than a single burst formation. When fitting the integrated spectra of selected young clusters (log (age/year) less than 7.5) with the different stellar population model libraries, this team noticed a concave-like spectrum shape of the observational data that prevents a good fit with the spectral models. The spectra of these young ages are from different observing runs which means that flux-calibration is not the reason for this bad fit. This presentation shows that this is due to multiple stellar populations.

Poster #11

Enabling New Class of Earth Science and Deep Space Nasa Missions using Innovative Deployable Antennas

Nacer Chahat, National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL), California Institute of Technology, United States

Traditional satellites often come implemented with high-performance, high-power, and multi-functional instrumentation with stringent requirements. Complex designs translate into high mass and volume, making any satellite payload extremely expensive and time-consuming to design and fabricate. Hence, scientists and engineers have been exploring the possibility of generating useful science using small satellites. The SmallSat paradigm promises rapid delivery at a fraction of the cost and time of conventional spacecraft.

Meeting the combined high gain and low stowage volume constraint has been a huge challenge confronting antenna designers; so much so that before the last two years there have been no smallSat antenna designs that have had gains over 15dBi. NASA's Jet Propulsion Laboratory pioneered a new class of antennas using a creative deployment mechanism coupled with a robust electromagnetism antenna design. This opens up a new realm of options for low-cost near-Earth and Deep Space spacecraft platforms, such as CubeSats and SmallSats, with obvious savings not only on the instrument implementation, but also on the spacecraft and launch costs.

For the first time, MarCO CubeSats will venture far beyond LEO toward Mars. They will fly alongside the InSight Mission in 2018 and provide a real time bent pipe communication link during the critical Entry, Descent and Landing (EDL) phase of the InSight mission. The telecommunication link was enabled using a deployable high-gain reflectarray antenna.

For Earth Science, a constellation of spacecraft carrying identical copies of the same instrument can now be considered in various relative positions in low Earth orbit (LEO) to address the specific observational gaps left open by current missions requiring high-resolution vertical profiling capabilities. This is what RainCube, the first radar in a CubeSat, will do after launching at the end of 2017. It uses an innovative 0.5-meter deployable mesh reflector fitting in a highly constrained volume. NASA's Jet Propulsion Laboratory is currently developing even larger deployable antennas (~$1m^2$) to answer the needs of (1) Earth Science radar requiring smaller footprints and (2) Deep Space satellites venturing even farther in the solar system.

Poster #12

Graphene-Based Sensing Platform for Rapid Detection of Water Contaminants – from Concept to Product

Junhong Chen, University of Wisconsin-Milwaukee, United States

Water plays an important role in the economic world; only 3% of available water is potable, and with increasing demand, the need for safe drinking water is rising. The National Academy of Engineering identified "providing access to clean water" as one of the top ten grand challenges for engineering in the 21st century. Heavy metal ions, e.g., lead, mercury, and arsenic, are widely present in water systems. These heavy metal ions are poisonous and may lead to serious damage to organs, tissues and bones, and nervous systems of humans. Existing water quality monitoring mostly occurs at the water supply intake or water treatment plant, instead of along water distribution lines and at the point of use, which is considered inadequate given potential changes in water quality and associated risks within water distribution systems. Current detection methods for aqueous heavy metal ions are often too expensive or unsuitable for in-situ and real-time detection (an unmet need). Here, the team reports a graphene-based field-effect transistor platform that can be useful for real-time detection of a wide range of water contaminants such as heavy metals and bacteria. The working principle of the sensor is that the graphene conductivity (usually measured in resistance) changes with the binding of chemical or biological species to probes anchored on the graphene surface. As such, the presence of the chemicals can be determined by measuring the sensor resistance change. The breakthrough technology allows real-time detection (no sample preparation) of deadly contaminants with unprecedented sensitivity and specificity in field settings (outside a central laboratory facility) for single point testing (e.g., handheld device) or in-line continuous flow testing. This poster will introduce the platform technology and its development from concept to prototype products in the context of the US National Science Foundation Water Equipment and Policy Industry-University Cooperative Research Center.

Poster#13

Near Elimination of Air Traffic Disruption from Orbital and Sub-Orbital Commercial Space Traffic

Thomas Colvin, Institute of Electrical and Electronics Engineers, United States

Commercial aircraft are highly reliable vehicles, with accident rates less than one in a million. By contrast, even the most reliable launch vehicles have a 2% probability of failure. If a space vehicle explodes in flight, it can cause over 100,000 pieces of flaming debris to shower upon nearby commercial aircraft, causing them to fail catastrophically. Therefore, there must be a set of procedures to mitigate the risk to aircraft during a space operation. Unfortunately, traditional methods of ensuring aircraft safety during a space operation are inefficient; they require massive, static no-fly zones that aircraft must reroute around. The additional distances flown, fuel burned, and time delays during these reroutes are so burdensome to the airline industry that space operations must be relegated to spaceports in isolated areas where few aircraft operate.

This poster presents a new probabilistic risk-mitigation framework, called compact envelopes, for safely and efficiently integrating space launch and reentry operations into the U.S. National Airspace System. Compact envelopes satisfy the Federal Aviation Administration's probabilistic standards for aircraft safety and also significantly reduces the volume of airspace that is restricted from aircraft use during space vehicle operations. Compact envelopes can potentially reduce aircraft disruptions due to space launch and reentry operations by two orders of magnitude, making routine co-existence of air and space traffic possible. Further, this would allow spaceports to operate in geographic areas that were previously considered impossible due to concerns about danger to aircraft and operational efficiency, clearing the way for point-to-point suborbital space travel from an air traffic management perspective.

Poster #14

Stochastic Programming Approaches to Articifial Lift Infrastructure Planning for Horizontal Wells

Selen Cremaschi, Auburn University, United States

Artificial lift methods (ALMs) are used in horizontal wells in order to lift accumulated fluid in the well and to help sustain well performance. At the first stage, the gas flow rate of a well declines to the point where the well must be deliquified to maintain the production. The reservoir pressure of the well continues to decline with time, and at second stage, additional energy is required for continued production. At each stage, one or more ALMs must be implemented to achieve a desirable well production performance. This poster presents a mathematical program that represents the artificial lift infrastructure planning problem with several case studies.

The artificial lift infrastructure planning problem involves the selection of ALMs that will be installed, and their installation and uninstallation schedule (if applicable). The objective is to maximize the net present value of the well(s). The revenue is estimated based on the produced fluids and their prices. The costs include the CAPEX and OPEX of selected ALMs, the local taxes, and royalty related expenses. The constraints are: 1) make sure that only one ALM is in operation at any given time; 2) model the production using appropriate hyperbolic decline curves after the installation of each selected ALM; and 3) ensure that an ALM is only selected when it is appropriate for the field, and is uninstalled from the field when it violates any of its operational limitations. The production rates are uncertain and depend on selected ALMs.

The resulting model is a large scale non-convex mixed integer nonlinear program, and can only be solved for short planning horizons within reasonable times. An equivalent mixed integer linear program is constructed via exact linearization, which reduces the solution times considerably. The comparison of this model's recommendations with the historically implemented ALMs for the case studies reveals the model's recommendations can increase total production by around 10%.

Poster #15

Novel Solutions for Transient Thermal Management of Aerospace Applications

Peter de Bock, GE Global Research, United States

Aerospace thermal management is a challenging field as aircraft experience significantly different thermal environments during a mission. During cruise conditions thermal loads are often modest and ample cool air is surrounding the aircraft. However after landing, the plane can be parked on a hot tarmac, with hot engines that significantly heat the electronics during soakback. Also take-off provides a challenging point as the plane can be initially hot, and it could require significant time to cooldown before departure.

This transient set of load and boundary conditions is often managed by modeling the "worst-case" scenario coupling the highest load to the highest temperature boundary condition. As this situation only occurs infrequently during the life of an aircraft, the thermal management system is often over designed significantly. A novel thermal energy storage system is developed that can absorb heat effectively similar to the thermal equivalent of a capacitor. It is demonstrated that for highly transient mission the thermal capacitor can absorb heat during peak loads and overall result in a weight improved system. The technology for the thermal capacitor includes a novel heat conduction method to get heat in and out of phase change material such that a high capacitance but minimal resistance system is achieved.

Poster #16

Exploring the Earliest Environments of Mars & Mineralogy with VSWIR Spectroscopy

Bethany Ehlmann, California Institute of Technology, United States

The last decade of high resolution orbital imaging spectroscopy of Mars and in situ exploration with rovers has revealed nearly a dozen distinct aqueous, potentially habitable environments, including lacustrine, hydrothermal, and weathering, preserved in the rock record of early Mars and identified by diverse secondary minerals. These environments varied in space and time and do not necessarily imply a continually warm early Mars, but rather a warm and wet subsurface with punctuated periods of more clement conditions that allowed liquid water availability at the cold surface. I will describe the geology of a select set of these ancient environments as well as new, small shortwave infrared imaging spectrometer instruments that will enable new discoveries on future landed and orbital missions.

