BES9SM / Junior Colleges / Poster Presentation

Name	Ang Ming Liang
Institution	Anderson Junior College
Title of Abstract	The Development of an Open-Source Low 3D bioprinter and standard protocol for bioprinting
Authors	Ang Ming Liang
Abstract	The development of 3D bioprinting using computer aided design (CAD) software and open-source hardware is not well established within the bioenginerring community. This project details both a prototype for a 3D bioprinter and the biological protocols we used to print out PEG 3D cell cultures. The PEG 3D cell cultures uses standard LB broth solution, PBS buffers solution along with ampicillin to grow genetically engineered E. coli bacteria with both the gfp gene and ampicillin resistance gene at the LacZ region of the bacteria plasmid. This allow for fast screening and preparation of the E.coli for Bioprinting. The performance of the bioprinter is determined by comparing the CAD model specs and the actual measured length of the 3D cell culture, by using an accuracy equation . Another key performance indicator used is the natural contamination rate of the bioprinter without any ampicillin in the PEG solution to remove the contaminated bacteria. To determine the amount bacteria contamination in each PEG culture, we count the number of cultures under UV light and non-UV lighting conditions. The E.coli will fluoresce under the UV light, thus colonies that do not fluoresce is contaminated colonies. A Student t-test shows that the accuracy of the bioprinter is acceptable.

BES9SM / Junior Colleges / Poster Presentation

Name	Yoong Shuen Yin, Celine
Institution	Hwa Chong Institution
Title of Abstract	Mitochondrial Dysfunction in Skeletal Muscles during Insulin Resistance and Type 2 Diabetes
Authors	Yoong Shuen Yin, Celine, Wendy Phua
Abstract	Insulin resistance results from the impairment of the insulin signalling pathway and mitochondrial dysfunction in skeletal muscle. However, it remains uncertain the pathway in which mitochondrial dysfunction results in insulin resistance. Through the use of the drug carbonyl cyanide m-chlorophenyl hydrazone (CCCP) and insulin stimulation, the relationship in which a decrease in p- AKT levels in a dose-dependent manner causes the disruption of the mitochondrial potential due to depolarization of the mitochondrial membrane potential is shown. In the study, it is also shown that the disruption of mitochondrial membrane potential in C2C12 mouse myotubes results in insulin resistance, possibly through mitophagy via the E3 ubiquitin ligases, mitochondrial E3 ubiquitin protein ligase 1 (MUL1) and Parkin. In this research, the cause-effect relationship between mitochondrial dysfunction and insulin resistance, as well as the role MUL1 and Parkin plays in insulin resistance is studied.

BES9SM / Junior Colleges / Poster Presentation

Name	Liew Pei Yu Dawn
Institution	National Junior College
Title of Abstract	Selecting Common non-synonymous Single Nucleotide Polymorphism that could potentially be associated with Atopic Dermatitis in the Singaporean Population
Authors	Liew Pei Yu Dawn and Mr William Phua
Abstract	According to the World Health Organisation, Cancer is the leading cause of death, accounting for 8.2 million deaths in 2012. P53 inactivation is almost a universal feature in all 14.1 million current cancer cases, out of which 7 million are tumours resultant of defective signaling components in the p53 pathway. The p53 pathway is thus a prime target for cancer drug development. Interruption of the MDM2 regulation of p53 is necessary for p53 to accumulate in response to stress. Despite the discovery of small molecule inhibitors of this interaction like Nutlin-3a, no cellular protein inhibitor has been discovered. Proteins have multiple advantages over small molecule inhibitors, ranging from the financial perspective to specificity of drug delivery. In this study, we use our structure comparison program CLICK combined with molecular docking and molecular dynamics(MD) simulations to search the database of structures of proteins for potential inhibitors of this interaction. CLICK can superimpose the 3D structures of any pair of biomolecules, independent of topology. Three peptides (PDB code 4hx1C, 1lp9C, 2x04C) are found to be the best hits, with low binding energies in the range of ~-50 kcal/mol. Results from MD simulations show the complexes to be stable over 100ns. These complexes show that two out of three of the matched residues fit snugly into the MDM2 binding pocket. This study presents 3 peptides which should be further investigated and experimented in the light of developing a new inhibitor of MDM2 which could be used to develop peptide based drugs against cancer.

BES9SM / Junior Colleges / Poster Presentation

Name	Christine Ng Sih Chin
Institution	National Junior College
Title of Abstract	Discovering Anticancer Drugs
Authors	Christine Ng Sih Chin ,Dr Nguyen Ngoc Minh and Dr Chandra Verma
Abstract	According to the World Health Organisation, Cancer is the leading cause of death, accounting for 8.2 million deaths in 2012. P53 inactivation is almost a universal feature in all 14.1 million current cancer cases, out of which 7 million are tumours resultant of defective signaling components in the p53 pathway. The p53 pathway is thus a prime target for cancer drug development. Interruption of the MDM2 regulation of p53 is necessary for p53 to accumulate in response to stress. Despite the discovery of small molecule inhibitors of this interaction like Nutlin-3a, no cellular protein inhibitor has been discovered. Proteins have multiple advantages over small molecule inhibitors, ranging from the financial perspective to specificity of drug delivery. In this study, we use our structure comparison program CLICK combined with molecular docking and molecular dynamics(MD) simulations to search the database of structures of proteins for potential inhibitors of this interaction. CLICK can superimpose the 3D structures of any pair of biomolecules, independent of topology. Three peptides (PDB code 4hx1C, 1lp9C, 2x04C) are found to be the best hits, with low binding energies in the range of ~-50 kcal/mol. Results from MD simulations show the complexes to be stable over 100ns. These complexes show that two out of three of the matched residues fit snugly into the MDM2 binding pocket. This study presents 3 peptides which should be further investigated and experimented in the light of developing a new inhibitor of MDM2 which could be used to develop peptide based drugs against cancer.

BES9SM / Junior Colleges / Poster Presentation

Name	Yip Jia Yun
Institution	National Junior College
Title of Abstract	Design of Novel Hydroxylamine-based Spacers for Glycoconjugate Chemistry
Authors	Yip Jia Yun, Sim Shu Yu Rebecca and Ksenia Fedina
Abstract	Spacers play a crucial role in the structure of neoglycoconjugates, acting as a bridge to link an oligosaccharide to the biomolecule of interest, affecting the structure and overall physical properties of the neoglycoconjugate. When spacers are synthesised with predetermined structures and properties, these homogeneous forms will allow the roles of different glycoconjugates to be studied in greater depth. As glycoconjugates are essential for numerous biological responses, neoglycoconjugates are excellent synthetic analogue in the studies of these responses and developing potential cancer and influenza vaccines. In this research, two unique azido-O-methylhydroxyl amine spacers were specially designed, synthesized and conjugated to glucose and maltose. In addition, four different spacers, each containing two aminooxy groups, were also synthesized with the involvement of a modified Gabriel's synthesis with N-hydroxy-phthalimide, before being reduced by hydrazine hydrate. Conjugations of these spacers to glucose and lactose were also found to be successful in both basic and weakly acidic environments.

