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GSBES2022

Global Summit on Biomedical Engineering and Systems

June 16, 2022 **Virtual**

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FOREWORD

Dear Colleagues,

It is a great pleasure to announce that The Scientistt will host the Global Summit on Biomedical Engineering and Systems (GSBES2022) will be held during June 16 as a Virtual Conference (Webinar).

GSBES2022 aims to bring together the renowned researchers, scientists and scholars to exchange ideas, to present sophisticated research works and to discuss hot topics in the field and share their experiences on all aspects of Biomedical Engineering and Systems.

The GSBES2022 will be a 1 day event that means to gather the key players of the biomedical engineering and systems community and related sectors. This event is launched with the aims to become an established event, attracting global participants, intent on sharing, exchanging and exploring new avenues of Biomedical Engineering and Systems-related scientific and commercial developments.

A wide-ranging scientific program consisting of plenary lectures, keynote lectures, Invited lectures, parallel sessions, as well as poster sessions for young scientists covering all topics in Biomedical Engineering and Systems will be scheduled. This conference provides a wonderful opportunity for you to enhance your knowledge about the newest interdisciplinary approaches in Biomedical Engineering and Systems.

Moreover, the conference offers a valuable platform to create new contacts in the field of Biomedical Engineering and Systems, by providing valuable networking time for you to meet great personnel in the field.

We look forward to seeing you at GSBES2022 Webinar on June 16, 2022.

COMMITTEES

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Wei Deng
Associate Professor, School of Biomedical Engineering, University of Technology Sydney, Australia

Spatial and Temporal Control of Crispr-Cas9-Mediated Gene Editing Delivered via a Light-Triggered Liposome System

Abstract

The CRISPR-Cas9 and related systems offer a unique genome editing tool allowing facile and efficient introduction of heritable and locus-specific sequence modifications in the genome. Despite its molecular precision, temporal and spatial control of gene editing with CRISPR-Cas9 system is very limited. We developed a light-sensitive liposome delivery system that offers a high degree of spatial and temporal control of gene editing with CRISPR-Cas9 system. We demonstrated its efficient protein release by respectively assessing the targeted knockout of eGFP gene in human HEK293/GFP cells and TNFAIP3 gene in TNFα-induced HEK293 cells. We further validated our results at a single-cell resolution using an in vivo eGFP reporter system in zebrafish (77% knockout). These findings indicate that light-triggered liposomes may have new options for precisely control of CRISPR-Cas9 release and editing.

Biography

Wei Deng is an Associate Professor of Nanomedicine at School of Biomedical Engineering in University of Technology Sydney, Australia. Her research contribution was to develop bespoke liposome nanocarrier delivery systems for cancer therapy. Deng has a broad background in nanomedicine, with specific training and expertise in liposome and polymer nanocarrier engineering, tumor biology and interaction between nanocarriers with cells and animal body. She has 44 publications that are on an upward trajectory for citations, including three 1st author paper each over 100 citations and 5 papers each over 50 citations. Most other papers were published in the 1st quartile journals for their category, including Nature Communications, ACS Central Science, ACS Applied Materials and Interfaces, Advanced Materials, Molecular Therapy - Nucleic Acids and Acta Biomaterialia. Beyond the lab activities, Deng also co-founded a start-up company in collaboration with Canadian investors in 2020 and her two patents on liposome delivery technology were exclusively licensed to this company in 2021.

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5Senior Lecturer, Department of Electrical and Computer Systems Engineering, Monash University, Australia.

Eyes-Tracker Device and using Gaze-Capture by Eye Movements on Developing Virtual Education

Abstract
This research aims to show how eye-tracking technology can be employed to develop online teaching resources and enhance classroom engagement skills by collecting data from wearable eye-tracker. The target is focused on investigating text density through slides by aiming to look at included spacing, text size, and use of images by designing the platform in advance. The findings can be helpful that the wearable eye tracker gives informative feedback about the visual attention of the students. In this study, we considered four types of slides with different text densities. Each density level had two slides (one with pictures and one without) and a fixed time.Thestudydid not evaluate how much a person has learned/remembered, which we aim to address in our future work to investigate how text density affects concentration and memory recollection. Through these data visualizations, it is hoped to find potential correlations between gaze data and memory recollection. In this research, Tobii Pro SDK has been used to create a code for data collection and information from the eye tracker (Tobii Pro Nano). After collecting results and data and as the first step towards understanding the problem at hand, we looked into possible ways of creating accurate and interactive visualizations techniques.This was a critical step to a deeper understandingof the actual data to be collected. We used R to analyze and visualize data. The design for running a large number of cohorts is ready for further actual data collection.

Excel data visualization; By averaging the left and right eyes for each of the x and y coordinates, plus pupil diameter, it was able to make some basic data visualizations in Excel using scatter plots and line graphs. It was found that the left and right eyes mainly were similar, so this average rarely, if ever, led to poor results.Looking at the gaze points; Being able to look at how the gaze changed over time can tell us about the behaviour of people who read the slide, and also, we were able to extract parts of the presentation that the participants focused on the most. It can be looked at if there are certain areas that they spent more or less time on, and what order they used to look at the contents and could tell where the most important information should be. It also could inform about confusion and distractive points. It can be simple data or more complex data forms, such as blinking and areas of interest.

Keywords
Eyes Tracker, Gaze-Capture, Virtual learning, Eyes Movements

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Biography

Dr Shahnaz Mansouri is a lecture at Faculty of Science, Monash University with the study background in Chemical and Process Engineering (PhD), Food Engineering (Bachelor & Master degrees) and Teaching (Master degree). She is Course Coordinator of the Master of Food Science and Agribusiness. Her research is focused on the developing quality of online education in science and engineering. She has worked in research and development, and quality control for various food manufacturing companies in Australia and abroad.

Dr. Mehrtash Haranti is currently a senior lecturer in the Faculty of Engineering, Monash University and an expert in the field of artificial intelligence, computer vision, and machine learning. His contributions to the field have been recognized by various prizes, honors, and awards including Most cited article, Image and Vision Computing, Elsevier, outstanding reviewer, IEEE Conference on Computer Vision and Pattern Recognition, 2021, and NICTA impact award, 2015.

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Towards Digital Transformation through Bioinformatics

Abstract
Digital transformation (DX) may be defined as the adoption of digital technology for improving the efficiency, value and innovation of a company. I believe that this is also effective in boosting biology/ medicine through bioinformatics. But how to do it is not trivial. One way may be to integrate various data from public databases and to make new discoveries. I have encouraged my graduate students to pursue this goal. In this talk, I will introduce two of them: one is an attempt to find a new distinction of non-CpG DNA methylation in between neurons and embryonic stem cells [1] and the other is an attempt to characterize various types of stem cells through the comparison of their transcriptome data [2]. Another possibility of accelerating DX in biomedicine is to construct a useful database by integrating various kinds of public raw data. I will introduce our current efforts in setting up a new database of architectures of cis regulatory regions. The database will enable end users to easily get information of cis regulatory regions of any (human) genes in various perspectives [3].

Keywords
digital transformation, bioinformatics, non-CpG methylation, stem cells, database, cis regulatory region

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Biography
Kenta Nakai was born in Osaka, Japan, in 1963. He received the PhD degree on the prediction of subcellular localization sites of proteins from Kyoto University in 1992. From 1989, he has worked at several institutions, including, Kyoto University, National Institute of Basic Biology, and Osaka University. From 1999 to 2003, he was an Associate Professor at the Institute of Medical Science, the University of Tokyo, Japan. Since 2003, he has been a full Professor at the same institute. His main research interest is to develop computational ways for interpreting biological information, especially that of transcriptional regulation, from genome sequence data. In 2020, he was awarded the first JSBi Prize for his research activity on “Genome and protein sequence analysis, especially for prediction of subcellular localization signals” by the Japanese Society of Bioinformatics. He has published more than 160 papers, three of which have been cited more than 1000 times.