Poster #17

The Water Content of Martian Recurring Slope Lineae: Insights from Infrared Instrumentation

Christopher Edwards, Northern Arizona University, United States

Observations of Recurring Slope Lineae (RSL) from the High Resolution Imaging Science Experiment (HiRISE) have been interpreted as present-day, seasonally variable liquid water flows; however, orbital spectroscopy has not confirmed the presence of liquid H2O, only hydrated salts. Thermal Emission Imaging System (THEMIS) temperature data and a numerical heat transfer model definitively constrain the amount of water associated with RSL. Surface temperature differences between RSL-bearing and dry RSL-free terrains are consistent with no water associated with RSL and, based on measurement uncertainties, limit their water content to less than 0.5-3 wt%. In addition, distinct high thermal inertia regolith signatures expected with encrusting evaporitic salt deposits from cyclical briny water flows are not observed, indicating low water salinity (if any), and/or low enough volumes to prevent their formation. Alternatively, the observed salts may be pre-existing in soils at low abundances (i.e. near or below detection limits) and largely immobile (not encrusting). These RSL-rich surfaces experience ~100K diurnal temperature oscillations, possible freeze/thaw cycles and/or complete evaporation on timescales that challenge their habitability potential. The unique surface temperature measurements provided by THEMIS are consistent with a dry RSL hypothesis, or at least significantly limit their water content.

Poster #18

Cell Therapy in Neurodegenerative Disorders- the Case of Alzheimer's Disease

Zeinab El Maadawi, Cairo University, Egypt

Alzheimer's disease (AD) is a progressive neurodegenerative disorder and currently is the most common type of dementia in the world. It is reported to affect 35.6 million patients worldwide. The number of patients who suffer from AD and other dementias worldwide is estimated to reach 115.4 million by 2050. AD is characterized by abnormal protein deposits in the brain that include amyloid β (Aβ) peptides and tau-protein fibers forming neurofibrillary tangles (NFTs).

Current pharmacological treatment has limited efficacy and only provides symptomatic relief without long-term cure. As a result, cell-replacement therapy using stem cells is an emerging potential treatment to AD. Animal trials using stem cells to treat and modulate cognitive impairment in AD models are designated to intervene via different mechanisms such as replacing damaged cholinergic neurons, protecting neurons from toxic amyloid protein aggregates or tau neurofibrillary tangles, and promoting neurogenesis in hippocampus.

This team studied the effect of mesenchymal stem cells (MSCs) on a mice model of AD. MSCs were harvested, labeled & then injected in AD mice. Animals were tested for their locomotor activity and memory using open field test and Y-maze. Histopathological evaluation was done by detecting amyloid β (Aβ) peptides and neurofibrillary tangles (NFTs). In addition, immunohistochemistry of glial fibrillary acidic protein (GFAP) which is a marker for astrocytes, Caspase 3 for apoptosis, and CD68 for active microglia was done and was subjected to image analysis & quantitative morphometric study. Statistical analysis revealed significant decrease in GFAP, Caspase 3, and CD68 immunoreaction in the group that received MSCs compared to control. Labeled MSCs were clearly demonstrated in mice brains up to two months after MSC injection. These results showed promising therapeutic effect and improve our understanding about the mechanism of dementia in AD.

Poster #19

Nanostructured Polymers for Sustainable Energy and Nanotemplating Applications
Thomas Epps, University of Delaware, United States

Block polymers (BP)s are macromolecules formed from two or more distinct types of polymer segments that are chemically connected. The self-assembly of these BPs can facilitate materials design for many emerging nanotechnologies. The Epps group is focused on understanding and applying the structure/property/function relationships inherent in nanostructured polymers to design, synthesize, and characterize new systems exhibiting molecular-level assembly. A particular interest in the research group is developing functional materials for a variety of potential platforms including membranes (fuel cells, solar cells, lithium batteries, analytical separations), green and bio-based materials, coatings, nanoscale templates, and drug delivery capsules. Three areas of recent progress in the group involve: 1) generating new conducting membranes for lithium battery membranes with improved room temperature ion conductivity and enhanced electrochemical stability; 2) designing bio-based styrene and bisphenol-A alternatives for thermoset and thermoplastic applications using waste feedstocks from the pulp and paper industry; and 3) developing new methods for the scalable alignment and templating of nanostructures for electronic materials and data storage applications. Each of these systems leverages understandings of thermodynamic and kinetic constraints in soft materials to engineer functional systems ideal for improving sustainability, human health, and the environment.

Poster #20

Enhancing Sustainability through Simulation: Green Buildings and Nanostructured Solar Cells
Baskar Ganapathysubramanian, Iowa State University, United States

The past decade has seen rapid improvements in cyber infrastructure along with concurrent advances in computational sciences. This has greatly enabled the scope of simulation techniques to model, control, and design complex systems. In particular, leveraging computational science progress has substantially enhanced sustainability efforts. This poster illustrates two such examples where high performance computing, applied mathematics, and data-driven analysis enabled breakthroughs in solar energy devices and building sustainability efforts.

Green buildings: The poster shows how a collaborative effort between an architect, a computational scientist, and a control theorist enabled the vision of enhancing the use of naturally occurring energy flows within buildings to achieve thermal comfort and air quality, while minimizing fossil fuel consumption. The team developed advanced computational techniques to predictively model green buildings (that seek to leverage as much of natural ventilation as possible while gracefully coupling with active conditioning strategies) and design optimal sensor placement strategies. This has resulted in next generation control algorithms and building design guidelines that substantially reduce the building energy footprint.

Clean energy: Organic (and Perovskite based) electronics represent a promising low-cost strategy for harnessing solar energy. A key technological bottleneck to widespread use is the unclear link between processing conditions and how it affects morphology and performance. This is further complicated by the large set of solvents, substrates and fabrication conditions available to fabricate these material systems. This serves as compelling reasons for developing material informatics tools to be used as virtual manufacturing tools for accelerated design. The team has developed computational strategies that predictively link fabrication process nanostructure and property of thin film solar devices to rapidly explore the manufacturing space.

Poster #21

Improving Water Quality in MENA Region by Persulfate-Based Advanced Oxidation Technologies

Antoine Ghauch, American University of Beirut, Lebanon

The use of Persulfate (PS) for the decontamination of water effluents has been recently introduced as a reliable advanced oxidation process able to be sustained in solution based on different methods of PS activation. This team's work on pharmaceutical compounds and AUB MC hospital effluent showed complete degradation and mineralization of several active ingredients upon use of chemical, thermal, as well as photolytic persulfate activation. Pharmaceutical active ingredients include Ibuprofen, Ketoprofen, Sulfamethoxazole, Naproxen, Ranitidine, Bisoprolol, Chloramphenicol as well as methylene blue. The results obtained on chemical activation showed the high potential of industrial iron waste collected from a local car workshop to sustain iron corrosion products in solution allowing smooth PS activation resulting in an increase of the reaction stoichiometric efficiency to above 60%. On the other hand, thermal activation along with chemical activation showed synergistic effect of PS pharmaceutical oxidation toward full mineralization. Furthermore, recent investigations into UV/PS activation using a low pressure mercury lamp of 4.9 Watts showed excellent results on the degradation of chloramphenicol antibiotics in water. This could easily open the way toward PS activation in water using renewable energy upon solar irradiation under specific experimental conditions. Research outcomes from the PEER program showed that Persulfate technology can be applied at low cost to remediate polluted effluents with no environmental impact as for example leachates of solid waste or reverse osmosis effluent in addition to special effluents e.g. fuel resulting from pyrolysis of solid waste. Additional investigations are planned for scaling up the technology and building reactors adapted to each situation e.g. industrial, municipal, etc.

Poster #22

Neural mechanisms of performance evaluation in singing birds

Jesse Goldberg, Cornell University, United States

Virtually all of our behaviors are learned through trial and error by matching our performance to internal goals. Yet remarkably it remains unknown how the brain evaluates performance as 'good' or 'bad' during practice. For example, when learning a piano concerto how do you know if you struck the right or wrong note? The problem is that there is nothing intrinsically 'good' or 'bad' about the sound of A-sharp – it entirely depends if that's the key you wanted to strike at that time of the song. In tasks where animals seek primary rewards such as food or juice, dopamine neurons in the ventral tegmental area (VTA) evaluate behavior by encoding reward prediction error, the difference between predicted and actual reward outcome. Yet in contrast to reward processing, performance evaluation requires sensory feedback to be compared with internal benchmarks that change from moment to moment in a sequence. We don't know how the brain does this. This poster shows for the first time that dopamine activity encodes performance error. The team recorded songbird dopamine neurons as they controlled perceived error with distorted auditory feedback and found that when a specific part of the song sequence is distorted with auditory feedback (sounds bad), basal ganglia-projecting dopamine neurons are phasically suppressed; when that specific part of the song is left undistorted (sounds good), these neurons are phasically activated. Thus dopamine activity encodes performance error by evaluating the quality of ongoing behavior relative to internal performance benchmarks. The identification of dopaminergic performance error signals in birdsong demonstrates that reinforcement mechanisms can generalize to a wide array of natural behaviors where performance is matched to complex and ever-changing internal goals.

Poster #23

Gamma Ray Bursts: Probes of the Early Universe

Sylvan Guiriec, NASA Goddard Space Flight Center, United States

Looking far away in space is looking far back in time, almost as far as when our universe was born in the Big Bang. Gamma ray bursts (GRBs) are the brightest explosions in space. They release in a few seconds energy equivalent to the total mass of the sun in jets of matter and light that propagate through space at relativistic velocities. Because they are so bright in the gamma-ray regime, where photons do not get absorbed by dense matter, GRBs can be observed across most of the visible Universe. These explosions can reveal, therefore, the places of black hole formation, either from the collapses of hyper-massive stars or from the mergers of compact objects. Such mergers are the origins of gravitational wave signals, such as the ones recently discovered from two black hole - black hole mergers.