BES9SM / Junior Colleges / Poster Presentation

Name	Wilson Chua Wei Cheng
Institution	NUS High School of Mathematics and Science
Title of Abstract	Reduction of Hemolysis in Superhydrophobic Blood Pump Tubing
Authors	Presenters/Members: Wilson Chua Wei Cheng, Chia Wei Shen, Joel (NUS High School), Mentors: Dr. Lai Changquan, Dr. Yap Choon Hwai (NUS)
Abstract	Extracorporeal blood pumping causes hemolysis due to shear stresses generated in the tubings. This is a major issue as it limits the time and extent that extracorporeal pumping can be applied to assist in the circulation of a patient. Recently, superhydrophobic surfaces have been reported to reduce drag in fluid flows. Here, we investigate the feasibility of using superhydrophobic surfaces for the reduction of hemolysis in extracorporeal pumping. This was accomplished by circulating blood in flow circuits comprised of tubing coated with an industrially available water repellent. Through periodic photospectrometric analysis of the plasma hemoglobin concentration, it was shown that the hemolysis rate was consistently lower in the tubes with superhydrophobic coating than the tubes without. It was also found that the difference in hemolytic rates increases as the mean flow rate increases, reaching up to 63.60% for a flow rate of 1.468L/min. Based on simulations performed in ANSYS FLUENT, it was verified that the lower hemolytic rates in the coated tubes was directly related to the lower shear stresses associated with the inviscid flow effectuated by the superhydrophobic coating.

BES9SM / Junior Colleges / Poster Presentation

Name	Clara Lavanya Apollos
Institution	NUS High School of Mathematics and Science
Title of Abstract	Study on Using Molecular Beacons for DNA Quantification in Diagnostics
Authors	Clara Lavanya APOLLOS, Aurino M. KEMAS, SEOH Kah Huat Robin
Abstract	This study explores the possibility of using molecular beacons for end-point DNA quantification in the specific context of quantifying DNA from the V-Ki-ras2 Kirsten rat sarcoma viral oncogene homolog (KRAS) gene. Mutations in the KRAS gene are known to affect the efficacy of certain treatments targeting colorectal cancer; the beacons were to be used in complement with a diagnostic assay for identifying the presence or absence of said mutations. This study examines the effect of five factors: the fluorophore choice, the stem length, the concentration of magnesium ions in solution, the concentration of molecular beacon in solution, and whether or not the solutions are heated prior to reading their fluorescence on the linearity of the relationship between their average fluorescence and the amount of DNA in solution as well as the signal-to-noise ratio (S/N) of the results, leading to conclusions on how these factors affect the efficacy of molecular beacons' hybridisation with their target DNA.

BES9SM / Junior Colleges / Poster Presentation

Name	Kee Jie Yi Vivian
Institution	Victoria Junior College
Title of Abstract	Hand-in-Hand: Dual Robotic Hand Passive Movement with Motor Imagery Brain-Computer Interface
Authors	Kee Jie Yi Vivian, Germaine Thong, Yuen Wei Han
Abstract	A Motor Imagery Brain-Computer Interface (MI-BCI) detects changes in a person's scalp brain signals, or electroencephalogram (EEG), when he performs the imagination of limb motor movement, or Motor Imagery (MI). This is possible because MI-BCI comprises computational methods that are calibrated to classify these different EEG changes during MI; thus, MI-BCI has been employed in various fields, including neurorehabilitation, to improve motor functions. However, as MI cannot be observed by another person, it is difficult to determine if MI was performed correctly. Recent studies have proposed using Passive Movement (PM), which provides robotically-assisted single limb movement that is visible to another person, as an alternative standardised means of MI-BCI calibration. Our research focuses on the design and development of dual robotic hands that perform PM by clenching and relaxing an individual's left and right hands concurrently, to investigate the feasibility of using them to calibrate a 3-class (left hand, right hand and idle state) MI-BCI. EEG was collected from three experiment sessions, two of which were BCI calibration sessions using MI and PM respectively, with the robotic hands used in the latter. The third session was an MI testing session, with EEG obtained here used for evaluation later on. Experiment results on four subjects showed that 10-fold cross-validation accuracy on 3-class PM (81.24%) was higher than that of 3-class MI (73.84%), with both accuracies above chance level (39.6%). The MI-calibrated BCI and PM-calibrated BCI were subsequently assessed with EEG collected in the MI testing session, with the PM-calibrated BCI yielding a lower maximum kappa value (0.240) than the MI-calibrated BCI (0.464). Nevertheless, results from this study provide a starting point of calibrating MI-BCI with different methods, and conducting a larger scale subject evaluation that could involve patients with motor disabilities to further investigate the feasibility of calibrating MI-BCI with PM.

BES9SM / Polytechnics / Poster Presentation

Name	Nathaniel Teo Ie Renn
Name of School / College / Institution	Nanyang Polytechnic
Title of Abstract	Enhancing wheelchair mobility
Authors	Nathaniel Teo Ie Renn
Abstract	A problem I observed while studying the wheelchair bound was that long term use of the wheelchair in terms of energy spent and distance covered was not very efficient. Every full revolution of the wheel and the distance it covered depended on the strength and the angle of the push coming about from the user. I have addressed these problems as well as the problem of affordability in my project. Studying the new line of wheelchairs that hospitals in Singapore have adopted, I have based my device design on the wheelchair, and allowed it to fit to the existing wheelchair with minimal change to the overall wheelchair. After reading research papers and conducting research of my own, the original wheelchair design focuses on the users shoulder and forearm muscles to operate. My device works with the principle of a one-way bearing and a lever, allowing the wheelchair user to fully utilize his chest, triceps, and shoulder muscles instead of just the shoulder muscles in the original design. I am currently working on adding an additional component that will convert the kinetic energy into electric energy, that will in turn power a small motor that can move the wheelchair.