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Development of Single-Molecule Electrical Identification toward Epi Transcriptomic Sequencing

Abstract
The research field of epiomics and epitranscriptomics, which comprehensively investigate molecular modifications and damages of biomolecules caused by diseases and environmental changes, and the relationships among the molecules, has been recently attracting interests. Therefore, the development of comprehensive detection of these molecules is one of the most importanttarget for development ofrecent analytical methods.There are three major issuesfor the detection of epiomic molecules. The first is that the epi-molecules is rare, compared to the non epi-molecules. Secondly, there are a lot of chemical species of the epimolecules, and thirdly, most of epimolecules are unstable before they can be detected by the conventional sensors. Single-molecule electrical detection methods using nanodevices is one of the candidate for addressing this issues. The nanodevices includes nanopores, nanogap electrodes, and nanopipettes, and theyenableto detect each of differences in the physical properties of each molecule without anychemical probing or amplification processes.

In this study, we utilizedsingle-molecule quantum measurementby using nano-gap devices for epi-molecule detection. Up to now, we have previously reported the identification of basic molecules such as DNA/RNA [1] and amino acids [2]. Here, we focused on rare epimolecules in DNA/RNA, especiallynucleotide methylation, and detected two types of methylation: 5mC (5-methyl-cytosine) and m6A(N6-Methyladenosine) in extracted RNA from colon cancer cells. We found evidence that the m6A modification promoted the 5mC modification 1.5-fold [3]. This indicates that RNAs that regulate genes are regulated by epimodification and cross-talk with each other, i.e., the existence of an epitranscriptome.These reports suggest that epi-modification of microRNAs may regulate gene expression.

Keywords
Single-Molecule detection, DNA, RNA, epi-modification

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[3] Single-Molecule RNA Sequencing for Simultaneous Detection of m6A and 5mC, Sci. Rep. (2021),11,19304.

Biography
Takahito Ohshiro was born in Shizuoka, Japan, in 1973. He received the PhD degree on a study of single-molecule biopolymer electrical detection (“STM Molecular Tips for Electrically Pinpointing Complementary Nucleobases”) from the University of Tokyo, Japan, 2008. From 2009, he has worked at the following institutions and company, including, University of Tokyo, RIKEN,

and Osaka university, and the university-launched venture company of next-generation single-molecule sequencer (Quantum biosystems). From 2016, he is an Associate Professor, the ISIR, Osaka University, Japan. His research areas include analytical chemistry, nanotechnology, artificial intelligence, nanobio-device, surface science, molecular biology. His main research interest is to develop a single-molecule electrical detection system by using solid-state nano-devices. Based on the system, he has reported a single-molecular electrical sequencing method for biopolymers such as DNA, RNA, peptide and so on. These studies are published in the peer-reviewed journal including Nature Nanotechnology, Scientific Reports, PNAS, and so on.

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A Mathematical Model of Tumor-Immune Interactions with an Immune Checkpoint Inhibitor

Abstract

Blockade of immune checkpoints has recently been shown as a revolutionary strategy in the fight against cancers. Based on recent mouse experiments and clinical trials, large tumors can be completely suppressed with an additional blockade of immune checkpoints. We construct mathematical models capturing key interactions among malignant tumor cells, CD4+ T cells, anti-tumor cytokines, and immune checkpoint inhibitor of CTLA-4 to explore the importance of immune checkpoints on regression of tumor. Our study shows that blockade of immune checkpoints plays essential roles in immune responses. Continuous and one day pulse immune therapies by either T cells, anti-tumor cytokines, anti-CTLA-4 or a joint therapy are administered to exam the effectiveness of immune therapies. Our investigation indicates anti-tumor cytokine is potentially a key factor in determining the future of the malignant tumor. The malignant tumor can be suppressed thoroughly with reasonable dosages of anti-tumor cytokines if pre-radiation along with anti-CTLA-4 therapy are implemented.

Keywords

Immunotherapy, Cytokine, Ordinary differential equations, Immune checkpoint

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Biography

Jui-Ling Yu has completed her PhD from the Department of Mathematics, Michigan State University, USA. She is a full professor in the Department of Data Sciences and Big Data Analytics, Providence University, Taiwan. She has published more than 20 papers in reputed journals and conferences and has been serving as a guest editorial board member of repute. Her research interests are mathematical biology and numerical methods. Her current project includes the modeling of immunotherapy, oncolytic virus therapy, and to study their dynamics.

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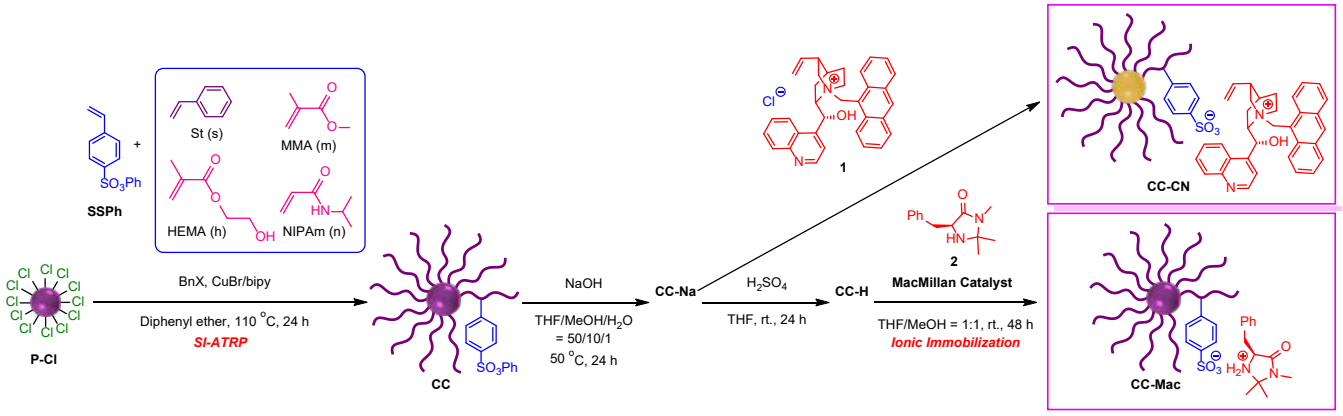
Development of Efficient Polymer Microsphere-Supported Chiral Organo-Catalyst for Asymmetric Synthesis

Abstract

Functional polymer microspheres have been attracted considerable attention for their potential applications in a variety of fields such as coatings, electronics, biomedical engineering, and organic synthesis.Recently, we have successfully synthesized core-corona polymer microspheres (CC) by the graft copolymerization of an achiral vinyl monomer and p-phenylstyrenesulfonate(SSPh) using surface-initiated atom transfer radical polymerization (SI-ATRP) in which polymer microspheres having benzyl halide moiety (P-Cl)[1] was used as a macroinitiator. Core-corona microspheres, CC-Na having sodium sulfonate and CC-H having sulfonic acid were synthesizedby the treatment of NaOH and H2SO4, respectively.Chiral cinchonidinium salt (1) and MacMillan catalyst (2) were immobilized onto the side chain of CC-Na[2] and CC-H to afford core-corona microsphere-supported chiral catalyst, CC-CN, and CC-Mac with ionic bonding, respectively (Scheme 1).



Scheme 1. Synthesis of core-corona microsphere-supported chiral organocatalyst.

CC-CN and CC-Mac were used as a heterogeneous polymeric organocatalyst for the asymmetric alkylation reaction of glycine Schiff base[3,4]and in the asymmetric Diels-Alder reaction[5], respectively. In both reactions, we found that the nature of core and corona affected both the yield and enantioselectivity. These catalysts could be reused several times without loss of enantioselectivity.

Keywords: Surface-initiated ATRP, Core-corona microsphere, Heterogeneous chiral catalyst, Asymmetric synthesis, Reusability.

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Biography

Dr. Md. Wali Ullah is currently working as an Associate Professor in the Department of Chemistry at Comilla University, Bangladesh. Dr. Ullah received his Bachelor of Science with four years integrated honors (B.Sc. honors) and Master of Science (M.Sc.) degrees with distinction from the Department of Chemistry, University of Rajshahi, Bangladesh, in 2008 and 2010, respectively. He obtained the Degree of Doctor of Philosophy in Engineering from Toyohashi University of Technology, Japan, in 2019, under the direct supervision of Prof. Dr. Naoki Haraguchi. In his Ph.D. project, he pioneered the synthesis of sulfonated core-corona polymer microspheres for the immobilization of cinchonidinium salt and MacMillan catalyst. He works in the fields of polymer chemistry, sustainable organic chemistry, materials science, and nanotechnology. He has academic experience of more than nine (09) years and published a lot of papers in various international journals. He is carrying out his research work with collaborators in the aligned fields. His research interests focused on the design and synthesis of polymer microsphere-supported heterogeneous chiral organo catalysts and their applications to asymmetric organic reactions for the development of sustainable chemistry.