For these reasons, astrophysicists have high expectations for using GRBs as cosmological probes. However, our understanding of the mechanisms powering GRBs is still limited. Over the past years, this group has been developing a model for GRBs that significantly disentangles the various simultaneous emission processes that power these sources. This presentation will show how this new model offers a very promising relation that may establish GRBs as standard candles and, therefore, as prime tools for cosmology.

Poster #24

Exciton Management on High Efficiency Polymer Non Fullerene Solar Cells

Kenan Gundogdu, North Carolina State University, United States

Currently one of the major research problems in polymer based OPVs is the efficient generation and transportation of charges within the device structure. Charge generation involves splitting of excitons and hence a driving force for moving the electron and hole apart at the D/A interfaces. This driving force has to be minimized in order to avoid large V_oc losses. There are a number of factors impacts the V_oc, the energy level alignments at the interface, dielectric response of the material, energetic disorder, lifetime of the CT state, and the density of the states. Over the last few years there has been a significant improvement in terms of material science aspect of the BHJs. The introduction of small molecule acceptors (SMA) and polymer acceptors provided significant flexibility in engineering the interface properties. Hence we can study charge generation and transport dynamics comprehensively. The flexibility of using different materials for both donor and acceptor provides opportunity to tune the optical and electronic characteristics that will enable both highly efficient charge generation and high V_oc, ultimately improving the efficiency of the solar cells. This presentation will summarize some of the recent work on ultrafast spectroscopy of OPVs based on all-polymer and polymer/small molecule acceptor blends. By characterization of variety of blends we found some design rules for both electronic and morphological properties of the BHJs. Specifically, this poster will discuss the role of exciton lifetime, Forster resonant energy transfer (FRET), and interfacial energy level alignments in efficient charge generation in polymer/SMA BHJs.

Poster #25

The Brain and Decision-Making: Perceptual-Cognitive Interactions
Claudine Habak, Cognitive Neuroimaging Unit, ECAE, United Arab Emirates

Fast, objective, and effective measures of brain function hold multiple applications for the fields of communication and health. Some perceptual-cognitive tests probe brain function at various levels of processing (low, intermediate, high), especially when paired with neuroimaging techniques. These tests 1) allow us to better understand how the brain analyzes information and 2) are highly sensitive to slight changes in function, such as changes in health, development, and/or performance. The purpose here is to define differential patterns of behavioral and brain activity that reveal the brain's processing rules. Perceptual-cognitive mechanisms involve human sensations, actions, and decisions, all of which depend on neural communication, with interactions between lower-level sensory brain regions and higher-level decision-making brain centers. Decision-making or taking action, therefore, relies not only on its inherent operations, but also on sensory processing. These systems interact and adapt to maintain optimal function within the environment.

Using perceptual-cognitive tasks in fMRI, this team finds that for equal tasks, small changes in visual information can shift the balance of brain activity towards lower (posterior) or higher (anterior) brain regions; where lower-region activity reflects more automatic brain processing, and higher-region activity, more demanding processing. This suggests that the way in which information is communicated can lead to easier or more difficult brain processing and change the level of brain analysis regardless of task demands. This allows us to define what and how to elicit optimal processing demands for the brain to perceive and use information effectively. These findings have implications for 1) optimizing information, so it is streamlined to the brain's inherent processing, 2) designing brain-friendly tools and communication for effective transmission, and 3) quantifying brain function and its health-related changes.

Poster #26

Nano-microbial sensors: An advanced Way for Rapid Pathogenic Detection
Rabeay Hassan, National Rsearch Centre, Egypt

Microbial infectious diseases remain a serious public health problem due to the fast-spreading of microbial pathogens and biological contaminants in the environment. Since the detection of pathogenic bacteria is necessary to the prevention and identification of health problems, sensitive detection assays are urgently needed, but reliable, sensitive, quantitative, and rapid assays for pathogenic microorganisms are not yet readily accessible. Bioelectrochemical systems including electrochemical sensors and biosensors are becoming an essential part of biological assays as they satisfy the expanding need for rapid and reliable measurements. However, in most critical diagnostic applications, the low level of sensitivity and specificity of the electrochemical assays is not sufficient. Interestingly, nanomaterials have the capacity to improve the stability, minimizing of sensor's surface fouling, and increasing sensitivity and selectivity. These unique properties make them extremely attractive sensing elements for optimization of the bioelectrochemical system. Thus, based on the electrochemical communication of the viable cells of pathogens with the nano-electrode, a new microbial sensor has been proposed for the desirable objective. The team looks forward to the proposed microbial sensor being a platform for the quality control and monitoring of the target microbial pathogens in medical and environmental samples.

Poster #27

Cannabinoids Transduction Signal Pathway in Gt1-7 Immortalized Hypothalamic Neurons

Hanaa Hoddah, Faculty of Sciences-Tetouan, Morocco

Using immortalized hypothalamic GT1-7 neurons, which express the CB1 cannabinoid receptor (CB1R) and three Ca2+ channel types (T, R and L), this team found that the CB1R agonist WIN 55,212-2 inhibited the voltage-gated Ca2+ currents by about 35%. The inhibition by WIN 55,212-2 (10 microM) was reversible and prevented by nifedipine (3 microM), suggesting a selective action on L-type Ca2+ channels (LTCCs). WIN 55,212-2 action exhibited all the features of voltage-independent Ca2+ channel modulation: 1) no changes of the activation kinetics, 2) equal depressive action at all potentials and 3) no facilitation following strong prepulses. At variance with WIN 55,212-2, the CB1R inverse agonist AM-251 (10 microM) caused 20% increase of Ca2+ currents. The inhibition of LTCCs by WIN 55,212-2 was prevented by overnight PTX-incubation and by intracellular perfusion with GDP-beta-S. The latter caused also a 20% Ca2+ current up-regulation. WIN 55,212-2 action was also prevented by application of the PKA-blocker H89 or by loading the neurons with 8-CPT-cAMP. The team's results suggest that LTCCs in GT1-7 neurons are partially inhibited at rest due to a constitutive CB1R activity removed by AM-251 and GDP-beta-S. Activation of CB1R via PTX-sensitive G proteins and cAMP/PKA pathway selectively depresses LTCCs that critically control the synchronized spontaneous firing and pulsatile release of gonadotropin-releasing hormone in GT1-7 neurons.

Poster #28

Toward Developing Novel Deep UV Technology for Biophotonics and Solar Energy Conversion and Beyond

Wojciech Jadwisienczak, Ohio University, United States

The project capitalizes on combining interdisciplinary experimental and theoretical studies on exploration of science and engineering of nano-III-nitride semiconductors and their alloys for development of robust solid state, mercury-free (Hg-free) deep ultraviolet (UV-C, 190-280 nm) devices for light generation/detection and solar energy conversion. III-nitride semiconductors, such as binary (AlN, BN), ternary (AlGaN), and quaternary (AlInGaN) alloys as well as the novel boron-containing III-nitride compounds, such as BAlN, BAlGaN and AlInGaN are of great interest for applications in rapidly evolving deep UV optoelectronics & biophotonics technologies. The fundamental science part of the project is the growth, characterization, and theoretical modeling of these materials with different dimensionality, whereas the engineering aspect focuses on development of deep UV light emitting devices, solar energy converters, sensors etc. Specifically, the project will focus on generation of deep UV radiation and its applications in photonics, photochemistry, water germicidal, and bio-photonics applications (e.g. chemical-free, no chlorine additive disinfection of potable water, waste water, and seawater treatment for immediate field testing and applications in rural communities in line with the theme of "Water for Sustainable Living"). Currently, the mercury (Hg) discharge lamps used for these applications have limited quantum efficiency, require complex infrastructure, and have the strong negative environmental impacts of Hg disposal. The project capitalizes on already existing collaboration among research groups from United States, Tunisia, Saudi Arabia, and Pakistan and the broader impacts of the project include societal implications of developing cohesive understanding of novel UV technology for world-wide civilian applications. The project also aims to foster the participation of faculty and students from the U.S. and Arab countries in science and education abroad.

Poster #29

Wearable Computers on the Edge of the Cloud

Roozbeh Jafari, Texas A&M University, United States

As wearable computers gain traction in the consumer market, the bold vision of unobtrusive, pervasive and continuous physiological and bio-kinematics signal monitoring is taking hold in everyday life. These platforms provide new avenues to continuously monitor individuals, whether it is intended to detect an early onset of a disease, assess human performance, or the effectiveness of a treatment. In the past few years, the community has observed a large number of applications that have been developed using wearable computers. There are a number of fundamental challenges that need to be addressed before realizing the true ubiquitous use of the wearable systems.

This poster provides an overview of the team's activities and highlights several wearable applications including a wrist-worn watch capable of monitoring ECG, PPG, and blood pressure and a motion-based wearable system for gesture recognition and sign language recognition. The poster highlights challenges associated with reducing the form factor and enhancing the usability of the data obtained in users' natural environment. The poster will cover several solutions aimed at enhancing the usability of wearable applications on the edge of the cloud providing signal processing support.

Poster #30

Integration of Solar Renewable Energy in Demand-Side Management for Smart Home Environment

Yaser Jararweh, Jordan University of Science and Technology, Jordan

Environmental concerns and high prices of fossil fuels increase the feasibility of using solar renewable energy sources in a smart grid. Nowadays many smart homes adopt the use of solar renewable energy sources to satisfy their load demand. This poster proposes a mechanism for scheduling load demand of Smart Home Environment according to the availability of solar renewable energy and the varying price of grid energy. Binary linear programming is used to model the proposed mechanism. Two types of demands are used in this model: 1) must run demand, and 2) scheduled demand. The proposed mechanism aims to minimize smart home electricity cost by maximizing the usage of solar renewable energy. Simulation shows that the proposed energy scheduling mechanism minimizes total electricity cost by 48% and maximizes the used solar renewable energy to 65% of the total generated renewable energy.