BES9SM / Polytechnics / Poster Presentation

Name	BRIEN CHEOW JOON SIANG
Name of School / College / Institution	Nanyang Polytechnic
Title of Abstract	Development of in-ear blood volume pulse (BVP) monitoring device
Authors	BRIEN CHEOW JOON SIANG
Abstract	Photoplethysmography (PPG) is a reliable and low-cost optical technique to detect blood volume changes in peripheral tissues, such as finger tips, ear lobes. In a simple implementation, it uses an infra-red LED (light emitting diode) to shine light through a reasonably translucent tissue with perfused blood flow and a photo detector that receives the transmitted or reflected light. Since blood flow pattern follows the cardiac cycle, PPG provides information for heart beat rate, heart rate variability, Dicrotic notch velocity and even arterial atherosclerosis. This project aims to develop a wearable in-ear device for monitoring PPG and detecting plausible cardiovascular diseases (CVD). The in-ear device will send PPG waveform data wirelessly to a receiver that will store and analyse the waveforms. Clinicians will recall the PPG data and diagnose or advise the patients accordingly. As compared to most PPG devices in the market that uses clip-type design for the sensors, this in-ear design is small and when placed into the ear canal, it will not be easily noticeable by others. It is enclosed with soft material and comfortable for users for long time monitoring.

BES9SM / Polytechnics / Poster Presentation

Name	Cheong Kai Jie
Name of School / College / Institution	Nanyang Polytechnic
Title of Abstract	Development of radial artery pulse waveform sensing device based on traditional Chinese medicine pulse diagnosis principle
Authors	Cheong Kai Jie
Abstract	Traditional Chinese medicine originated in ancient China and has evolved over thousands of years. One of the important diagnostic techniques of TCM is pulse diagnosis. Doctors examine the health condition of a patient by pressing and feeling the radial artery pulse of the patient. In this project, the system will obtain required pulse waveforms from different position along the radial artery. The waveforms will be automatically analysed to provide diagnostic result.

BES9SM / Polytechnics / Poster Presentation

Name	SUM GERON
Name of School / College / Institution	Nanyang Polytechnic
Title of Abstract	Design and Development of an innovative Stoma bag
Authors	Sum Geron
Abstract	The objective of the project is to design an innovative pouching system that will ease the emptying of the faeces and cleansing of the stoma pouching system. A stoma bag or pouching system is used in conjunction with a stoma to empty faecal matter in lieu of the anus. This stoma is created when a section of the colon has been removed due to diseases, so that it is no longer possible for faeces to exit via the anus; or as a temporary stop gap action when a portion of the colon (or large intestine) has been operated upon and needs to be 'rested' until it is healed.

BES9SM / Polytechnics / Poster Presentation

Name	NUR HUDA BINTE ISHAK
Name of School / College / Institution	Nanyang Polytechnic
Title of Abstract	Development of a Stomach Acid Detection Feeding Tube
Authors	NUR HUDA BINTE ISHAK
Abstract	A feeding tube is a medical device used to provide nutrition to patients who cannot obtain nutrition by mouth, are unable to swallow safely, or need nutritional supplementation. Placement may be temporary for the treatment of acute conditions or lifelong in the case of chronic disabilities. Stomach acid must be detected prior tube feeding is began. The objective of this project is to develop a Stomach Acid and Position Detection Feeding Tube.

BES9SM / Polytechnics / Poster Presentation

Name	Naurah Faiqa Bte Mohamed F and Jessica Chan Mei Yi
Name of School / College / Institution	Temasek Polytechnic
Title of Abstract	Co- encapsulation of fish oil with stigmasterol by microcapsules formed by various emulsification techniques using N-stearoyl O-butylglyceyl chitosan
Authors	Naurah Faiqa Bte Mohamed F, Jessica Chan Mei Yi (Temasek Polytechnic), Professor Zaher Judeh (SCBCE, Nanyang Technological University), Dr.Sudipta Chatterjee (SCBCE, Nanyang Technological University) and Dr.R.Raja (Temasek Polytechnic)
Abstract	Encapsulation was developed using membrane emulsification technique with three processing steps: emulsification, ultrasonification and freeze drying. The size and stability of emulsion and microcapsule droplet were characterized. The stability significantly decreased from +45.1 to +15.9mV and the size increased from11.8µm to 27.4 µm as a result of aggregation over 40 days. The Differential Scanning Calorimetry scans of pure fish oil and fish-oil stigmasterol showed similar increase in heat flow at 150°C. Emulsion droplets and microcapsule droplets were placed under an optical microscope and compared visually. Microcapsules with the modified chitosan wall provided higher creaming index values than those without. Peroxide and anisidine values of fish oil and stigmasterol loaded microcapsules were relatively higher than fish oil loaded microcapsules. . The ultrasonification technology used in this study could lead to application in the food industry improving the stability for the fish oil and better health benefits in the future.

Name: Tan Gyn Rhu

Name of School / College / Institution: Nanyang Technological University

Department / Division: Bioengineering

Title of Abstract: CONSTRUCTION, EXPRESSION AND PURIFICATION OF FERRITIN DISPLAYING CHIKUNGUNYA EPITOPE FOR POTENTIAL APPLICATION AS VACCINE

Authors: Tan Gyn Rhu

Abstract

Chikungunya virus has caused periodic outbreak of rheumatic disease in Africa and Asia. Since 2004, Chikungunya fever has reached epidemic proportions globally. Vaccines were developed but very few made it to clinical trial stage. A new vaccine platform using ferritin protein cage as carrier of antigenic Chikungunya epitope was created. This project involves the expression and characterization of the recombinant protein.

Ferritin is a ubiquitous protein produced by almost all living organism. In the presence of iron, it self-assembles into a globular protein complex with 24 protein subunits. Archaeoglobulus fulgidus ferritin is chosen in this project for its thermostability and high structural similarity to human ferritin. Two recombinant vaccine proteins were produced by gene overexpression in E.coli. , in which one of the construct incorporate the full length of Chikungunya E2EP3 epitope and another with a shorter, core E2EP3 epitope. SDS-PAGE showed that the target protein was successfully synthesized. The construct with the longer epitope gave low yield. The project then focus on protein characterization of the construct with shorter epitope. The protein was purified by Hydrophobic Interaction and Size Exclusion Chromatography. Dynamic Light Scattering and Transmission Electron Microscopy proved that protein cage was potentially formed. This project also involved the construction of recombinant plasmid for mutant ferritin with epitope. It was successfully created through Site Directed Mutagenesis. Thermal stability test of this mutant ferritin revealed that the optimum heat treatment condition is 75°C for a duration of fifteen minutes.