Raoul R. Nigmatullin, Vadim S. Alexandrov
Radioelectronics and Informative-Measurement Techniques department, Kazan National Research Technical University named after by A.N. Tupolev (KNRTU-KAI)

Application of the Complex Moments for the Selection of an Optimal Sensor

Abstract
In the first time we apply the statistics of the complex moments for selection of an optimal pressure sensor (from the available set of sensors) based on their statistical/correlation characteristics. The complex moments contain additional source of information and, therefore, they can be applied for comparison of random sequences registered for almost identical devices or gadgets. The proposed general algorithm allows calculating 12 key correlation parameters in the significance space. These correlation parameters allow realizing the desired comparison. New algorithm is rather general and can be applied for a set of other data if they are presented in the form of rectangle matrices. Each matrix contains N data points and M columns that are connected with repetitious cycle of measurements. Besides, we want to underline that the value of correlations evaluated with the help of Pearson correlation coefficient (PCC) has a relative character. One can introduce also external correlations based on the statistics of the fractional/complex moments that form a complete picture of correlations. To the PCC value of internal correlations one can add at least 7 additional external correlators evaluated in the space of fractional and complex moments in order to realize the justified choice. We do suppose that the proposed algorithm (containing an additional source of information in the complex space) can find a wide application in treatment of different data, where it is necessary to select the “best sensors/chips” based on their measured data, presented usually in the form of measured rectangle matrices. This approach is based on the previous generalizations related to the fractional moments [1-3].

Keywords
Complex moments, Optimal sensors, Relative correlations

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Biography
Raoul Rashid Nigmatullin received his Master Degree on specialization of theoretical physics from Kazan State University, Russia. In 1995 and 1996 he won twice the competition among Russian and Ex-Soviet Union scientists, working in the universities of Moscow, S-Petersburg, Novosibirsk, Tomsk and other leading universities and got the financial support from the International Soros Fund for two years to continue his scientific and pedagogical activity in Kazan University. Recently the American Biographical Institute selected his biography for the book “The Contemporary Who’s

Who" (Who's Making a Difference) 2002/2003, 2005/2007 issues. Now he is author of more than 200 publications in various branches of physics including quantum theory of magnetism, equilibrium and non-equilibrium statistical physics, physics of dielectrics and fractal physics. Half of these publications enter in the SCOPUS and Web of Science databases. He is well-cited scientist among other leading Russian scientists actively working in the modern science. In accordance with the ISI (International Scientific Institute) version his total citation index CItot = 2026 and his Hirsch index equals 22. The maximal citation of one paper is 152. He is a Member of International Dielectric Society (2000 year-Present) (up to 01/03 2014) Physical Society of Kazan State University. He got a Russian Grant –Scientific Support of the potential of the high Russian schools (2006-2007) 2005-2013 years "The development of Russian Scientific Potential" of the Leading Universities of Russia". Present he is a Full Professor of the Radio-electronics and Informative-Measurements Techniques Department KNRTU-KAI.

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Circular Economy: New Opportunities in Sustainable Nano Materials and Polymer Bio-Nanocomposites

Abstract

Green chemistry started for the search of benign methods for the development of nanoparticles from nature and their use in the field of antibacterial, antioxidant, and antitumor applications. Bio wastes are eco-friendly starting materials to produce typical nanoparticles with well-defined chemical composition, size, and morphology. Cellulose, starch, chitin and chitosan are the most abundant biopolymers around the world. All are under the polysaccharides family in which cellulose is one of the important structural components of the primary cell wall of green plants. Cellulose nanoparticles (fibers, crystals and whiskers) can be extracted from agrowaste resources such as jute, coir, bamboo, pineapple leafs, coir etc. Chitin is the second most abundant biopolymer after cellulose, it is a characteristic component of the cell walls of fungi, the exoskeletons of arthropods and nanoparticles of chitin (fibers, whiskers) can be extracted from shrimp and crab shells. Chitosan is the derivative of chitin, prepared by the removal of acetyl group from chitin (Deacetylation). Starch nano particles can be extracted from tapioca and potato wastes. These nanoparticles can be converted into smart and functional biomaterials by functionalization through chemical modifications (esterification, etherification, TEMPO oxidation, carboxylation and hydroxylation etc) due to presence of large amount of hydroxyl group on the surface. The preparation of these nanoparticles includes both series of chemical as well as mechanical treatments; crushing, grinding, alkali, bleaching and acid treatments. Transmission electron microscopy (TEM), scanning electron microscopy (SEM) and atomic force microscopy (AFM) are used to investigate the morphology of nanoscale biopolymers. Fourier transform infra-red spectroscopy (FTIR) and x ray diffraction (XRD) are being used to study the functional group changes, crystallographic texture of nanoscale biopolymers respectively. Since large quantities of bio wastes are produced annually, further utilization of cellulose, starch and chitins as functionalized materials is very much desired. The cellulose, starch and chitin nano particles are currently obtained as aqueous suspensions which are used as reinforcing additives for high performance environment-friendly biodegradable polymer materials. These nanocomposites are being used as biomedical composites for drug/gene delivery, nano scaffolds in tissue engineering and cosmetic orthodontics. The reinforcing effect of these nanoparticles results from the formation of a percolating network based on hydrogen bonding forces. The incorporation of these nano particles in several bio-based polymers have been discussed. The role of nano particle dispersion, distribution, interfacial adhesion and orientation on the properties of the ecofriendly bio nanocomposites have been carefully evaluated.

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Biography

Prof. Sabu Thomas is currently the Vice-Chancellor of Mahatma Gandhi University, Kottayam, Kerala, India. He is a Professor at the International and Inter University Centre for Nanoscience and Nanotechnology and Full Professor of Polymer Science and Engineering at the School of Chemical Sciences of Mahatma Gandhi University, Kottayam, Kerala, India. His ground-breaking research has covered the areas of polymer science and engineering, polymer nanocomposites, elastomers, polymer blends, interpenetrating polymer networks, polymer membranes, green composites and nanocomposites, nanomedicine and green nanotechnology. Prof. Thomas has received several national and international awards in recognition for his work, and recently received Honoris Causa (DSc) from the University of South Brittany, Lorient, France, in recognition for his contributions to polymer science and engineering. Prof. Thomas has published over 1200 peer- reviewed research papers, reviews and book chapters. He has co-edited more than 160 books. His current H index is 119 with more than 68000 citations.

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Muscle Contraction under Physiological Load: Novel Interpretation and Molecular Mechanism of Isometric Rapid Tension Recovery Experiments

Abstract

Ever since the pioneering work of Huxley and Simmons [1], it has been tacitly assumed that the generation of isometric force in physiologically important muscular contraction and the rapid tension recovery observed after quick release experiments are governed by the same mechanism. Within this framework, various explanations have been offered for the phenomenon of repriming of the early rapid tension recovery in muscle fibers by multiple-release experiments [2,3].

Based on the novel Nath's rotation-uncoiling-tilt (RUT) energy storage mechanism of muscle contraction [4–7], a different molecular mechanism of the isometric rapid tension recovery and repriming phenomenon is formulated here. It is proposed that the rapid tension regeneration in phase II after quick release takes place by elementary steps involving fast transition between strongly-bound crossbridge states that are distinct from, and occur after the elementary steps responsible for isometric force generation in muscle contraction. Thus, the rapid tension recovery processes occurring during muscular contraction under physiological loaded conditions do not represent the power-stroke/working stroke as postulated in earlier proposals [1–3]. Rather, the mechanical transients are now seen as molecular processes occurring in post–powerstroke, pre–detachment myosin crossbridges in the rigor state. However, unlike in the Huxley-Tideswell proposal [3], both heads of a myosin crossbridge contribute to isometric force by binding to different actin filaments, thereby explaining the double-headed nature of muscle myosin II, and both mechanically-strained heads tilt, and one or more heptads of their common S–2 coiled coil uncoil, to bear the load on the rigor crossbridge. Further, isometric quick release step sizes nm do not lead to complete recovery of tension in phase II, because one head of a myosin dimer detaches from actin. The detachment occurs because a step/shortening size/length beyond nm induces a supercoiling of S–2 coiled coil and an untilting of bound heads that brings them closer than a limit, which is sterically and mechanically unfavorable. However, a smaller quick release step imposed on a nm step after a time interval of ms allows the tilt and uncoiling to be completely recovered, and thereby enables complete regeneration of the tension. These rapid tension recovery steps are fast and take ms, and do not require the unlikely assumption that heads detach and re-attach [2], a process that takes place on a much longer timescale of ms.