Poster #31

Earth and Planetary Atmospheric Entry Flows: Impact and Control of Laminar-to-Turbulent Transition

Joseph Jewell, Air Force Research Laboratory, United States

The measurement and prediction of high-speed boundary-layer transition (BLT) is critical to hypersonic vehicle design, including the design of planetary entry and earth re-entry platforms. Increased skin friction, drag, and surface heating rate after transition increase the necessary weight of the thermal protection system (TPS) and add challenges for vehicle control. Studying this phenomena from a fundamental perspective is a necessary approach to advance the state of the art in BLT predictive science, which in turn leads to more efficient TPS design, more responsive entry vehicle control, and a reduction in mission risk and uncertainty. In the present work, the team performs experimental and computational studies in concert to elucidate the driving mechanisms of BLT with real-gas chemistry (thermochemical nonequilibrium at high enthalpy), and examine a potential technique for delaying or controlling the BLT process. Experiments are performed at re-entry-like conditions at Mach 6 in the T5 Hypervelocity Reflected Shock Tunnel at Caltech, using a 1m length 5-degree half angle axisymmetric cone instrumented with 80 fast-response annular thermocouples, complemented by boundary layer stability computations. The effect of CO_2/air gas mixtures is examined. In nondimensionalized terms, transition delay with increasing CO_2 concentration is observed: tests in 100% and 50% CO_2, by mass, transition up to 25% and 15% later, respectively, than air experiments. Finally, a novel method to control transition location with boundary layer gas injection is investigated. An appropriate porous-metal injector section for the cone is designed and fabricated, and the efficacy of injected CO_2 for delaying transition is gauged at various mass flow rates and compared with both no injection and chemically inert argon injection cases. In preliminary results, CO_2 injection is seen to delay transition, and inert argon injection seems to promote it.

Poster #32

Rock Properties Prediction using 3D X-ray Computed Tomography Images

Mohamed Soufiane Jouini, Petroleum Institute, United Arab Emirates

In the oil industry, rock properties obtained from cores during drilling are crucial to evaluate hydrocarbon reserves in oilfields. Properties are measured experimentally in laboratory on 1.5 inch diameter cylindrical samples. Nevertheless, measurement techniques might be time-consuming in some cases or very difficult to carry out in unconsolidated rocks, for example. This team proposes two new approaches to overcome these limitations by estimating rock properties using mathematical modeling and 3D X-ray Computed Tomography (CT) scanner images. The first method is a stochastic approach where the textures of X-ray CT scan images are modeled by implementing a parametric model including first and second order statistics. A neural network is then used to find a potential relationship between textural descriptors and rock properties. After the learning process, the calibrated neural network allows predicting rock properties. The main objective is to obtain reliable continuous rock properties estimation values along cores. Also, the descriptors are used to classify the main representative textural facies in core samples before cutting core in order to optimize core plug extraction. The second method is a deterministic approach where image processing techniques and numerical simulations are combined to predict rock properties. The first step consists of segmenting 3D high resolution micro-Tomography images (1 to 40 microns) into solid and porous phases. Then, based on the extracted pore network, several properties like porosity, permeability and elasticity are estimated. The team implements numerical simulations techniques such as Lattice Boltzmann approach to simulate fluid flow and Finite Element Method to solve the elasticity equation on the digital image model of rocks. Finally, estimation results are compared with experimental measurements for real data using both approaches.

Poster #33

EEG Brain Exploration and Signal Processing for Hand Motion and Pain Level Estimation

Ala’ Khalifeh, German Jordanian University, Jordan

This poster summarizes two ongoing funded projects at the German Jordanian University in cooperation with Dr. Rami Alazrai, Dr. Yaser Mowafi, and Dr. Nasim AlNuman.

The purpose of the first project is to capture and record ElectroEncephaloGram (EEG) signals of the brain that are associated with movement of a particular body part, such as hand and finger movement. The electromyography (EMG) of the hand muscles are also recorded and analyzed to study and analyze the relationship between the two signals and the hand movement. In order to achieve that goal, a set of hand and finger movements are performed, while recording their locations in the space using a motion capture system such as Vicon, at the same time, both sEEG and EMG signals are captured and analyzed by extracting defined features and using classification and regression methods to understand the relationship between these signals and the hand and finger movements and angles. The main purpose is to be able to use these signals to control a prosthetics arm for a hand amputee subject.

The other ongoing project is to analyze the EEG signal that are associated with human pain, which can be artificial one, such as an induced tonic pain, or real pain such as the pain associated with cancer patients. The purpose here is to find a quantitative way to measure the pain subjectively, using the recorded EEG signal during the pain period, which helps the physicians in estimating the pain level and adjusting the pain relief medications accordingly.

To assure the projects applicability and feasibility, both two projects are conducted in cooperation with industrial partners, mainly, the Royal Medical Services Farah Rehabilitation Center for the first project and the King Hussein Cancer Center in Jordan for the second project.

Poster #34

Effect of Asprin and Clopidogrel administration in Experimental Traumatic Brain Injury

Firas Kobeissy, American University of Beirut, Lebanon

Traumatic brain injury (TBI) often referred to as the “silent epidemic,” is a non-degenerative non congenital insult to the brain due to a blow or penetrating object that disrupts the function of the brain leading to permanent or temporary impairment of neuropsychological functions . Antiplatelet agents such as clopidogrel and Acetyl-Salicylic Acid- ASA (aspirin) inhibits the formation of blood clot by inhibiting platelet aggregation and activation and are essential adjuncts to the medical care of patients with cardiovascular disease and had been co-administered in elderly patients, Clinical studies show that patients taking anti platelets before head trauma are at an increased risk to develop serious intra cranial hemorrhage when compared to untreated patients.

This study assesses the different aspects of systemic changes as well as different bio-markers of brain injury after co-administration of clopidogrel and aspirin after experimental models of brain injury and in the control group. Rats were divided into five groups (control, TBI , TBI +Aspirin 20 mg/kg ip , TBI+ clopidogrel 10 mg / kg, TBI +Combination) and treatments were given for two days . Brain samples were then assessed for changes in the levels of different proteins . Immunofluorescence was also performed on different proteins notably Gfap and Neun. Finally, ELISA and EIA were used to find serum proteins associated to brain injury and inflammation. The lab found that aspirin and clopidogrel inhibited platelet aggregation alone and in combination. Additionally, Thromboxane (TXB2), whose level is indicative of activated platelets ,increased after TBI when compared to control group, but its level in all treated groups was comparable to control . WB data confirmed that spectrin cleavage (an early marker of necrotic and apoptotic cell death following TBI) increased in TBI when compared to control groups and in rats treated with combination, spectrin cleavage is highest among all groups.

Poster #35

Shaping the Spectrum of Thermal Radiation: Nanostructures for Solar Power and Energy-Efficiency

Andrej Lenert, University of Michigan, United States

By manipulating the structure of materials at the nanoscale, we can tune the spectrum of thermal radiation. In doing so, we can selectively enhance or suppress certain modes linked to either desirable or undesirable properties. Such energy-selective transport holds promise for more efficient solar power generation and thermal management of buildings. However, several research questions remain including: 1) What spectral features are most important to the success of a realistic energy system?, 2) How can we design scalable nanostructured materials to meet these requirements? and 3) Can such approaches outperform state-of-the-art technologies?

This poster presents two energy-selective transport mechanisms and their applications. The first utilizes nanoporous materials, such as aerogels, where energy-selectivity is based on how far radiation penetrates into a material. By targeting low penetration depths at long wavelengths, the poster shows how these materials can improve the efficiency of concentrated solar power and passive radiative cooling. The second utilizes high-temperature nanophotonic materials, where energy-selectivity is based on the interaction of thermal radiation with wavelength-scale structures. By suppressing radiative exchange at low energies, the lab demonstrates a solar thermal photovoltaic (STPV) device that is an order of magnitude more efficient than previous STPVs and has the potential to exceed the limit of single-junction solar cells. This work provides a mechanistic understanding of these energy-selective transport phenomena and offers strategies for how to best engineer both the energy system, and the nanomaterial to leverage these mechanisms. With integration of thermal storage, these technologies can become an important part of distributed energy systems and may lead to increased adoption of intermittent renewables.

Poster #36

Puzzling Slippery and/or Sticky Water at Surfaces and Interfaces

Li Liu, Rensselaer Polytechnic Institute, United States

Despite 300 years of research, the 63 anomalies that distinguish water from other liquids lack a coherent explanation and so sometimes water is called the prototype "complex fluid." However, aside from the complexity of water that is far from being understood, water is perhaps the most ubiquitous, and the most essential, of any molecules on earth. Indeed, it defies the imagination of even the most creative science fiction writers to picture what life would be like without water, and one often hears the adage "biology cannot be understood until water is understood."

This poster introduces some of the unsolved mysteries of water at surfaces and interfaces, and demonstrates recent progress in solving them. It is important to understand that we utilize the behavior of water, slippery and/or sticky, to understand nano-structured systems since materials respond (structurally, dynamically, and functionally) to surface and interfacial water. The poster presents evidence from experiments and computer simulations supporting the research observations. The topics include, but are not limited to, density and structural changes of liquid water through confinement, temperature, and pressure, water vapor condensation on nanostructures, the mysterious behavior of water near a protein.