BES9SM / Undergraduates / Poster Presentation

Name	Nur Syairah
Name of School / College / Institution	Nanyang Technological University
Title of Abstract	TARGETED DELIVERY OF PROTEIN NANOCAGES FOR MELASMA TREATMENT
Authors	Nur Syairah, Sathyamoorthy Bhaskar, Asst Prof Sierin Lim
Abstract	Melasma is a skin condition that involves the hyperpigmentation of skin. The hyperpigmentation of skin is due to excessive exposure to Ultraviolet (UV) rays. UV rays stimulate a skin cell called melanocyte. When stimulated, melanocytes produce melanin. Melanin in turn would then cause the pigmentations of the skin. Melasma highly affects those who live in sun-exposed areas, and is generally common among women. Currently, treatments for Melasma include topical creams, laser treatments and dietary supplements. However, these treatments are not effective. One of the reasons why these treatments are not as effective is because it does not have specific targeting of cells. With the use of a melanocyte-stimulating hormone (MSH) called Alpha-MSH, cell targeting can be achieved. Integrating Alpha-MSH and E2 nanocage, an efficient drug delivery system can be acquired. Cell targeting can be achieved with this technology.

BES9SM / Undergraduates / Poster Presentation

Name	Ye Tayzar Aung
Name of School / College / Institution	Nanyang Technological University
Department / Division	School of Chemical and Biomedical Engineering

Title of Abstract	IN VITRO MODEL TO STUDY CELL-CELL INTERACTION
Authors	Ye Tayzar Aung, Menon V. Nishanth, Ying Zhang, Shiying Liu, Yuejun Kang

Abstract

Cancer is one of the deadliest medical conditions and a large number of researchers are trying to understand the mechanisms involved in tumor cell survival and progression. Various in vitro models have been developed over the decades to study cancer progression. One such technology, used presently, for the creation of smart in vitro models is microfluidics which has been shown to be extremely effective over the conventional cell culture systems. In our study, the microfluidic technology was used to create in vitro models within which cancer migration can be observed and studied. The microfludic chip used is a 3-channel device with the channels separated from each other by micro-pillars. Collagen gel was used to separate the side channels. Human hepatocarcinoma (HepG2) cells were cultured within the chip on one side of the collagen gel while chemokines were introduced in the other side. Owing to the porosity of the gel, the chemokines diffuse through the gel and induce the cells to migrate. Transforming growth factor-b (TGF-b), platelet derived growth factor (PDGF), fibroblast growth factor (FGF) and vascular endothelial growth factor (VEGF) were used. It was observed that TGF-b and PDGF induced HepG2 migration while FGF and VEGF did not induce any migration even at higher concentrations. The cell migration was quantified by measuring cell area coverage within collagen over a period of 6 days. Confocal microscopy was performed to observe 3D cell migration through the collagen gel. The study helps understand the role of different chemokines in tumor cell migration. In the future, the chemokines will be replaced by stromal cells to develop a co-culture system to study the impact of stromal cells on tumor cell migration. Such a model will help study the mechanisms the tumor cells undergo as they migrate in vivo in the presence of stromal cells.

Name	Chia Yan Qing
Level of Study	Undergraduate
Name of School / College / Institution	Nanyang Technological University
Department / Division	School of CHemical and Biomedical Engineering

Title of Abstract	The Development of Polyelectrolyte Microfibers Scaffold for the Establishment of an Annulus Tissue Model in Intervertebral Disc Engineering
Authors	Yan Qing Chia, Yon Jin Chuah, Yingnan Wu, Mei Ling Cheong Shirlynn, Jun Jie Ng Joshua, Yuejun Kang

Abstract

Intervertebral discs (IVD) are located between two vertebrae of the spine and mainly function to resist spinal compression and provide flexibility. It is inevitable that disc degeneration or traumatic injury to the IVD could results in lower back pain and disability in severe cases. While surgery can eliminate the pain, it does not address the underlying biological problems. Therefore, there is a need for the development of a tissue engineered intervertebral disc that could potentially replace the damaged disc which is still in its infancy. The lack of a suitable tissue model for in vitro investigation of IVD development has limit the advancement of therapeutic treatment for IVD repair. One of the complexity of the IVD constructs lies on the annulus fibrosus (AF) which comprises of multiple lamellae tissues. Besides that, the source of autologous AF cells to develop AF tissue model is limited and thus the focus has been shifted to mesenchymal stem cell based engineering.

In this study, we developed an AF tissue model with mesenchymal stem cells within multiple layer of polyelectrolyte microfibres as an in-vitro investigation platform for AF development. With this model, we further investigated the effect of the different extracellular matrix (e.g. hyaluronic acid and collagen) on the differentiation of the mesenchymal stem cells (MSCs) towards an AF like tissue. Incorporation of extracellular matrix has shown to enhance MSCs differentiation towards an AF like tissue by upregulation of their specific protein markers. The developed AF tissue model could be further used to gain insights of the AF pathophysiology and enhance the development of an IVD construct for future therapeutic treatment of IVD.

BES9SM / Undergraduates / Poster Presentation

Name	Guan Zhao Han Bjorn
Level of Study	Undergraduate
Name of School / College / Institution	Nanyang Technological University
Department / Division	Division of Bioengineering

Title of Abstract	Biological AND Logic Gate Comparator
Authors	AU-YEUNG SHANG YONG BENJAMIN and GUAN ZHAO HAN BJORN,

Abstract

Micro-organisms process external stimuli through genetic circuits; under ideal circumstances, they produce desirable outputs. In this study, a synthetic AND gate with digital-like behaviour has been constructed in silico within an engineered Escherichia coli bacterium. Our AND gate functions as a comparator that integrates information from two inputs to produce an output. The first input, Arabinose, inhibits the PBAD promoter whereas the second, Isopropyl β-D-1-thiogalactopyranoside (IPTG), inhibits the PLac promoter; the following concentrations of both inputs have been experimented with: 3.30E-07, 1.30E-06, 5.20E-06, 2.10E-05, 8.30E-05, 3.30E-04, 1.30E-03 and 5.30E-03. PBAD and PLac promoters control co-activating transcription genes HrpS and HrpR respectively. The subsequent S-R protein complex activates the PhrpL promoter which drives output production – green fluorescent protein (GFP). Under the condition that both inputs are in the ON configuration – the concentrations of both inputs are at least the minimum required – appreciable concentrations of GFP are produced. Results indicate that increasing the concentrations of either input reduces the switching point, which is assumed to be half the maximum GFP output concentration. Sensitivity analysis in silico has indicated that seven parameters have a significant influence on concentration of GFP produced in two manners. Firstly, the switching point of the comparator is highly sensitive to the association constant (1) and dissociation constant of R Translation (2), and the repression coefficient of R transcription (3). Secondly, the maximum GFP output concentration is highly sensitive to the transcription rate (4) and translation rate (5) of GFP, and the decay rate of mRNA (6) and GFP (7). Our AND gate is modular - it can be integrated into other gene circuits, possibly producing other desirable outputs such as insulin and glucagon.