The above concepts are shown to be capable of extension to the population-level of crossbridges in muscle. Thus, detachment of a population of crossbridges has to wait for the attachment of another population of crossbridges and their conversion to force-generating structures. In turn, this latter population has to wait for the population of resisting rigor crossbridges to become strain-free and detach before they can collectively execute their power strokes and pull the loaded actin filaments towards the M-line. Hence physiological muscle contraction under load is both attachment and detachment-limited.

Keywords

Biomechanics and biophysics; Muscle contraction; Molecular mechanism; Tension transients in muscle fibers; Isometric rapid tension recovery; Myosin cross bridges

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Biography

Sunil Nath, FNAE, FDNA, is Professor at the Department of Biochemical Engineering and Biotechnology, Indian Institute of Technology, Delhi, India. He was educated at IIT Kanpur, Princeton University, National Research Institute of Biotechnology, Germany, and MIT. He is best known for the pioneering formulation, by innovative systems biology and engineering approaches, of Nath's torsional mechanism of energy transduction and ATP synthesis and Nath's two-ion theory of energy coupling and ATP synthesis, and Nath's rotation-uncoiling-tilt energy storage mechanism of muscle contraction, named so by other authors/researchers. He has published 70 peer-reviewed journal papers, and over 60 conference papers. He is a Fellow of the Indian National Academy of Engineering (INAE) since 2017. He was elected Fellow of the Danish Academy of Natural Sciences (DNA) in 2021, and is included in the Stanford list of top 2% of world's scientists, 2020 (within the top 0.7%).

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Influence of the Presence of an Intravaginal Probe on the Pelvic Floor Muscular Activity in Women with Vulvodynia

Abstract

Introduction. Vulvodynia is a clinical disorder that affects 16% of women during their lifetime and it relates to a widespread or localized pain at the clitoris, labia or vestibule for at least 3 months[1]. The pelvic floor muscles (PFM)are usually involved in its pathophysiology, so that surface electromyography (sEMG) can be a useful technique to assist its assessment and diagnosis[2]. Pelvic sEMGsignals can be recorded with probes inserted into the vagina or rectum, or with self-adhesive electrodesattached to the perineum. Some studies performed on healthy women have proved that intracavitary probes do not alter PFM activation[3]. However, this may not be true in patients with vulvodynia, whousually complain about pain during penetration and thus the presence of the probe into the vagina may elicit pain and prevent them from performing contractions properly. The objective of the present study was thus to assess differences in the PFM activity recorded with self-adhesive electrodes depending on the presence or absence of an intravaginal probe.

Methods

Twenty-eight women with vulvodynia were recruited by the Obstetrics and Gynecology Service of Hospital La Fe, Valencia.Four monopolar sEMG signals of their PFM were recorded by self-adhesive electrodes placed on both labia majora, as well as one bipolar signal of each of the labia. Patients carried out five contractions of 5seach interspaced withresting periods of 10s during the recording, which was performed twice: first with a PeriformTM probe into the vagina and then without it. The root mean square (RMS)[4], median frequency (MDF)[5], Dimitrov'sindex (DI)[6] and sample entropy(SampEn) [7]of the signals recorded during PFM contractions, as well as of 10s of signal recorded before them, were computed. Statistically significant differences between sEMG features when the probe was into vs. out of the vaginawere assessed according to a paired sample T-test or Wilcoxon signed-rank test(significance level:5%) for each channel.

Results

Generally, there were no significant differences between the PFM activity recorded when the probe was into vs. out of the vagina. The only region thatshowed significant differences in all its sEMG featureswas the lower area of the right side and only during contractions. When the probe was in place, the PFM activity's energy was lowerthan when it was not (RMS: 3.25±1.40vs. 3.75±1.58μV, p-value:<0.01), its spectral content was shifted towards greater frequencies (MDF: 151±18 vs. 147±17Hz, p-value: 0.02; DI: 1.01·10-14±0.30·10-14 vs. 1.21·10-14±0.43·10-14Hz-6, p-value:<0.01)

and its complexity was higher (SampEn: 0.51±0.04 vs. 0.49±0.05, p-value:<0.01). The reference electrode was placed on the right iliac spine, i.e. near to this PFM region, so itcould have influenced the significant differences obtained.

Conclusion

As other authors have reported inhealthywomen, the presence of an intravaginal probe does not affect the PFM activity in womenwithvulvodynia. However, given the pain it elicited in patients, the assessment of the PFM activity should onlyrely on self-adhesive electrodes. Other locations of the reference electrode should be considered in future studies.

Keywords

vulvodynia, pelvic floor muscles, surface electromyography, intravaginal probe

Supplementary Table

Table 1. P-values of the statistical test assessing differences in the RMS, MDF, DI and SampEn of the sEMG signal recorded during PFM relaxation and contraction when the PeriformTM probe was into vs. out of the vagina. Results are shown for each monopolar (right upper, right lower, left upper, left lower) and bipolar (right, left) signal.

		Right upper	Right lower	Left upper	Left lower	Right	Left
PFM relaxation	RMS	0.12	0.23	0.12	0.37	0.65	0.08
	MDF	0.48	0.35	0.41	0.33	0.23	0.47
	DI	0.58	0.65	0.33	0.40	0.05	0.09
	SampEn	0.47	0.21	0.28	0.21	0.05	0.08
PFM contraction	RMS	0.15	<0.01	0.20	0.26	0.27	0.12
	MDF	0.02	0.02	0.71	0.71	0.69	0.68
	DI	0.06	<0.01	0.13	0.23	0.21	0.24
	SampEn	0.10	<0.01	0.15	0.10	0.41	0.08

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Biography

Monica Albaladejo-Belmonte was born on March 28, 1997 in Pilar de la Horadada (Alicante, Spain). She holds a bachelor's degree in Biomedical Engineering, specialisation in information and communication technologies (2019), and a master's degree in Biomedical Engineering, specialisation in bioelectronics and medical technology (2020), from the Universitat de Politècnica de València (Valencia, Spain). She is currently a PhD student in the doctorate programme in Technologies for Health and Well-being from Universitat Politècnica de València, with a predoctoral contract from the Generalitat Valenciana (ACIF/2021/012). She is carrying out her doctoral thesis in Centro de Investigación e Innovación en Bioingeniería of Universitat Politècnica de València, in collaboration with the Obstetrics and Gynaecology Service of the Hospital La Fe (Valencia, Spain).

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Structural Characterization of Nanoparticles for Smart Drug Delivery: Tuning Nanostructure and Tissue Interaction

Abstract

Nanoparticles and nanoemulsions composed by a hydrophobic core stabilized by physiological lipids or surfactants have been widely proposed as efficient vectors for efficient and targeted drug delivery. Besides optimal encapsulation, the design of the best vectors has to face key properties as tissue targeting and drug controlled release. According to the final target, the selected administration route and the delivery strategy, bioadhesive or biopenetrating agents, like chitosan, hyaluronic acid and PEGylated surfactants, profitably modulate the residence time and the interaction of nanoparticles with tissues and with the mucus barrier.

We applied a complete structural characterization of different new nanovectors selected as promising mediators to enable nasal systemic and brain delivery of active compounds. The nanosystems were investigated for their physicochemical and structural properties and for their impact on the biopharmaceutical aspects critical for nasal and nose-to-brain delivery: biocompatibility, drug release, muco-adhesion and permeation across the nasal mucosa. Nanoparticle size and composition, surface charge and internal structure (multi-layered, core-shell or raspberry-like, as assessed by small angle neutron scattering, SANS) were demonstrated to have an impact on both the drug release profile and, strikingly, their behaviour at the biological interface. The interaction with the mucus layer and the kinetics and extent of transport of the drug across excised animal nasal epithelium were modulated by nanoparticle structure and surface.
The correlation between nanoparticles structure and their biopharmaceutical properties appears to be a pivotal point for the development of novel platforms suitable for systemic and brain delivery of pharmaceutical compounds via intranasal administration.