The lab group looks into improving engineering processes related with water for sustainable living (e.g., water extraction and desalination) through fundamental understanding of water's behavior at surfaces and interfaces.

Poster #37

Using Artificial Neural Networks to Forecast Hurricane Impacts Resulting from Multiple Hazards

Hussam Mahmoud, Colorado State University, United States

Hurricanes are an example of a multi-hazard event with impacts that can highly vary depending on many factors. The intensity of these multiple factors, along with the population affected, tie into the resulting outcome in a complex and nonlinear manner making it increasingly difficult to link all these variables together and connect them to a clear and concise socio-economic outcome. This presentation will provide an overview of the use of artificial neural networks to relate complex interdependencies between the different hazard aspects, as well as the interdependencies between varying infrastructure and locational characteristics, in relation to a tropical cyclone event. An original neural network model was successfully created for tropical cyclones making landfall in the United States using meteorological parameters, landfall location, and population affected in order to provide an Impact Level based on economic damage in relation to historical events. Artificial neural networks are artificial intelligence programs that can be used to replicate expert knowledge learned from such historical events through pattern recognition. This modelling approach also allows for the ability to connect multiple variables that are not linearly related. When determining resilience of a community, multiple sectors and hazards intertwine in order to create an overall outcome, or impact, from an event. The degree of such an outcome, in terms of economic damage, could illustrate the resilience of a location from a hurricane. The results of multiple hind-casting simulations for this model illustrate the applicable use of artificial neural networks as a means to forecast outcomes from such events.

Poster #38

Efficiency Restoration of the Innovative Daylighting Systems

Mohammed Mayhoub, Al-Azhar University, Egypt

The provision of daylighting in buildings reduces energy consumption required by electric lighting systems and protects the environment. In addition, it improves the visual environment within buildings, which reflects on the productivity and well-being of its users. In order to maximize the utilization of daylighting, many innovative daylighting systems (IDS) have been developed and all of them depend on optical materials to collect and deliver daylight. As a result, dirt accumulation on the surface of the IDS affects efficiency, especially in desert regions. The problem of dirt accumulation has been addressed in the field of solar panels since the 1940s, and many cleaning methods have been developed. However, the application of these methods on the IDS needs further investigation due to the large differences between the solar panels and optical components of the IDS in terms of materials, size, shape and many other aspects.

This study investigates dirt accumulation effects on the IDS and possible cleaning methods. It suggests six cleaning mechanisms and twelve cleaning systems that suit different types of IDS in various operating circumstances. The suggested systems can be developed using already available technologies in order to achieve the ultimate in IDS efficiency restoration. However, before this can be done, the economic, environmental, and operational aspects, in addition to potential levels of efficacy and applicability must be assessed.

The study generates parametric tools to predict the economic performances of cleaning systems prior to implementation, considering the most sensitive parameters affecting the cost of cleaning, whether the process is manual or automated. The tool parametrically presents the payback periods of automated cleaning systems in a wide range of configurations. A second tool parametrically presents the annual manual cleaning cost as a percentage of the monetary value of the energy savings gained due to utilization of the IDS.

Poster #39

Neuroprotective Effects of Ezetimibe versus Simvastatin in Alzheimer's Induced Dementia: Perspective

Wael Mohamed, Menoufia Medical School, Egypt

Among many theories, brain insulin resistance stands out in the last decade as a new approach for AD. Lipid lowering agents, including Simvastatin and Ezetimibe, can provide a neuroprotective effect through their lipid lowering actions. The objective of this study was to investigate and compare the potential neuroprotective effects of Ezetimibe and Simvastatin in Alzheimer's STZ rat model. In addition, the lab group explored their potential effects on IGF-1 receptors in the brain. The team utilized 49 female Sprague-Dawely rats allocated into seven equal groups: AD model (single unilateral ICV STZ, 3mg/kg), Sham group (single unilateral ICV 0.9 saline), Simvastatin Treated and Ezetimibe Treated groups received the same regimen as AD model plus simvastatin 10 mg/kg P.O and Ezetimibe 10 mg/kg P.O for 21 days respectively. Simvastatin and Ezetimibe control groups received Simvastatin 10 mg/kg P.O and Ezetimibe 10 mg/kg P.O for 21 days respectively while the blank group was maintained on DW and a standard diet for 21 days. At the 15th day, all animals were evaluated regarding spatial memory and learning through MWM and novel object recognition tests. At the 21st day, rats were scarified and brains sections were stained with Congo red and Golgi-Nissel stains to detect amyloid plaques and neuro-degeneration respectively. Brain sections were immune-stained against Anti-tau and Anti IGF-1 receptor antibodies. The Simvastatin treated group showed better performance in MWM and novel object recognition tests.

Both drugs showed potential protective effects through reducing amyloid plaques and tau proteins.IGF-1 receptors showed up regulation in hippocampus and frontal cortex with both drugs. Both Simvastatin and Ezetimibe could prevent AD, evidenced by reducing amyloid and tau proteins. A key mechanism for this is through up regulation of IGF-1 receptors in the hippocampus and cerebral cortex that needs further evaluation.

Poster #40

Next Generation Stretchable Electronics based on Crumpled Two-dimensional Materials

SungWoo Nam, University of Illinois at Urbana-Champaign, United States

Superb electromechanical properties of two-dimensional (2D) materials provide substantial promise for advanced nanoelectromechanical devices, flexible electronics, and wearable sensor devices. This poster presents unique fabrication and processing of folded and crumpled 2D materials-based micro-/nano-structures for advanced optoelectronic sensors. First, it introduces two approaches: (1) a rapid and scalable method of creating crumpled graphene and MoS_2 monolayer surfaces by soft-matter transformation of shape-memory polymers, and (2) swelling/shrinking-induced crumpling process. Second, it discusses the unique application of crumpled/buckled 2D materials for a stretchable photodetector with enhanced and strain-tunable photoresponsivity. The lab group's photodetector is based exclusively on graphene and transforms the two dimensional material into three dimensional (3D) crumpled structures. This added dimensionality enhances the photoabsorption of graphene by increasing its areal density with a buckled 3D structure, which simultaneously improves device stretchability to 200% strain. A c.a. 400% enhancement in photoresponsivity is achieved compared to the responsivity of a flat graphene photodetector. Furthermore, the lab demonstrates a new concept of strain-tunable photoresponsivity where a 200% applied tensile strain results in 100% modulation in photoresponsivity. The lab group's approach to forming crumpled 2D materials-based micro-/nano-structures offers a unique avenue for creating multifunctional sensors, and furthermore, these capabilities could be applied to stretchable and conformal interfaces for use in wearable electronics.

Poster #41

The Emerging Era of Nanotechnology in the Pharmaceutical Field and its Connection with Other Fields

Maha Nasr, Ain Shams University, Egypt

Nanotechnology refers to structures which are below one micrometer in size. As particle size is decreased, the ratio of surface atoms or molecules to the total number increases, producing materials with large surface area, correlating with an increase in surface reactivity. This in turn leads to changes in their electrical, magnetic, optical, and biological properties. The multi-disciplinary nature of nanotechnology allows for collaboration of different scientific fields, namely chemistry, engineering, pharmacy, and medicine to create nano-systems of unique properties.

In the pharmaceutical field, nano-particulate drug delivery systems represent a promising approach since they allow alteration of the biopharmaceutical and pharmacokinetic properties of drug molecules, enhance their potential for systemic administration, achieve site-specific delivery, and alleviate unwanted toxicity caused by nonspecific distribution. This in turn leads to improved patient compliance and obtaining desirable therapeutic outcomes.

This poster identifies the role of nanotechnology in advancing the field of pharmaceutics and industrial pharmacy, and provides a succinct summary of its application in the pharmaceutical field as well as the potential risks posed by the use of nanoparticles. It also provides an insight on how pharmaceutical nanotechnology can benefit from other sciences such as engineering, chemistry, and medicine.

Poster #42

Smart Dynamic Single Crystals for Energy Conversion

Pance Naumov, New York University Abu Dhabi, United Arab Emirates

Elastic materials that are capable of stimuli-responsive mechanical reconfiguration are indispensable for fabrication of mechanically tunable elements for actuation and energy harvesting, including flexible electronics, artificial muscles, and microfluidic elements. The advanced materials that will qualify for these applications in the future must fulfill an extended list of requirements including reversibility, rapid and controllable mechanical response that is proportional to the applied stimulus, and extended lifetime without fatigue. Elastic properties are counter-intuitive for single crystals of molecular materials which are normally perceived as stiff and brittle entities. The growing realization that under certain circumstances organic-based crystals can exhibit superior mechanical properties and enhanced coupling between the incident force and the mechanical energy has recently turned these materials into a promising new platform for rapid and efficient actuation. The favorable elastic constants inherent to their ordered structures are expected to result in faster time responses and more rapid relaxation for recovery. This presentation will provide an overview of the current status in the emerging fields of mechanical characterization and mechanically responsive crystalline materials.