BES9SM / Undergraduates / Poster Presentation

Name	Adib Ridzuan
Level of Study	Undergraduate
Name of School / College / Institution	National University of Singapore
Department / Division	Department of Biomedical Engineering

Title of Abstract	DEVELOPMENT OF A ROBOTIC PLATFORM FOR MULTIPLE SECTION TENDON-DRIVEN FLEXIBLE ROBOT FOR NATURAL ORIFICE TRANSLUMINAL ENDOSCOPIC SURGERY (NOTES)

Authors: Adib Ridzuan Bin Mohamad Roslan, Xu Wenjun, Ren Hongliang

Abstract

Robot assisted surgery involves the use of an advanced surgical tool to perform minimally invasive surgical procedures such as diseases in urology, cardiology and diseases of the head and neck. This system claims to have better outcomes or reduced complications for patients. A surgical example is the Natural Orifice Transluminal Endoscopic Surgery (NOTES). NOTES is a novel procedure in laparoscopic surgery or any general surgery today. It minimizes incision scars and post-op complications through minimally invasive procedures by utilizing the natural orifice of the body such as the oral cavity or the anal cavity. Much research has been done in the development of tendon driven flexible robots. This project taps on this concept and its potential application in robot-assisted surgical devices. Hence, this project focuses on developing a robotic platform for a multiple section flexible robot in robot-assisted NOTES. This platform explores the use of a tendon driven mechanism to actuate a multiple section flexible robot which aims to provide a greater degree of freedom as compared to a single section to tackle more challenging path obstacles. This platform designed has 3 separate components. The main driving mechanical components are stepper motors which independently provide tensile force on the tendons, to initiate movements in the flexible robot in various degrees. The software configurations are conducted in Arduino ATMega2560 which contains the kinematics algorithm, allowing the user to control the platform with the use of a computer or a joystick. This platform hopes to provide the groundwork needed in developing a simple tendon-driven flexible robot-assisted surgical device. This idea was conceptualised and fabricated into a working prototype under funding from the Biomedical Engineering department of the National University of Singapore as a Final Year Project.

Name	Koh Hui Lin
Level of Study	Undergraduate
Name of School / College / Institution	National University of Singapore
Department / Division	Biomedical Engineering

Title of Abstract

A Study on the Kinematics of Human Subjects in Using a New Backward Fall Compensatory Limb Response Training Device

Authors

Koh Hui Lin, Li Zhuoyun, Adon Chan, Tay Ee Ling and Chong Yok Rue Desmond

Abstract

Objective: Falls are the leading cause of serious injury in the elderly population. Compensatory stepping and grasping reactions are important in preventing falls. Hence a new compensatory limb response training device has been developed to train the elderly in using compensatory limb responses to reduce risk of backward fall. The aim of the study was to test the efficacy of the compensatory limb response training device against subjects with different balance recovery styles (i.e. single versus multiple steppers).

Method: The new device was used to provide consistent amount of perturbation with three lean angles of 7º, 9º and 11º. 20 healthy young subjects (aged 19 to 24) were recruited for the study with institutional ethical approval. 3D motion analysis was performed by using the Vicon Nexus system together with body markers for kinematics data capture. Compensatory step response parameters such as step length and backward swing velocity as well as compensatory upper extremity response parameters such as trunk and shoulder flexion/extension angular velocity were examined. Statistical analysis was conducted on the parameters using SPSS.

Results: Step length significantly increased across the three backward lean angles for both single and multiple steppers. However, for each lean angle, multiple steppers took significantly shorter step length than single steppers. Backward swing velocity also significantly increased across the first two backward lean angles for both single and multiple steppers. However, for each lean angle of 7º and 9º, multiple steppers took significantly smaller backward swing velocity than single steppers.

Conclusion: Perturbation in the form of varying lean angles was hence effective in evoking a significant change in subject’s compensatory step response. The device was also able to differentiate subjects with various balance recovery styles. To further determine the efficacy of the device, healthy elderly will be recruited for the study in the next stage.

BES9SM / Undergraduates / Poster Presentation

Name	Sharon Lee
Level of Study	Undergraduate
Name of School / College / Institution	National University of Singapore
Department / Division	Biomedical Engineering
Title of Abstract	The size-relevant margination of nanoparticles with a protein corona with and without a protein corona
Authors	Lee, WL Sharon, Ho, YT, Kah, CY James
Abstract	The conjugation of biomolecules onto nanoparticulate materials for biomedical applications has seen promising results in vitro. However, their translation in vivo has faced obstacles due to the presence of a protein corona. This corona masks active functional groups on nanoparticles (NPs) which markedly hinders their biological interactions. Interestingly, a burgeoning number of research groups have explored the use of the corona for drug loading and release applications. To that end, a gap exists in the literature on how these serum-coated NPs can be effectively designed for their successful margination towards the vascular wall for subsequent extravasation across the endothelium. In this study, microfluidic devices were used as vascular models to study how a serum corona influenced the margination of polystyrene NPs in vitro. With a corona absent, empirical data with NPs showed a predominant size dependency of NP propensity for margination. The presence of a corona, however, seemingly increased the binding affinity of NPs to an adhesion layer that lined the walls of the microfluidic channel. We thus sought a different method for quantifying the flow distribution profile of NPs that is independent of binding affinity differences; observing a different flow distribution profile from the prior method. With this, we observed that the margination behaviour of corona-coated NPs is influenced not just primarily by its size, and hypothesized that it is confounded by the synergistic effect of its other physical parameters such as density and shape. In conclusion, we describe a viable microfluidic platform and method for probing the margination propensities of nanoparticulate systems. The findings of the present study further provide valuable insight for the optimized design and engineering of the protein corona on nanoparticulate systems for a myriad of biological applications.