Keywords

autoaggregating biological macromolecules, small angle neutron scattering, transmucosal delivery, bioadhesiveness, nasal delivery.

Biography

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Elena Del Favero is an associated professor of Applied Physics at University of Milan, where she teach Medical Physics at the Medical School and at other courses of the Faculty of Medicine. Her research activities focus on the physico-chemical properties of auto aggregating complex systems of biological macromolecules: structural, dynamic, thermotropic, lyotropic and interaction properties. She collaborate with national and international partners with expertise in different bio-related disciplines. Her Main topics: structural organization and dynamics of complex lipid systems

(biomimetic membranes); mesoscale characterization of aggregates of Abeta and Tau peptides; structure of nanoparticles for drug delivery and controlled release; • interaction of model membranes with peptides, proteins and ion channels; smart materials for tissue regeneration. Physical techniques: laser light scattering (visible, UV), calorimetry, Neutron and X-ray techniques at the European Large Scale Facilities.

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Thermal Infrared Imaging in Human-Machine Interaction: Modern Approaches and Future Perspectives

Abstract

Human-machine interaction (HMI) is a widely spreading research field, aiming at studying the interaction and communication between human users and machines. It is strictly related to the area of Ergonomics, which generally studies the human factors influencing the interaction of humans with living/working scenarios [1].

In HMI, it is of paramount importance to establish the psychophysiological state of the human agent to favor the interaction with the machine, whether it be a robot or a vehicle [2]. Typically, psychophysiological states are assessed through behavioral analysis and/or the measurements of autonomic nervous system (ANS)-related parameters, i.e. galvanic skin response, hand palm temperature, modulations of heart beat and/or breathing rate, and peripheral vascular tone.

Classical approaches developed to monitor these variables require the use of contact sensors or devices, thus resulting invasive for the subject and, overall, biasing the estimation of the psychophysiological state, since the complete participation of the individual is required.

To overcome the limitations of contact sensors, computational psychophysiology based on thermal infrared (IR) imaging has been assessed as a solution for the quantitative evaluation of several parameters associated with ANS activity [3]. In fact, IR imaging allows to estimate at a distance autonomic parameter, such as the cardiac pulse, the breathing rate, the cutaneous blood perfusion rate, the sudomotor response, and, in general, to have an assessment of the psychophysiological responses to an external stimulation (i.e. the stress response [4], the cognitive workload [5]).

The possibility to access these human factors through a non-contact technology makes thermal IR imaging perfectly suitable in the HMI field. In particular, it has been successfully used in the automotive research area, to assess the psychophysiological state of the driver and a relevant number of scientific works are available. Most of these publications concern driver drowsiness/fatigue monitoring and emotional state detection [6-8]. Recently, some machine learning-based models have been developed to classify the stress [9], the drowsiness [10] and the cognitive workload [11] of the driver relying on thermal features of facial regions of interest ROIs), in particular relative to the nosetip and corrugator ROIs.

Another important field of application has been the robotics research area, with a deep focus on social robots and rehabilitative robots. In the first kind of application, the main aim is using thermal IR imaging to understand the human's need and his/her affective state during the interaction with the artificial agent and regulate consequentially the behavior of the social robot, as to reproduce a human-like interaction [12]. In the context of rehabilitation robots, instead, the objective is to monitor the emotional and motivational state of the subjects as to enhance the rehabilitative outcomes in patients with motor impairment [13].

Future studies still need to be performed to strengthen and improve the interaction between the human and the artificial agent, but the perspective is strongly promising, given also the possibility to rely on miniaturized thermal cameras, which can be easily embedded into the interacting machine system.

Keywords
Thermal infrared imaging; human-machine interaction; machine learning; affective computing; computational psychophysiology

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Biography
Daniela Cardone obtained a Master's Degree in Biomedical Engineering at the La Sapienza University of Rome and the title of Ph.D. in Neuroscience and Neuroimaging at the University "G. d'Annunzio "of Chieti-Pescara.Currently, she is Research Fellow for the PON ADAS + project "Development of advanced technologies and systems for car safety through ADAS platforms" at the Department of Neuroscience of the University of "G. d'Annunzio".

Her research work mainly concerns the development of processing methods for images and physiological signals, of various nature. Her main activity concerns thermal infrared (IR) imaging. In this context, she developed real-time tracking algorithms for specific areas of interest and IR image warping methods on anatomical templates. She also dealt with the realization of image fusion algorithms between visible and thermal images.More recently, her research has focused on affective computing and human-machine interaction, with particular reference to the automotive research field.

Chiara Di Tucci,
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Role of Alpha Lipoic Acid in Infertility

Infertility is an increasingly frequent health condition, which may depend on female or male factors. Oxidative stress (OS), resulting from a disrupted balance between reactive oxygen species (ROS) and protective antioxidants, affects the reproductive lifespan of men and women. In this review, we examine if alpha lipoic acid (ALA), among the oral supplements currently in use, has an evidence-based beneficial role in the context of female and male infertility.

Methods

We performed a search from English literature using Pub Med database with the following keywords: 'female infertility', 'male infertility', 'semen', 'sperm', 'sub-fertile man', 'alpha-lipoic acid', ' alpha lipoic acid', 'lipoid acid', 'endometriosis', 'chronic pelvic pain', 'follicular fluid' and 'oocytes'. We included clinical trials, multicentric studies and reviews. The total number of references found after automatically and manually excluding duplicates was 180. After primary and secondary screening, 28 articles were selected.

Results

The available literature demonstrates the positive effects of ALA in multiple processes from oocyte maturation (0.87 ± 0.9% of oocyte in MII vs 0.81 ± 3.9%; $p < .05$) to fertilization, embryo development (57.7% vs 75.7% grade 1 embryo; $p < .05$) and reproductive outcomes. Its regular administration both in sub-fertile women and men shows to reduce pelvic pain in endometriosis ($p < .05$), regularize menstrual flow and metabolic disorders ($p < .01$) and improve sperm quality ($p < .001$).

Conclusions

ALA represents a promising new molecule in the field of couple infertility. More clinical studies are needed in order to enhance its use in clinical practice.

Biography

Chiara Di Tucci, MD completed her residency in Obstetrics and Gynecology at "Sapienza" University of Rome, Italy. She obtained PhD in Gynecology Oncology in 2019 at Sapienza University of Rome. She is a practicing gynecology as medical executive in Local Health Unit of Rome. Her key areas of interest are: endometriosis, infertility and oncological gynecology. `She has published more than 35 papers in reputed journals and has been serving as an editorial board member of repute.

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A Blood DNA Methylation Biomarker Predicts Short Term Risk of Cardiovascular Events

Background
Emerging evidence highlights the epidemiological value of DNA methylation (DNAm)-based epigenetic clocks. However, they constitute non-specific biomarkers, representative of the general individual state of health rather than disease-specific biomarkers.

Methods
Using a multi-step approach, we developed a composite DNAm-based biomarker predictive of short-term risk for cardiovascular events. First, we developed novel DNAm surrogates for cardiovascular risk biomarkers (BMI, blood pressure, blood lipids, and coagulation markers). We used the EPIC Italy study (N=1,803) as the training dataset and four independent studies as the testing set: Understanding Society, TILDA, EXPOsOMICS CVD, and GSE174818 studies (N=2,107). Then, we used EPIC Italy data to train a model predictive of cardiovascular events, starting from 60 DNAm surrogate biomarkers (developed within this study plus those from previous literature). Finally, we evaluated the model's prediction performance through AUC analysis in EXPOsOMICS CVD dataset (160 case-control pairs in a prospective study nested in the cohort).

Results
We derived a DNAmCVDscore as a linear combination of ten DNAm surrogate biomarkers. In the independent testing set, the AUC were 0.77 and 0.85 for predicting cardiovascular events within five years and two years after recruitment, respectively. However, the prediction performance was poor for predicting long term cardiovascular events (AUC=0.52 for cardiovascular events during 18 years follow-up, 12 years on average).