Poster #43

The Creation of a Multi-Disciplinary Space Studies Program in the UAE

Carlos Niederstrasser, Orbital ATK, Inc., United States

In 2015 Yahsat, the Masdar Institute of Science and Technology, and Orbital ATK established the first Master's level, advanced space studies program in the Gulf Cooperation Council (GCC) region. This program has two components:

- A 'Master of Science program with a concentration in Space Systems and Technology' with the goal of educating students and launching them into the future workforce of the UAE
- A hands-on CubeSat project designed to expose the students to the broader issues related to systems engineering, and provides them with invaluable experience

The program was offcially announced in May 2015 in the presence of His Highness Sheikh Mohammed bin Rashid Al Maktoum, UAE Vice President, Prime Minister and Ruler of Dubai, and opened up to the first group of students in September 2015.

This poster highlights the process that led to the creation of this first-of-a-kind program, including the unique international partnership between academia and industry. Special attention is paid to challenges encountered during the initial stages of the project, as well as the success of the first academic year completed in June 2016.

Poster #44

Discovery of a New Generation of Nanomaterials to Clean the Environment and Convert Solar Energy

Alexander Orlov, Stony Brook University, United States

This group has developed a new generation of nanomaterials with unprecedented properties to accelerate chemical reactions relevant to energy and environmental applications. By reducing the particle size to less than 1 nm and applying new methods of nanoparticle synthesis, it improved the activity of the existing catalysts by several orders of magnitude. The transformative elements of this research also include development of new methods for in-situ studies of reaction and catalysts, which also include utilization of modern synchrotron based techniques. A discovery of new nanomaterials activated by solar light, which are capable of converting water into hydrogen fuel and carbon dioxide into hydrocarbon based fuel, have important implications for sustainable energy and environmental protection. Moreover, this approach was applied to remediation of contaminated water and air. This presentation will also demonstrate how to use solar activated coatings to create self-cleaning, air purifying infrastructure of modern cities.

Poster #45

Novel Solar Collectors for Co-Production of High Temperature Thermal Energy and Electricity

Todd Otanicar, The University of Tulsa, United States

Conventional photovoltaic (PV) cells only convert a fraction of the full solar spectrum to electricity. Because of this, a large portion of the incoming sunlight is reflected or absorbed as heat causing further inefficiencies. While PV continues to decrease in cost, the current cost of batteries makes energy storage cost prohibitive. Thermal absorbers are effective through the full solar spectrum and are inherently more expensive for electricity production, but thermal energy is readily stored. The University of Tulsa has developed a concentrating photovoltaic/ thermal (CPV/T) architecture which can achieve high concentration ratios while maintaining low PV temperatures by the means of its unique flow configuration that recaptures PV waste heat while absorbing less efficient wavelengths for the PV cell directly into the working fluid. This unique design is based upon seeding the heat transfer fluid with a unique combination of nanoparticles that effectively absorbs specific wavelengths and heats the working fluid. This approach has advantages over conventional "splitting" approaches which are highly sensitive to incidence angles, as well as improved heat transfer from direct thermal absorption. In the process heat market, the additional value added by the electricity production makes this system cost competitive even in the lowest cost natural gas markets. A full scale prototype of the system was recently constructed with a 5 m^2 aperture area on a single axis 14x concentration system. The system performance exceeds 35% exergetic efficiency while co-producing electricity and heat up to 300 C. Experimental results of thermal and electrical efficiency based on the impact of flow rate and inlet temperature are presented. The system is the first full scale demonstration of a hybrid CPV/T system utilizing a nanoparticle based selective filter, especially demonstrating hybrid performance at high temperatures needed in many industrial process heat sectors.

Poster #46

Rapid Microwave Assisted Sol-Gel Synthesis of CeO2 and CexSm1-xO2 Nanoparticle Catalysts for CO Oxidation

Kyriaki Polychronopoulou, Khalifa University, United Arab Emirates

CeO2 and CexSm1-xO2 nanoparticle mixed oxides have been synthesized by microwave assisted sol-gel (MW sol-gel) and conventional sol-gel (C sol-gel) synthesis. Different characterization techniques, namely, XRD, BET, Raman, SEM, FTIR, TEM, XPS, H2-TPR, CO2-TPD, and XPS have been employed to understand the process-structure-properties relationship of the catalysts. The CO oxidation performance has been determined both in the absence and in the presence of H2 in the feed gas stream. Microwave heating yields a more thermally stable precursor material which preserves 75% of its mass up to 600oC, attributable to the different chemical nature of the precursor. Varying the synthesis method has no profound effect on the surface area of the materials, which is in the range 4-35m2/g. C sol-gel synthesis yields CeO2 particles with a crystallite size of 29 nm compared to 21-27 nm for MW sol-gel synthesis (at different power values). The MW sol-gel CexSm1-xO2 catalysts exhibit a smaller crystallite size (12-18 nm). The pure ceria nanoparticles were shown to have a stoichiometry of approximately CeO1.95. The presence of Ce3+ and Sm3+ in the mixed oxide particles facilitates the presence of oxygen vacant sites, confirmed by Raman. Oxygen mobile species have been traced using H2-TPR studies and a compressive lattice strain in the 0.45-1.9% range of the cubic CexSm1-xO2 lattice were found to be strongly correlated with the CO oxidation performance in the presence and absence of H2 in the oxidation feed stream. MW sol-gel synthesis led to more active CeO2 and Ce0.5Sm0.5O2 catalysts, demonstrated by T50 (temperature where 50% CO conversion is achieved), being reduced by 131 oC and 47 oC, respectively. MW sol-gel synthesized Ce0.8Sm0.2O2 exhibited a high performance (~90%) for CO oxidation over a period of more than 20 h in stream.

Poster #47

Energy-Efficient Nano-Scale Computing Using Approximate Circuits

Sherief Reda, Brown University, United States

Minimizing energy consumption of computing circuits enables prolonged operation for battery-operated devices and it is key to alleviate the physical constraints on improving performance. Approximate computing is an emerging paradigm where circuits are deliberately designed such that their results are approximate. By giving up some arithmetic accuracy, it is possible to design nano-scale circuits with

dramatically lower power dissipation and smaller silicon footprint. Using approximate circuits is attractive for emerging classes of applications that are inherently tolerant to errors, which include signal and image processing, computer graphics, computer vision, machine learning, and neuromorphic computing.

This presentation will first describe new methods to design approximate circuits for basic arithmetic building blocks, such as adders, multipliers and dividers. These circuits use a novel circuit mechanism to dynamically zoom in on the most relevant bits in input operands and approximate the remaining bits. The approximate arithmetic circuits provide dramatic reductions in power consumption with negligible reduction in accuracy. The poster will then describe new automated methods to synthesize arbitrary approximate circuits. This lab group's techniques enable designers to automatically discover large number of approximate circuits from an input original circuit by mutating the original circuit in intelligent ways and retaining the most promising mutants. The tool identify the Pareto-optimal mutant circuits that give optimal trade-off between accuracy and power consumption and the poster will demonstrate results for various circuit applications, including circuits for convolutional neural network, which has recently emerged as a major success story in machine learning and computer vision. The poster will describe how the lab's techniques drastically simplify the underlying computation requirements in terms of circuit area cost and power consumption without compromising accuracy.

Poster #48

FTIR Spectrometer: From Bulky Instruments to Sensor Scale Devices

Yasser Sabry, Ain Shams University, Egypt

Producing a microscale Fourier transform infrared (FTIR) spectrometer with a wide spectral range is needed for transforming the bench-top bulky FTIR spectrometers to batch-fabricated handheld devices. This project aims at developing a wide spectral range optical MEMS based FTIR spectrometer. The core engine of the spectrometer is a monolithic fully-integrated Michelson interferometer. The main challenges are achieving wide spectral range in the NIR while keeping the lost cost feature of the handheld spectrometer and design the optical system such that it allows high volume production with economics of scale. Dealing with microscale interferometer requires precise alignment of the input/output coupling system. Therefore, a highly innovative optical design with a compact size and low cost is needed. A handheld FTIR spectrometer operating in the NIR over a wide spectral range has a huge market potential and of a great need for the people all over the world. The spectrometer will bring a new perspective to the optical spectroscopy with several applications in point of care sensors, agriculture, food, pharmaceuticals, industrial chemistry, oils& gas and biomedicine. The success in this project will significantly impact the daily life of people and the way they think about optics and photonics. It will inspire the youth to develop innovative products and the decision makers to invest more in the field of optics and photonics. Seeing all this change in the world and especially when our developing country shares in this change is a dream that the lab will do its best to fulfill. In addition, the lab is co-developing this product with an industrial partner who has established a very good network of customers and will commercialize the product. The success of the project will thus create a very inspiring success story for the cooperation between the industry and the academia and encourage other industrial partners to work more with our university and others in the field.

Poster #49

Shape Switching Nano Materials for Next Generation Biophotonics
Khalid Salaita, Emory University and Georgia Institute of Technology, United States

Photonic approaches for the controlling cells in living tissues are transforming the biological sciences, as exemplified by the field of optogenetics. The key reagents for optogenetics are light sensitive proteins that are triggered by light. A major limitation in this area is the lack of reagents to optically deliver physical inputs rather than chemical inputs to cells. Spatial and temporal control of mechanics at interfaces is important for fields ranging from lubrication and tribology to microfluidics, cell biology, and sensing. This requires nano scale materials that can change their shape in response to light, which is a significant challenge in the field.