BES9SM / Undergraduates / Poster Presentation

Name	Neerajha Ram
Level of Study	Undergraduate
Name of School / College / Institution	National University of Singapore
Department / Division	Department of Biomedical Engineering
Title of Abstract	Development of double network hydrogels for medical applications
Authors	Neerajha Ram, Yi Sun, Dr Ren Hongliang
Abstract	In this report, material characteristics of the polyacrylamide-agarose double network hydrogel system are investigated with final aim to replace silicone in soft robot fabrication. The current material of choice for soft robot fabrication is silicone, however, silicone poses drawbacks such as potential toxicity, non-customizability and inability to adapt to small and delicate structures. The novel application of using double network hydrogels in the fabrication of pneumatic soft robots to replace silicone as the material of choice can potentially solve these problems. Double network hydrogels are easy to fabricate, customizable according to use, inexpensive, promise good material properties and inexpensive. Fabricated double network hydrogels can be customized by simple alterations to preparation method. The following variables are investigated: (i) ultraviolet irradiation duration, (ii) crosslinker concentration, (iii) resting time and dehydration and (iv) incorporation of additional ingredients. This customizability allows for the tailoring of the hydrogel according to the required application in terms of tensile strength and elasticity. This experiment further demonstrates the viability of replacing silicone with the double network hydrogel by fabricating a preliminary pneumatic soft robotic endoscope with three degrees of freedom in two components. The robot is actuated using syringe pumps, with air pressure and air pressure rate carefully controlled. As existing applications of hydrogels do not involve large-scale soft robot fabrication and pneumatic actuation, this report presents a novel approach to better, safer, customizable and easy soft robot fabrication.

BES9SM / Undergraduates / Poster Presentation

Name	Benjamin Ang
Level of Study	Undergraduate
Name of School / College / Institution	National University of Singapore
Department / Division	Biomedical Engineering
Title of Abstract	Design of a Soft Robotic Exoskeleton with Plastic Extension Actuators for Stroke Patients with Spastic Finger Flexors
Authors	Benjamin Ang, Yeow Chen Hua Raye
Abstract	In this paper, we present the design of a soft robotic exoskeleton with an extension return mechanism. The exoskeleton primarily consists of cylindrical plastic actuators that are fitted into the finger slots of a glove. The actuators are relatively thin and lightweight, making the device easily wearable and non-obstructive to finger joint movements. Experiments were conducted to characterize its range of motion and the extension force provided by the device. Electromyography (EMG) readings at the extensor muscles of the fingers were also studied to verify the functionality of the device and presented in this paper.

BES9SM / Undergraduates / Poster Presentation

Name	Loh Kai Ting
Level of Study	Undergraduate
Name of School / College / Institution	National University of Singapore
Department / Division	Biomedical Engineering
Title of Abstract	Tracking Magnetic Particles under Ultrasound Imaging using Contrast-Enhancing Microbubbles
Authors	Loh Kai Ting, Dr Ren Hongliang, Dr Li Jun
Abstract	Magnetic microbubbles which can be controlled by an external magnetic field have been explored as a method for precise and efficient drug delivery. Due to the increased usage of drug delivery microbubbles using ultrasound imaging, there is increased interest to develop a tracking algorithm to locate the in vivo position of the microbubbles once delivered. In this project, ultrasound imaging of magnetic spheres with encapsulated microbubbles is furthered studied. A technique for the fabrication of microbubble encapsulated magnetic spheres is presented. The resultant magnetic spheres were subsequently imaged using ultrasound and the encapsulated microbubbles proved to appear as bright spots and resulted in enhanced ultrasound image contrast, as compared to the solid magnetic spheres which appeared dull. The objective of this project is to optimize the tracking of the microbubbles from the obtained ultrasound images and to perform image analysis to identify the location of the microbubbles. Further development of the magnetic microbubbles and tracking algorithm can lead to future use of the tracking algorithm in the case of in vivo injection of the magnetic microbubbles.

Name	Kim Jaejung
Level of Study	Undergraduate
Name of School / College / Institution	National University of Singapore
Department / Division	Biomedical Engineering

Title of Abstract	Photodynamic Therapy Using Titania Coated Upconversion Nanoparticles

Authors	Kim, J., Lucky, S. S., Huang, K., Idris, N. M., Zhang, Y.

Abstract

In this study, the photodynamic therapy (PDT) efficacy of the anti-EGFR-PEG conjugated titania coated upconversion nanoparticles (TiO2-UCNs) was determined in vitro. It is necessary to determine the PDT efficacy in order to evaluate the titania coated upconversion nanoparticles as a PDT agent, when subjected to surface modification with a stabilizer PEG and Epidermal Growth Factor Receptor (EGFR) targeting moiety anti-EGFR affibody.

Upconversion nanoparticles (UCNs) were coated with titanium dioxide (TiO2), forming titania coated upconversion nanoparticles (TiO2-UCNs). TiO2-UCNs were then surface modified with anti-EGFR and PEG to produce anti-EGFR-PEG-TiO2-UCNs. PDT efficacy of the prepared nanoparticles was then determined in vitro. Also, the selective targeting ability of the anti-EGFR-PEG-TiO2-UCNs was investigated by incubating the nanoparticles in different type of cell lines such as OSCC, A-431 and MCF-7 followed by taking fluorescent images and PDT. Fluorescent images showed significantly greater uptake of surface modified nanoparticles in OSCC and A-431 cell lines compared MCF-7 cell line. Both OSCC and A-431 cell lines express EGFR while MCF-7 cell line is absent of EGFR. Therefore, the result indicates selective targeting ability of surface modified nanoparticles towards EGFR expressing cancer cells, making it superior than bare nanoparticles. Moreover, in vitro PDT results in EGFR positive and EGFR negative cell lines showed significantly greater cell death in EGFR expressing cell line compared to that in EGFR absent cell line. This further supports that anti-EGFR-PEG-TiO2-UCNs possess selective killing ability towards EGFR expressing cancer cells. Further experiments are currently being carried out in vivo to evaluate PDT efficacy of the nanoparticles on a living organism.

Name	Xie Yingyao
Level of Study	Undergraduate
Name of School / College / Institution	National University of Singapore
Department / Division	Biomedical Engineering

Title of Abstract	The Brain Anatomical Development in Early Childhood
Authors	Author: Xie Yingyao Mentor: Qiu Anqi

Abstract

The cerebellum plays the most important role in motor controls such as coordination and balance. Growing evidence from neuroimaging studies have also revealed its significance in other cognitive functions such as language, working memory and emotional processing which usually develop rapidly from 6 to 10 years old. In addition, each function is controlled by one or more unique region in the cerebellum, e.g. lobules. The functional development is usually correlated to its morphological growth. The morphological study highly relies on the accurate and consistent parcellation of cerebellum in order to retrieve volumetric information from MRI images. Moreover, a fully automated system for large scale image analysis since manual segmentation of cerebellum is subjective and inefficient. In this thesis, the author proposed an automatic segmentation pipeline that is able to parcellate cerebellum into lobules based on the atlas-based segmentation algorithm. Morphological operations and intensity normalization tools are also incorporated in the pipeline to improve the segmentation. By comparing the segmentation with manual segmentation, the accuracy of the pipeline is proved to be at least 70%. A batch of images from subjects aged from 6-10 years old is processed through the pipeline to obtain the volumetric data for each lobule. After statistical analysis of the data, it is found that lobules in the anterior lobe which mainly contribute to the motor function remains relatively constant while there are significant changes of volume in the posterior lobe, indicating a rapid development of non-motor functions in this period.