Conclusions
We describe a novel DNAm based biomarker, DNAmCVDscore, strongly predictive of short-term CVD.

Keywords
Penalized regression, cardiovascular events, DNA methylation, surrogate biomarkers.

Biography
Doctor Giovanni Fiorito has a background in Mathematics and a PhD in Complex Systems for Life Sciences. He is currently Associated Researcher at the Department of Biomedical Sciences, University of Sassari, Italy. He is also Visiting Researcher at the School of Public Health, Imperial College, London, UK and Trinity College, Dublin, UK. His research involves the analyses of multi-omic data in molecular epidemiology, clinical, and randomized trial studies. His recent research focused on the role of epigenetic (specifically DNA methylation) modifications associated with

biological ageing (epigenetic clocks, epigenetic drift, and DNA methylation surrogates of various exposures) for predicting longevity, healthy ageing, and the risk of ageing-related diseases (cancer, cardiovascular diseases, and mental disorders), with the aim of identifying novel biomarkers for ageing-related diseases early detection and screening.

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Profiling Retinal Epithelial Cell Editomes Reveals Molecular Mechanisms Modulated by RNA Editing after A2E Induced Oxidative Stress Mediated by Blue Light

Abstract

RNA modification is a molecular process able to regulate gene expression by shaping the transcriptional profiles of cells in a multi-cellular organism. Individual nucleosides in RNA can undergo base modifications, defined as RNA editing events. More than a hundred different types of nucleoside changes have been identified on cellular RNAs to date, but the most prevalent is the hydrolytic deamination of adenosine (A) to generate inosine (I), catalyzed by the adenosine deaminase that act on RNA (ADAR) family. Inosine is commonly recognized as guanosine by cellular machineries, as well as by sequencing enzymes. Consequently, A-to-I modifications, appearing as A-to-G substitutions, tend to affects gene expression through protein recoding, splicing, stability, RNA export and heterochromatin formation, increasing both transcriptome and proteome diversity. Very interestingly, A-to-I editing is fundamental for proper neuronal development in mammals, and altered RNA editing levels in central nervous system (CNS) transcripts occur in many neuropathological disorders, including neurodegenerative diseases [1]. In this study, we realized an RNA sequencing (RNA-Seq) experiment, exploiting the advantages of next-generation sequencing (NGS) that permitted to improve and facilitate the large-scale identification of RNA editing sites.A transcriptome-wide approach was applied to identify changes in neural editing in retinal pigment epithelium (RPE) cells exposed to the oxidant agent N-retinylidene-N-retinylethanolamine (A2E) and induced blue light. Comparing editomes of treated and untreated cells at two time points (3h and 6h) after the basal one led to the identification of neural transcripts characteristics of oxidative stress induction. The accurate identification of RNA editing sites in RNA-Seq data required ad hoc computational methodologies, which must account for all of the most difficult challenging aspects, such as incomplete and variable penetrance of editing events, tissue-specific gene expression patterns, relatively high rates of sequencing errors associated with NGS technologies and the presence of underlying genomic variants that may bias analyses. Additionally, the methodological approaches enlisted the help of specialized databases such as REDIportal, DARNED and RADAR. More than 1,700 annotated editing sites were assigned to RNA canonical substitutions (A to I and C to T). Such sites, different between time-related treated samples, were located near genes involved in endoplasmic reticulum stress, chaperones activity, cell cycle regulation, vesicular trafficking, small GTPase signaling, retinoic acid cycle, microvascular impairments, chromosome instability, circadian rhythms, fatty acids metabolism, synapses integrity and retinal cells rescue. Our findings indicate that tissue-specific transcriptomic regulatory mechanisms are activated in response to induced oxidative stress mediated by blue light. Thus, this pilot study could represent an important step

towards discovery of unclear molecular mechanisms linking oxidative stress and etiopathogenesis of retinal dystrophies.

Keywords
Editome; RNA-Seq; RPE; NGS; ADAR; Oxidative Stress.

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Biography
Luigi Donato, PhD in “Applied Biology and Experimental Medicine”, frequents the Labs of Molecular Genetics of University of Messina, Italy. He is a researcher of the IEMEST institute in Palermo, Italy, too. He published more than 50 papers in reputed journals and participated in more than 30 national and international congresses, also being in the Organizing Committee in several of them. He was a member of ARVO and he is a member of AIBG. He joined the Editorial Board of several journals, such as “Cell Cycle”, “BMC Bioinformatics”, also acting as Guest Editor for “Antioxidants” and “Frontiers in Genetics”. His main research fields are retinal dystrophies and omics approaches.

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SWIM: A Network-Based Approach for Human Diseases

Abstract

Integrating the outcomes of co-expression network analysis with the human interactome network could aid to predict novel putative disease genes and modules. Recently, we developed SWIM (SWItch Miner) methodology, a network-based approach able to predict important (switch) genes within the co-expression network that regulate disease state transitions. The phenotype-specific applications of SWIM were broad and include the identifications of switch genes in grapevine berry maturation as well as human cancers, including glioblastoma[1–5]. In viticulture, SWIM has been gainfully applied to the global gene expression atlas of grapevine in order to identify switch genes between immature and mature phase of the developmental program of grapevine. In cancer research, SWIM has been gainfully applied to a large panel of cancer datasets from TCGA in order to characterize disease etiologies and identify potential therapeutic targets. Yet, the application of SWIM on glioblastoma allowed us to uncover new insights into the molecular mechanism determining the stem-like phenotype of glioblastoma cells. Recently, SWIM methodology, has been successfully applied to chronic obstructive pulmonary disease (COPD), a severe lung disease characterized by progressive and incompletely reversible airflow obstruction[6]. COPD switch genes appear to form localized connected subnetworks displaying an intriguingly common pattern of upregulation in COPD cases compared with controls. A more sophisticated analysis revealed that they were not only topologically related, but also functionally relevant to the observed phenotype as witnessed by their enrichment in the regulation of inflammatory and immune responses. The results obtained in COPD were compared with those obtained in the acute respiratory distress syndrome (ARDS), another severe lung disease with an inflammatory component. Interestingly, ARDS switch genes were different from COPD switch genes, but the major pathways affected in the two diseases were similar, emphasizing that different diseases often have common underlying mechanisms and share intermediate endophenotypes (convergent phenotypes) [7,8]human diseases have been differentiated and categorized based on the organ system in which they primarily manifest. Recently, an alternative view is emerging that emphasizes that different diseases often have common underlying mechanisms and shared intermediate pathophenotypes, or endo(pheno. Moreover, the two lists of switch genes, when mapped to the human interactome, appear to form non-overlapping modules and to be situated in different network neighborhoods. This observation demonstrates that even though different diseases can share similar endophenotypes, the molecular network determinants responsible for them are disease-specific. Inspired by the results obtained by SWIM network analysis of cancers and COPD[2,6], we investigated three other complex diseases for a more generalizable understanding of the highly interconnected nature of human diseases. Specifically, two cardiac disorders, ischemic and non-ischemic cardiomyopathy, and one neurodegenerative disorder, Alzheimer's disease, were analyzed. These new results, together with the previously obtained analyses from the application of SWIM to ten different tumor types and COPD, were mapped to the human interactome in order to overlay the PPI network with disease information derived from SWIM-based disease correlation networks.Our goal was to assess the utility of SWIM network analysis in classifying several different disorders and in understanding their complex interconnections in the human interactome. In particular, through the construction of a

SWIM-informed human disease network by analogy with [9], we found that switch genes associated with specific disorders are closer to each other than to other nodes in the network, and tend to form localized connected subnetworks. These subnetworks overlap between similar diseases and are situated in different neighborhoods for pathologically distinct phenotypes, consistent with the well-known topological proximity property of disease genes. These findings allowed us to demonstrate how SWIM-based correlation network analysis can serve as a useful tool for efficient screening of potentially new disease gene associations. When integrated with an interactome-based network analysis, it not only identifies novel candidate disease genes, but also may offer testable hypotheses by which to elucidate the molecular underpinnings of human disease and reveal commonalities between seemingly unrelated diseases.