To address this challenge, this newly formed research group has developed photonic methods to harness light for delivering precise physical inputs (Nature Methods 2016). This poster will describe the development of optomechanical actuator (OMA) nanoparticles to manipulate living system with high spatiotemporal resolution using near-infrared illumination. Nanophotonic particles are comprised of a gold nanorod coated with a thermoresponsive polymer shell. Illumination leads to local heating, and particle collapse, thus delivering piconewton forces to specific cell surface receptors with high spatial (~micron scale) and temporal resolution (msec timescales). Optomechanical actuator nanoparticles were used to exert forces through the integrin receptors, thus mechanically controlling focal adhesion formation, cell protrusion, and cell migration in living cells. This new approach to controlling mechanotransduction circuits allows for optically controlling cell migration without the use of genetic engineering.

Poster #50

Towards A Food-Energy-Water (FEW) Security program
Sobhi Samhan, Palestinian Water Authority, Palestinian Territory, Occupied

Resource scarcity leads to increased pressure on local resources and environmental degradation as a result of overexploitation. This project introduces innovations in sustainable development to solve water scarcity challenges in Palestine (West Bank/Gaza). Growth in the agriculture sector has been found, on average, to be at least twice as effective in reducing poverty as growth in other sectors and this project aims to explore innovations in water collection, storage, treatment, and irrigation techniques in order to improve efficiency and effectiveness of water available for food production in the agricultural sector. Water insecurity is high in Palestine. The harvested rain water is usually not enough for the prevailing growing and irrigating techniques even in the rainy areas. Water utilized from shallow ground wells often has high salinity levels, and salty water is the enemy of crops like bell peppers, dates, seedless grapes, fresh herbs, and beans grown by Palestinian farmers. In order to feed a population expected to grow to 9 billion people by 2050, the world will have to double its current food production, all climate change increases droughts will leads to less predictable rains. This is a particular challenge for sustainable development in Palestine, with the population growth rate estimated at over 3% in Gaza.

USAID is introducing Palestinians to a new solution - magnetic technology - which breaks down salt molecules in water to make the water easier for the plants to absorb. USAID designed the project in coordination with the Ministry of Agriculture in 2012 as part of USAID’s Feed the Future activities, and farmers growing vegetables and herbs using treated water are producing 20 percent more than the control plots on the same acreage. Brackish water as byproduct from RO after desalination process is considered as environmentally impact. TDS of these ions ranged from (5000 mg/L -10000mg/L).

Poster #51

Cognitive Neuroscience and its Clinical and Educational Relevance.
Mohamed Seghier, Cognitive Neuroimaging Unit, ECAE, United Arab Emirates

Cognitive neuroscience research has found many applications in the clinical domain over the last two decades, thanks to recent advances in functional neuroimaging and brain mapping techniques. This ranges from the possibility to identify the dominant hemisphere and the language epicenters prior to surgery in order to minimize postoperative deficits, the possibility to localize epileptic foci non-invasively in drug-resistant epileptic patients, the development of new behavioral interventions based on how the brain processes information, and more recent work on the identification of functional biomarkers that can be clinically useful for diagnostic or prognostic purposes.

This presentation discusses a new emerging field that concerns the relevance of cognitive neuroscience in the educational setting. Education is about enhancing learning and cognitive neuroscience is about understanding the cognitive/mental processes involved in learning and how they are implemented in the brain. Cognitive neuroscience can therefore shed light on many issues: (1) Help educators to understand the diversity of abilities and disabilities, and the potential biological factors that can explain why there is a wide variation in learning ability; (2) Understand that the brain is plastic, and everything we do changes our brain even in adulthood and old age; (3) The brain has an inherent resilience capacity, which can be harnessed to overcome many learning difficulties if the right interventions are applied; (4) Inform adaptive learning technology, with the possibility to transfer neuroscientific insights to technology-based platforms. Bridging the gap between education and cognitive neuroscience needs a transdisciplinary approach where researchers from different fields can put their expertise at the service of this still ongoing endeavor.

Poster #52

Can Bioenergetics be more Predictive of Microbial Ecosystems Activity than Community Identity?
Jorge Rodriguez R., Masdar Institute, United Arab Emirates

Bioenergetics modelling appears to have a larger capacity in defining microbial ecosystems activity than originally expected, with respect to the extensive current use of molecular techniques to investigate community identity. This lab group's modelling results suggest that the activity of microbial ecosystems can be defined by bioenergetic modelling at three main levels:

When a generalized bioenergy-based model is used to describe the competition between biochemically possible metabolisms, the prevailing successful ones, the reasons behind their success and some syntrophisms are correctly predicted. This has been applied to glucose fermentation and to nitrogen oxidation and reduction ecosystems. Metabolic activities appear to be selected by maximum energy harvest rate. Based on this, this presentation postulates that it is mainly energetics who defined the today existing microbial metabolisms, pathway lengths and synergisms among them.

When the thermodynamics of certain anaerobic fermentative reactions are studied, conclusions can be drawn out about their potential reversibility. Quasi equilibrium calculations can be used to estimate concentration limits for the feasibility of pathway steps and compare with physiological and kinetic limits. Based on this, this presentation postulates that in energy limited microbial ecosystems, thermodynamic limitations can impose unfeasible intermediate metabolite concentrations rendering a metabolic pathway impossible or reversing it.

When anaerobic fermentation microbial ecosystems are described as mass- and electron-balanced metabolic networks, an optimization of the network for maximum energy yield provides an accurate prediction of product formation. This has been successfully applied to the prediction products shifts as a function of the environmental ph. This presentation postulates that in energy limited microbial ecosystems such as fermentations, a bioenergetic maximum energy harvest rate criteria defines the product spectrum irrespective of the microbial community.

Poster #53

Extending The Frontiers of (Opto)Electronics with Atom-Thick Materials

Berardi Sensale Rodriguez, The University of Utah, United States

This presentation will discuss two-dimensional (2D) materials, as a platform for: (1) efficient optoelectronic devices with reduced footprint; (2) technologies bridging the terahertz gap; and (3) as building blocks for new high-speed electronic device concepts. By employing two-dimensional materials as the active element in (opto)electronic devices, design with unprecedented degrees of freedom, low-cost, and ease of fabrication is possible. Two-dimensional materials can be integrated with silicon-based technologies and provide for an enhanced optical response as well as superior electronic transport properties. Therefore, leading to a substantial improvement with respect to the existing art in terms of device performance. Graphene, two-dimensional materials beyond graphene, and Dirac-materials beyond graphene will be discussed in these contexts. Experimental results as well as theory and simulations predicting the potentials of these materials will be discussed.

Poster #54

Estimate of the Effect of Micro-vibration on the next Algerian Satellite (Alsat-1B) MTF

Chahira Serief, Centre de Développement des Satellites, Algeria

Alsat-1B is the next Algerian Earth Observation satellite planned for launch for the third quarter of 2016. It is a collaborative project between the Algerian Space Agency (ASAL) and Surrey Satellite Technology Ltd. (SSTL) and it is part of a know-how technology transfer program that brings advanced satellite technology skills and knowledge into Algeria. Alsat-1B will provide image products with a resolution of 12m/24m at nadir in 5 bands (Panchromatic and Multispectral - blue, green, red, and NIR) and a swath of 147 km.

One of the main factors affecting the performance of optical payloads is micro-vibration. Micro-vibration is a low level disturbance, which is exceptionally difficult to control or reduce by the attitude and orbital control system (AOCS) of a spacecraft. Micro-vibration on Alsat-1B spacecraft, which is based on the SSTL100 platform, is mainly caused by mechanical noise generated by the reaction wheels. Micro-vibration usually causes problems for sensitive payloads. It can be the cause of Modulation Transfer Function (MTF) reduction, blurring of the image, or can generate artefacts in the imagery. Therefore, analyzing the effects of micro-vibration on the image products quality will be of great importance in compensating image motion. The aim of this work is to provide estimates of the Alsat-1B dynamic MTF that may be experienced operationally including the effects of micro-vibration. The MTF is an often used figure of merit for describing the resolving capability of optical imaging systems.

Poster #55

Enabling Future Nanomedicine via Bio-Electromagnetic Modeling of In-Vivo Wireless Nanosensor Networks

Raed Shubair, Khalifa University and MIT, United Arab Emirates

Nanotechnology refers to the design, production and application of structures, devices or systems at the incredibly small scale of atoms and molecules- the “nanoscale”. As a result, this technology has the potential to remarkably affect the development of the healthcare sector by revolutionizing both the diagnostic and therapeutic approach of diseases. Nanosized devices operating inside the human body open up new prospects in the healthcare domain. The technology of nano-bio-sensors is presented to highlight their ability to sense the biochemical and biophysical signals associated with diseases at the molecular or cellular levels. In vivo wireless nanosensor networks (iWNSNs) will result in a plethora of applications ranging from intrabody health-monitoring to drug delivery systems. With the development of miniature plasmonic signal sources, antennas, and detectors, wireless communications among intrabody nanodevices will expectedly be enabled in the Terahertz Band (0.1-10 THz). This result motivates the analysis of the phenomena affecting the propagation of electromagnetic signals inside the human body. In this paper, a rigorous channel model for intrabody communication in iWNSNs is developed. The total path loss is computed by taking into account the combined effect of the spreading of the propagating wave, molecular absorption from human tissues, as well as scattering from both small and large body particles. The overall attenuation model of intrabody THz propagation facilitates the accurate design and practical deployment of iWNSNs.

Poster #56

Nano-Infused Threads for Next Generation of Tissue Embedded Electronics

Sameer Sonkusale, Tufts University, United States

Tissue embedded electronic devices that can intimiately interact with biological tissues will herald a new generation of bioelectronic interfaces. Conventional devices are limited to two-dimensional substrates and hence their tissue integration is geometrically constrained to surfaces of tissues and organs. However the ability to integrate functional devices such as electronics, sensors and actuators in three dimensions that can interweave the multiple layers of tissues and organs in complex geometry will be a significant advance. Towards this goal we propose a tool-kit of nanomaterial infused threads for three dimensional tissue integration for medical diagnostics.