BES9SM / Undergraduates / Poster Presentation

Name	Kang Wei Cherng Malvin
Level of Study	Undergraduate
Name of School / College / Institution	National University of Singapore
Department / Division	Biomedical Engineering
Title of Abstract	Rapid Detection of Carbapenamase-Producing Enterrobacteriaceae (CPE)
Authors	Malvin Kang, Jeanette Teo, James Kah
Abstract	The growing global crisis of antibiotics resistance poses a threat for the effective treatment of a wide range of infections, and is further worsened with the rise in CPE, which secrete carbapenem-hydrolyzing enzymes that render the bacteria resistant to carbapenems, the major last-resort class of antiobiotics. CPE is a healthcare threat due to their highly transmissible nature conferred in part from the association of the carbapenamase-encoding gene with mobile genetic elements. Current detection methods for CPE, which includes modified Hodge's test and CarbaNP test, are time-consuming and not highly specific to detect specific classes of carbapenamases, and are not optimal for the clinical needs of isolating patients in order to prevent further nosocomial transmission. The goal of the project is to make use of Surface Enhanced Raman Spectroscopy (SERS) to detect carbapenamase in bacterial culture samples using plasmonic nanoparticles as SERS substrates to enhance the Raman signal. We first synthesize gold and silver spherical nanoparticles for the conjugation of imipenem (IMP), and we evaluate the effect of IMP on colloidal stability. Preliminary results show that under near neutral pH conditions, aggregation was observed for both gold and silver nanoparticles colloid, possibly due to the positive charge of the amine group on IMP that results in charge compensation of the negatively-charged nanoparticles, leading to aggregation. Future works to improve the conjugation of IMP to plasmonic nanoparticles could include varying the pH, the use of carbodimide chemistry via NHS-EDC, and the use of benzylpenicillin (BP) as a cheaper antibiotics option for proof of concept, since there are thepublished reports showing the conjugation of BP onto silver nanoparticles and their corresponding SERS signature.

BES9SM / Undergraduates / Poster Presentation

Name	Michelle Tan Yu Lin
Level of Study	Undergraduate
Name of School / College / Institution	National University of Singapore
Department / Division	Biomedical Engineering

Title of Abstract: The Importance of environmental signal- sensing mechanoreceptors in brown adipocyte differentiation.

Authors: Michelle Tan, Anna Golracyzk, Prof Michael Raghunath

Abstract

Obesity is a prevalence problem in many countries and the main cause of it is due to the excess energy being stored as fats in the white adipose tissue. Recently, it was discovered that the human body contains small depots of functionally distinct tissue called the brown adipose tissue (BAT), which helps to burn excess of fat through its thermogenic properties. Therefore, increasing amount of brown adipose tissue or even, converting the white adipose tissue into brown adipose tissue is an attractive therapeutic method to help induce weight loss through increase in energy expenditure. The origin of brown adipose tissue is not fully understood, which makes it difficult to develop therapeutic agents which will promote brown adipogenesis. Current literature suggests that transient receptor potential (TRP) channels are involved in adipocyte differentiation and are possible candidates to regulate energy metabolism and thermogenesis. TRPs can be activated by various environmental signals like temperature changes or osmotic stress. In particular, activation of TRPM8, the cold sensing receptor, has demonstrated great potential in mediating thermogenesis.

We have investigated the effect of cold stimuli on brown adipocyte differentiation through TRPM8 activation. The desirable result is one of which would highly contribute to the development of screening platform for novel agents promoting brown adipogenesis.

BES9SM / Undergraduates / Poster Presentation

Name	Veena Salim
Level of Study	Undergraduate
Name of School / College / Institution	National University of Singapore
Department / Division	Biomedical Engineering

Title of Abstract	Biomechanics Study of Novel Lower Limb Exoskeleton for Gait Rehabilitation
Authors	Veena Salim

Abstract

Stroke is one of the major causes of serious gait disorder that can disrupt activities of daily living. Repetitive training is able to aid the recovery of the motor function through brain plasticity process.

Neuro Rehabilitation team in Singapore Institute for Neurotechnology (SINAPSE) is developing a novel knee-ankle-foot orthosis (KAFO) for stroke rehabilitation that is compact, modular and portable. The robot is able to detect gait phases with hidden Markov model (HMM) and provide assistance to the lower limbs at the targeted gait phases, following assisted-as-needed (AAN) control strategy. The level of the robotic assistance is adjusted based on the kinematics of the lower limbs during overground walking.
The objective of this study is to evaluate the performance of the novel KAFO by performing biomechanics analysis of the gait parameters, kinematics and kinetics under various walking conditions. Six male subjects were recruited to conduct uninterrupted gaits under six experimental conditions: free walking, zero torque walking, resistive walking, assistive force control walking and two levels of assistive impedance control. To imitate the stroke gait pattern, an elastic band was installed at the robot knee joint, reducing the knee flexion in the swing phase. The assistance was provided to the knee joint at pre-swing and mid-swing phases. The gait parameters and kinematics data were obtained from Inertial Measurement Unit (IMU) sensors. Surface EMG were placed at rectus femoris and semitendinosus muscles to detect the activity of knee flexor and extensor respectively.

The three assistive modes tested in this study were able to enhance the knee flexion in the swing phase. Furthermore, it can be concluded that the gait detection method was able to detect the gait phases and the control strategy could provide assistance at the desired gait phase.