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Biography

Paola Paci was trained as a theoretical physicist and she worked over 18 years on the field of computer modeling. She holds a degree in Physics from the University of Rome “Sapienza” and a Ph.D in Physics from the University of Pavia “A. Volta”. She holds a master in bioinformatics, named “Master in Bioinformatica: Applicazionibiomediche e farmaceutiche”, cum laude at the University of Rome “Sapienza”, defending a thesis on a software development for functional analysis of gene expression. Since 2011 to 29 February 2020 she was a researcher of Institute for Systems Analysis and Computer Science “A. Ruberti” (IASI) of National Research Council (CNR) in Rome. Since 2March 2020 she is Associate Professor at Department of Computer, Control and Management Engineering “A. Ruberti”, Sapienza University of Rome.

Rossana E. Madrid
Universidad Nacional de Tucuman, Argentina

The Revolution of POC Devices for Health Care

Point of Care (POC) devices are currently widespread, and devices have been developed for numerous applications in the health area. The intersection of different areas of science, such as nanotechnology, for the development of more sensitive devices; microfluidics, leading to Lab-on-a-Chip (LoC) manufacturing; new and interesting materials such as hydrogels to mimic biological entities, smart mobile technologies, etc., allow to generate better opportunities for both diagnosis or monitoring of a treatment or disease. Wearable sensors for healthcare applications are undergoing even more phenomenal development. These also includes “smart clothing” that can connect people with the cloud and Big Data for sustainable health monitoring. All these technologies have grown exponentially in recent years. However, this growth in the research and development level has not been accompanied in the same way with their transfer and marketing. The vast majority remain in the field of research and do not proceed to the stage of commercial development. Regulations, experiences of failures, long clinical trials, technical limitationsor adoption by end-users are the main difficulties that these devices must face in order to move to the commercial stage. However, although many of these technologies are in the early stages of development, many are already in our homes, and we believe that despite the difficulties mentioned, and due to their great potential, in a very few years these technologies will become so common that we would not be able to do without them.

Biography

Rossana Madrid is EE and Ph.D. in Bioengineering. She is currently Full Professor of Biomedical Transducers and Biosensors and Microsystems of the Biomedical Engineering Program, and also at the Doctoral degree, at the Faculty of Exact Sciences and Technology at the University of Tucumán, Argentina. She is Principal Researcher at the National Council of Scientific and Technical Research of Argentina (CONICET). She has published R&D papers in national and international journals, two chapters in books and has developed four patents. Her main research fields include sensors and biosensors, microfluidic systems and paper-based POC devices for biomedical and environmental applications.

Manisha Witmans

Associate Clinical Professor, University of Alberta
Canada

Evolving Wearable Technology in Sleep Medicine

Abstract

Sleep is an important foundational physiological function and humans spend one third of our lives sleeping. Since the discovery of REM in 1953, advances in sleep medicine have increased exponentially. Yes, monitoring sleep is a challenge. Wearable technology has revolutionized our ability to monitor sleep. Applications of wearable technology in sleep medicine will be discussed as it impacts health.

Biography

Dr. Witmans is a Board Certified Sleep Specialist who also sub specializes in pediatric pulmonology. Originally from Slave Lake, Alberta, Dr. Witmans completed her medical training at the University of Saskatchewan, her residency in Pediatrics and her Fellowship in Pediatric Respirology at the University of Calgary, Alberta Children's Hospital. She subsequently completed additional fellowship training in Pulmonology and Sleep Medicine at the Children's Hospital in Los Angeles, California. After returning to Alberta, she developed the pediatric sleep program at the Stollery Children's Hospital in Edmonton. Currently, she is an Associate Clinical Professor at the University of Alberta and has a busy private practice office in Sherwood Park, Alberta. Her expertise in sleep medicine has enabled her to play an integral part in the development of the current international guidelines on the use of polysomnography in pediatric respiratory and non-respiratory sleep disorders. She has several publications and collaborations to her name, and is a sought-after journal and grant reviewer. She is involved with numerous committees to help address sleep problems in children nationally and internationally. Dr. Witmans is also involved in various research projects involving pediatric sleep medicine.

Guojun Chen
Biomedical Engineering McGill University, Montreal, H3G1Y6 QC, Canada

Delivery of Cold Atmospheric Plasma for Cancer Immunotherapy

As the fourth state of matter, plasma's unique properties and interactions with other states of matter offer many promising opportunities for investigation and discovery. In particular, cold atmospheric plasma (CAP), operating at atmospheric pressure and room temperature, has remarkable potential for biomedical applications through various delivery methods. Our recent studies discovered that through CAP can effectively evoke anti-tumor immune responses for enhanced cancer immunotherapy. Furthermore, though proper delivery of CAP, the overall antitumor efficacy can be further amplified. In this presentation, two CAP delivery applications will be introduced, including microneedle-mediated transdermal CAP delivery for synergizing immune checkpoint blockade, and portable air-fed CAP devices for post-surgical cancer immunotherapy.

Biography
Dr. Guojun Chen is an Assistant Professor in Biomedical Engineering at McGill University. Dr. Chen obtained his doctoral degree at the University of Wisconsin-Madison in 2017. He received postdoctoral training at UCLA before he joined McGill University in 2021. His research focuses on engineering novel biomaterials and devices for enhanced cancer immunotherapy and gene therapy. He has published over 70 papers, including in Nature Nanotechnology, PNAS, Nature Biomedical Engineering, and is a co-inventor of seven patents. Dr. Chen is the recipient of Young Investigator award from Chinese Association of Biomaterials. He currently serves as an editorial board member of Biomaterials.

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Thomas J Webster
Interstellar Therapeutics, Boston, MA USA

20 Years of Commercializing Self-Assembled Nanomaterials: Fighting COVID-19, Inhibiting Infection, Killing Cancer, and Regenerating Tissues

Abstract

Self-assembled Nanomaterials will self-assemble into predictable nano dimensions in aqueous solutions suitable for numerous applications from medicine to energy storage and more. This talk will cover over 20 years of research and efforts to commercialize such materials into real medical products. In particular, one type of self-assembled Nanomaterials composed of DNA base pairs has been the focus of our efforts to functionalize with specific peptides suitable for attaching to SARS-CoV-2 and all of its known variants. After binding to SARS-CoV-2, the self-assembled molecule inhibits SARS-CoV-2 binding to and entering mammalian cells keeping it from replicating. Moreover, these unique self-assembled Nanomaterials have been functionalized with peptides to attach to and penetrate to kill gram-positive bacteria, gram-negative bacteria, and antibiotic-resistant bacteria. Further, these self-assembled Nanomaterials were functionalized with peptides to attach to and kill cancer cells. Lastly, significant effort has been spent to functionalize these self-assembled Nanomaterials with peptides to promote bone, cartilage, vascular, skin and other tissue growth (Figure 1). In vitro and in vivo studies will be presented as well as lessons learned trying to commercialize university based research into real commercial products.

Keywords

self-assembled Nanomaterials, COVID-19, infection, cancer, tissue regeneration

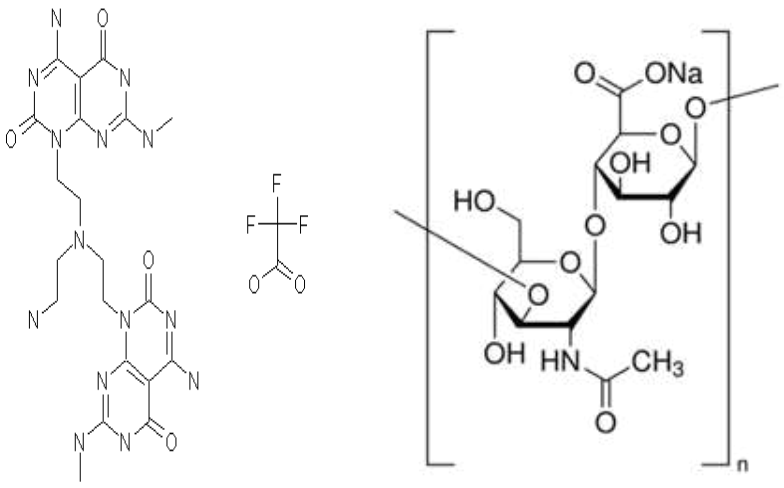

Figure 1: Example of the novel self-assembled material used to treat aging skin.