Threads, traditionally used in the apparel industry, is proposed as a flexible, stretchable and extremely versatile substrate for the creation of hybrid tissue constructs and active biomedical implants for organ replacement and repair. The wicking property and flexibility of threads enables creation of complex three-dimensional (3D) microfluidic networks that interface intimately with biological tissues in three dimensions. This lab has also developed a suite of physical and chemical sensors integrated with such microfluidic networks to monitor physiochemical tissue properties, all made from thread. The physical and chemical sensors are fabricated from nanomaterial-infused conductive threads and are connected to electronic circuitry using thread-based flexible interconnects for readout, signal conditioning, and wireless transmission. To demonstrate the suite of integrated sensors, the lab utilized this thread-based device platforms to measure strain, as well as gastric and subcutaneous pH in vitro and in vivo.
The research effort is a significant step towards truly three-dimensional bioelectronic interfaces with living tissues.

Poster #57

Goal-directed locomotion in vertebrates: a fruitful collaboration between robotics and neuroscience.

Cesare Stefanini, Khalifa University, United Arab Emirates

The lamprey is one of the few vertebrates in which the neural mechanisms are well described at a cellular level and can be somehow replicated artificially. Indeed, certain aspects such as goal-directed locomotion and behavior selection, can be validated through robotic artefacts. In particular, swimming is a functionally important behavior where neuromuscular structures, neural control architecture and operation can be replicated following models from biology and neuroscience. This talk presents a biomimetic system inspired by the lamprey, an early vertebrate that locomotes using anguilliform swimming. The artefact possesses extra- and proprioceptive sensory receptors, muscle-like actuation, distributed embedded control and a vision system. Experiments on optimized swimming and on goal-directed locomotion will be described, as well as the assessment of the performance of the system, which shows high energy efficiency and adaptive behaviour. While the focus is on providing a robotic platform for testing biological models, the proposed system can also be of major relevance for the development of new high performance engineering systems.

Poster #58

Integrated Urban Management of Energy and Water: Institutional Analysis of Energy System Transitions

Jennie Stephens, Northeastern University, United States

As energy systems throughout the world are transitioning to integrate more distributed renewable-based energy, accelerating deployment of solar PV and other renewable sources is requiring rapid institutional innovation. This period of innovation provides an opportunity for a broad range of improvements in integrated urban and regional management, including management at the energy-water nexus.

Using a systems approach as an expansion of urban metabolism and expanding the social-ecological-infrastructural systems frameworks by Ramaswami et al (2012), this institutional analysis explores decision-making processes at the interface of energy and water in the urban context. With multiple types of newly available data, including remote sensing, municipal, and crowdsourced data streams, new possibilities for integrated management of energy and water are emerging, but the associated institutional innovations required to support this integrated management have not yet been adequately considered.

Building on work by Ahamed et al (2016) focused on developing indicators for managing the energy-water-food nexus for the metropolitan area of Denver Colorado, this project considers the practical application and effective implementation of new forms of data analytics at the energy-water nexus. As renewable energy expands in cities, communities, and regions, implications for water management are only beginning to be considered. As water resources are strained by changes in climate and more frequent extreme weather events, energy implications and resilience of coupled energy-water systems are emerging as key concerns. Integrating consideration of transboundary flows of energy and water in urban governance offers new management opportunities. By identifying institutional and cultural constraints and opportunities for integrated energy-water management in the urban context, this research contributes to the implementation of new analytical capabilities for energy nexus science.

Poster #59

Clumped Isotope Geochemistry: A New Tool in Carbon Sequestration, Climate, and Petroleum Exploration

Aradhna Tripati, University of California, Los Angeles, United States

Our ability to fundamentally understand Earth's evolution since its formation depends on having clear windows into past environments. The geosciences are undergoing a period of rapidly expanding insights into these questions because of development of new tools, particularly in isotope geochemistry, that illuminate the past from new angles. The ability to measure multiple rare isotope substitutions into molecules (i.e., rare isotope "clumps") are initiating a new era in isotope-based research, yielding information that is beyond what was possible using more traditional approaches. This technique has enormous potential in areas of geoscience ranging from petroleum exploration to carbon sequestration to the study of climate processes and earth systems history. The proposed poster will discuss the potential for application to each of these areas.

Poster #60

Neural Cell Adhesion Molecule Peptide Mimetics Modulate Affective Behavior

Cortney Turner, University of Michigan, United States

Recent studies have highlighted the importance of the fibroblast growth factor (FGF) family in modulating emotionality. Moreover, ligands that activate FGF receptors, such as FGF2, have antidepressant and anxiolytic effects in animal models. Neural cell adhesion molecule (NCAM) is also known to bind to and activate FGF receptors. Therefore, this study assessed the ability of NCAM peptide mimetics to modulate anxiety-like and depression-like behavior in rodents. Anxiety-like behavior was measured on the elevated plus-maze and depression-like behavior was measured on the forced swim test. Specifically, we assessed the acute and chronic effects of three different NCAM peptide mimetics that have previously been shown to have effects on learning and memory in rodents. One peptide increased anxiety-like behavior in the EPM acutely. Chronically, it decreased depression-like behavior in the FST. The second peptide decreased depression-like behavior both acutely and chronically. The third peptide increased anxiety-like behavior acutely. Chronically, it decreased anxiety-like behavior. These findings lend support for the idea that NCAM peptides can modulate emotionality in animal models. Moreover, some peptides may be more beneficial in treating major depressive disorder, whereas others may be more beneficial in treating anxiety disorders

Poster #61

Hardware and Software Design of the Onboard Computer of ISRASAT1 Cube satellite

Sondos Mohamed Wasfi, Institute of Space Research and Aerospace, Sudan

The On-Board Computer (OBC) in cube satellites is the subsystem which acts as a bridge that connects the other subsystems with each other. It supervises many of the tasks that are done by the different subsystems of the satellite and performs housekeeping and monitoring to ensure the health and status of those subsystems. The hardware and software design of the OBC mainly depends on the mission of the cube satellite. ISRASAT1 is a research project at the Institute of Space Research and Aerospace to develop a cube satellite that sends image, beacon, and telemetry data to the ground station. This poster aims to illustrate the main role of the OBC of ISRASAT1, and to present the hardware and software design activities carried by the OBC team.

Poster #62

Nanoscale Memristive Devices for Brain-inspired Computing and Beyond

Qiangfei Xia, University of Massachusetts Amherst, United States

Developing electronics beyond Moore's Law requires revolutionary vision in novel devices, disruptive technologies, new materials, and alternative computer architecture for the post-CMOS era. Memristive devices emerge as promising nanoelectronic components for a broad spectrum of applications in memory, computing and beyond. This poster will first introduce the fundamental concepts and emerging applications of memristors such as in brain-inspired computing and reconfigurable radiofrequency (RF) systems. Next, the performance and mechanism of novel memristors including hafnium oxide devices with record high endurance and data retention, and self-rectifying all-silicon based devices will be discussed. Finally, the poster will showcase disruptive nanofabrication technologies that have enabled array of smallest memristors (8 nm) and 3-dimensional (3D) crossbars, and address integration and operation of the first memristor-CMOS hybrid integrated circuits built on foundry-made CMOS substrates.

Poster #63

Radiative Cooling-Cold Storage

Ronggui Yang, University of Colorado Boulder, United States

This project proposes to develop transformational radiative cooled-cold storage system (RadiCold) that can disruptively impact the cooling technologies of thermoelectric power plants. With a perfect reflectance of sunlight and an almost 100% absorption at infrared wavelengths between 7.6 - 13 µm, a polymer thin film that encapsulates silica microbeads as infrared absorbers on a 100-nm-thick silver thin film forms the RadiCold surface with greater than 100 W/m2 radiative cooling flux for both day and nighttime operation. An innovative two-stage cold collection technique will address the significant energy density mismatch between the radiative heat flux (~100W/m2) and the 100s of MW cooling demand of power plants. The success of the proposed research will enable transformational power plant cooling technologies that dissipate no water to the atmosphere, no loss of efficiency to power plants, and less than 5% increase in levelized cost of electricity (LCOE). This project will have a transformative impact on the nation's electricity production and use, consumption of fuels, and greenhouse gas emissions.

Poster #64

Renewable Energy from Bio-Inspired Nanomaterials

Rusen Yang, University of Minnesota Twin Cities, United States

Nanoscale energy harvester holds promise for the development of self-powered nanosystems, while molecular self-assembly of bio-inspired materials has attracted much research effort in recent years. This poster reports the controlled growth of vertically aligned FF peptide microrods and their application in piezoelectric nanogenerators. Piezoelectric FF peptide microstructures were fabricated on various substrates through a novel epitaxial growth approach. A low-temperature process was developed to produced vertically aligned FF peptide microrods. Applying electric field during the growth was found to result in uniform polarization in grown peptide microrods. Their energy conversion performance was further investigated and a single layer peptide could produce an open-circuit-voltage over 1 V, which was significantly greater than the output from other piezoelectric biomaterials. The performance of peptide-based nanogenerators under different excitations was also studied. This work can enable new applications of bio-inspired materials in areas such as energy harvesting and storage, electromechanical sensing and actuation, drug delivery, as well as fundamental studies of FF-based structures.