Biography

Thomas J. Webster's (H index: 108; Google Scholar) degrees are in chemical engineering from the University of Pittsburgh (B.S., 1995) and in biomedical engineering from RPI (Ph.D., 2000). He has

served as a professor at Purdue (2000-2005), Brown (2005-2012), and Northeastern (2012-2021) Universities and has formed over a dozen companies who have numerous FDA approved medical products currently improving human health. He has directed numerous international centers in biomaterials and has graduated over 200 students with over 750 peer-reviewed publications. Prof. Webster is a fellow of over 8 academic societies and is a SCOPUS highly cited researcher (top 1% citations for materials science and mixed fields) as well as a Public Library of Science (PLOS) World Top 2% Scientist by Citations in all fields.

J. Xie
Department of Surgery-Transplant and Holland Regenerative Medicine Program, University of Nebraska Medical Center, Omaha, NE, 68198

New Forms of Electrospun Nanofiber Materials for Biomedical Applications

Abstract
Electrospinning is an enabling nanotechnology which is capable of producing a rich variety of novel structured materials in many biomedical applications. New forms of electrospun nanofiber materials were recently developed in our lab including nanofiber foams/sponges, short nanofibers, nanofiber aerogels, nanofiber microspheres, and porous nanofiber microspheres.1-6 These developed materials have been demonstrated in several biomedical applications (e.g., hemostasis, tissue regeneration, and cell delivery). The compressed nanofiber foam is capable of re-expanding to its original shape in atmosphere, water and blood within ten seconds. Such nanofiber foams exhibit greater capacity of water/blood absorption compared to current commercial products and high efficacy in whole blood clotting assay, in particular for thrombin-immobilized samples. These nanofiber foams are capable of being packed into a syringe for injection. The in vivo tests indicated the effectiveness of nanofiber foams for hemostasis in a porcine liver injury model. In summary, the newly developed electrospun nanofiber materials show great promise in biomedical applications.

Keywords
Electrospinning, Nanofibers, Expansion, Tissue Regeneration, Drug Delivery

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Biography
Jingwei Xie received his B.S. and M.S. from Nanjing University of Technology, China, and his Ph.D. from the National University of Singapore (2007). He worked as a postdoctoral fellow in the Xia group at Washington University in St. Louis. He is currently a Professor in the Department of Surgery Transplant and Holland Regenerative Medicine Program at University of Nebraska Medical Center. He is also an adjunct faculty in the Department of Mechanical & Materials Engineering at the University of Nebraska-Lincoln. His research interests include biomaterials, drug delivery, nanomedicine, tissue engineering, regenerative medicine, wound infection and healing, and hemostasis.

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Constantinos Sioutas,
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Evaluating the Impact of Coronavirus-19 Pandemic on the Chemical andToxicological Characteristics of Ambient Fine Particulate Matter (Pm2.5) in the Metropolitan Area of Milan, Italy

This study investigates the changes in the toxicological and chemical characteristics of PM2.5 in the Milan metropolitan area during three distinct COVID-19 restriction periods: (I) full-lockdown (FL), (II) partial-lockdown (PL), and (III) full-relaxation (FR).PM2.5 samples were collected on quartz filters and evaluatedfor their elemental and organic carbon (EC/OC), redox-active metal, water-soluble organic carbon (WSOC), and individual organic species contents. The 2',7'-dichlorodihydrofluorescein (DCFH) and dithiothreitol (DTT) assays were utilized to assess the PM2.5oxidative potential. Our results showed a reduction in the ambient concentrations of traffic relatedPM2.5polycyclic aromatic hydrocarbons and road dust markers (e.g., Fe, Mn, Cu, Cr, and Ti) during the lockdown periods (i.e., FL and PL)contrastedto those measured in the year 2019.Furthermore, the implemented restrictions on road trafficsignificantly reduced the mass concentration of the above-mentioned species and the PM2.5 oxidative potentialduring FL compared with PL and FR. Consistent with this finding, a decreasein the emissions of atmospheric pollutants, including nitrogen dioxide (NO2) and benzene (C6H6), during the entire COVID-19 period in comparison to the year 2019 was observed. Nevertheless, ambient concentrations of black carbon (BC) and PM2.5during the lockdown phase were comparable (Pvalue= 0.10-0.75) with those measured at the same period in 2019, due to the enhanced residential biomass burning emissions as a result ofthe adopted stay-home strategies. Therefore, results from this study confirm the impact of the adopted COVID-19 road traffic restrictions on the oxidative potential of PM2.5 in the Milan area and can be helpful in adopting mitigation policiesto reduce the exposure to PM2.5.

Keyword
COVID-19, Coronavirus, Po Valley, PM2.5 characterization, PM2.5 oxidative potential

Biography
Dr. Constantinos Sioutas, Sc.D., is the first holder of the Fred Champion Professorship in Civil and Environmental Engineering at the University of Southern California (USC), starting in 2006, and the director of the University of Southern California Aerosol Laboratory at the department of Civil and Environmental Engineering

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A Novel Synthesis of an Ultrasound-Responsive Gene Delivery Nanoplatform for Bone Disorders

Abstract

The primary goal of this project was to create, optimize, and assess an ultrasound-responsive targeted nanobubble gene delivery system for the controlled release of the silencing Catheps in K small interfering RNA (CTSK siRNA) to treat osteoporosis. An in situsono chemical method was used to synthesize the nanobubbles. Composed of a perfluorocarbon gaseous core, stabilized with an albumin protein shell, encapsulated with CTSK siRNA, and functionalized with alendronate (AL) to target the bone, the complete nanobubble (NB) was synthesized (CTSK siRNA-NB-AL). After the developmental procedure, a therapeutic ultrasound probe was used to test the sensitivity of CTSK siRNA-NB-AL. The human bone marrow-derived mesenchymal stem cell biocompatibility results showed that there was no significant cell death ($p>0.05$). The suppression of osteoclasto genesis was shown when CTSK siRNA-NB-AL was added to the human osteoclast precursors. Overall, the project confirms the promise of ultrasound and nanotechnology to distribute CTSK siRNA into osteoclasts. The research also introduces an innovative ultrasound-responsive gene delivery nanoplatform that can be further utilized as a drug, gene, and/or oxygen delivery system for numerous illnesses such as neurodegenerative diseases, bone disorders, or cancer.

Keywords

Nanobubble, Osteoporosis, Ultrasound, siRNA delivery, Bone targeting

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B. Thilagar
Mayo Clinic, United States

Understanding Medical Devices and Apps used by Our Patients.

Abstract
Over the last decade there has been considerable advancement in the field of personal wearable devices. The use of these devices has increased significantly in the general population. There has been significant amount of medical data collected from these devices however, it is still uncertain what is the best use of this clinical data during a patient visit in an outpatient encounter. The value of this data against reliable tried and tested medical monitoring is still not known completely. In this review we strive to ascertain the benefits and pitfalls in the use of this data both for the patient and the clinician treating them.

This review particularly focusses on several aspects this data such as in oximetry measurement, EKG tracing, personal breath test, home anthropometric measurements, home spirometry, personal genomic sequencing, dot blot tests done at home for laboratory evaluation.

Overall, the quality of commercially available app-based monitoring of sensing devices on wearable and phones is questionable. Based on a study by Wisniewski et al, nearly 50% of these aps made claims that appeared medical. Of the 120 aps analyzed none of them had FDA marketing approval. It is hard for patients to distinguish between good medical data and bad data. On one side there is a concern for increased screening, on the other side these devices may offer a false sense of security in their limited health data tracking ability that may be detrimental to the health of the patient.

Keywords
Wearables, iOS, Android, Apple, Google, medical devices, oxygen sensor, tracking, sensing

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Biography
Dr. Bright Thilagar MD, FACP, SFHM is a Clinical Associate Consultant and an Assistant Professor at Mayo Clinic, Rochester, MN. He completed his Masters in Medical Management at Carnegie Mellon University and is a Certified Physician Leader at the American College of Physicians. He is

interested in medical device research, usage trends by patients and their practical use in Clinical Medicine for providers. He is a startup advisor for the American College of Physicians advising early-stage companies on their clinical use possibilities.

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