BES9SM / Undergraduates / Poster Presentation

Name	Chiu Hsin Yao
Level of Study	Undergraduate
Name of School / College / Institution	National University of Singapore
Department / Division	Biomedical Engineering

Title of Abstract	Cytotoxicity and Intracellular Fate of Nanoparticles for LIve Cell Tracking
Authors	Chiu Hsin Yao, and Michael Raghunath

Abstract

The development in regenerative medicine and stem cells studies made cell transplantation a promising treatment for various diseases. However, this field is still in its infancy. The fate of transplanted cells would need to be closely monitored as many would not remain at targeted sites. Due to this issue, various live cell tracking techniques were explored. LuminiCell Tracker 670, an aggregation induced emission dots (AIE dot) produced by LuminiCell Pte. Ltd, has exhibited outstanding potential in live cell tracking ability. However, the fate of these nanoparticles after cellular uptake remains unknown. Hence this research aims to study the cellular uptake mechanism and intracellular pathway of LuminiCell Tracker 670 in human Mesenchymal Stem Cells (hMSCs). The effect of these nanoparticles on cell viability is also assessed.

Time lapse confocal study was conducted to verify the intracellular pathway by co-staining hMSCs incubated with LuminiCell Tracker 670 with various organelle stains. The results obtained were intriguing. LuminiCell Tracker 670 did not co-localise in any organelles and formed clusters along peripheral region of hMSCs. However, with slight modification to its surface property (ie. No HIV-1 Tat peptide), No-Tat-AIE dots were found to scatter evenly with observable lysosomal co-localisation. LuminiCell Tracker 670 with Tat peptide showed unusual dispersed membrane staining pattern which was reasoned to be closely related to the uptake mechanism of cell penetration Tat peptide by cells. Despite this unique membrane structure, cytotoxicity test revealed no significant cytotoxicity.

This research demonstrates that modifications to LuminiCell Tracker 670 surface affect cellular uptake mechanism and intracellular pathway. Nevertheless, this does not diminish LuminiCell Tracker 670’s function as live cell tracking tool. This is evident from its rapid cellular uptake, high fluorescent intensity and low cytotoxicity. More generally, this research highlights the effects of surface modification and bulk material on cellular uptake mechanism and intracellular pathway.

Name	Lim Kaiyang
Level of Study	Graduate
Name of School / College / Institution	Nanyang Technological University
Department / Division	School of Chemical and Biomedical Engineering

Title of Abstract: Development of a catheter functionalized by a polydopamine-peptide coating with antimicrobial and anti-biofilm properties

Authors: Kaiyang Lim, Ray Rong Yuan Chua, Ho Bow, Paul Anantharajah Tambyah, Kunn Ong Hadinoto, Susanna Su Jan Leong

Abstract: Catheter associated urinary tract infections (CAUTIs) are the most common hospital acquired infection worldwide aggravating the problem of antimicrobial resistance and patient morbidity. There is a need for a potent and robust antimicrobial coating for catheters to prevent these infections. An ideal coating agent should possess high antimicrobial efficacy and be easily and economically conjugated to the catheter surface. In this study, we report a simple yet effective immobilization strategy to attach a potent synthetic antimicrobial peptide, CWR11, onto catheter relevant surfaces. Polydopamine (PD) was deposited as a thin adherent film onto a polydimethylsiloxane (PDMS) surface to facilitate attachment of CWR11 onto the PD-functionalized polymer. Surface characterization of the CWR11-tethered surfaces confirmed the successful immobilization of peptides onto the PD-coated PDMS. The CWR11-immobilized PDMS slides displayed excellent antimicrobial (significant inhibition of 5 x 10^4 CFU CAUTI relevant microbes) and anti-biofilm (~92% enhanced anti-bacterial adherence) properties. To assess its clinical relevance, the PD-based immobilization platform was translated onto commercial silicone-coated Foley catheters. The CWR11-impregnated catheter displayed potent bactericidal properties against both gram-positive and gram-negative bacteria, and retained its antimicrobial functionality for at least 21 days, showing negligible cytotoxicity against human erythrocyte cells. The outcome of this study demonstrates the proof-of-concept potential of a polydopamine-CWR11-functionalized catheter to combat CAUTIs.

BES9SM / Postgraduates / Poster Presentation

Name	Margaret Phillips
Level of Study	Graduate
Name of School / College / Institution	Nanyang Technological University
Department / Division	School of Biological Sciences
Title of Abstract	Use of solution state NMR in structurally dynamic membrane and globular protein complexes
Authors	Margaret Phillips
Abstract	With the help of novel NMR methods and cost-effective sample preparation, we plan to explore the internal dynamics of both soluble and membrane proteins. In our study we have included two important membrane proteins namely Stromal Interaction Molecule 1 (STIM1) and Presenilin Enhancer-2 (PEN-2). STIM1 is a type I trans-membrane protein, present mainly in the Endoplasmic Reticulum. It is involved in mediating Calcium ion influx, when there is a depletion of calcium ions in the ER, by gating of store operated Ca 2+ ion channels – SOCs. PEN-2 is an essential sub-unit of gamma secretase and is speculated to play an important role in the maturation of gamma secretase complex and therefore its activity. The gamma secretase itself is involved in the proteolysis of trans-membrane proteins like the Notch protein and the Amyloid Precursor Protein. The high resolution structure and mechanism of action of both proteins have not been fully understood. Our results for STIM1 indicate that most constructs gave good expression and purity. Almost all showed well defined secondary structure lacking proper tertiary fold. Due to significant line broadening for almost all resonances, backbone assignment could not be completed for STIM1. Our studies with PEN-2 showed that it is a thermally stable monomer in solution with intrinsically disordered domains. More experiment and data analysis is needed to understand the three dimensional structure of PEN-2 and its role in the active gamma secretase complex.

BES9SM / Postgraduates / Poster Presentation

Name	Venkatraman Anandalakshmi
Level of Study	Graduate
Name of School / College / Institution	Nanyang Technological University
Title of Abstract	TGFBIp associated Corneal Dystrophy- exploring structure-based drug development strategies for disease prevention and treatment
Authors	Venkatraman Anadalakshmi, Jodhbir S. Mehta, Konstantin Pervushin
Abstract	Corneal Dystrophies (CDs) are a group of bilateral, symmetrical and heterogeneous inherited disorders leading to loss of corneal transparency. The disease is characterised by the deposits of misfolded and aggregated proteins as amyloid fibres, amorphous powder or a mixed form of both in various layers of the cornea. Depending on the type of mutation, the age of onset, severity of the disease, the layer of the cornea in which the proteins are deposited and the kind of deposits vary from individual to individual. Mutations occurring in the transforming growth factor beta induced (TGFBI) gene, have been found to be the major cause of the majority of stromal CDs. There are more than 65 different mutations reported in this gene. TGFBIp is found to be present in various other tissues. However, mutations found in TGFBI are associated only with cornea specific disorders. This implies the possibility of a unique mechanism of aggregation in the cornea and the interactions with other tissue-specific factors that may be involved in the aberrant aggregation of mutants. There is no animal model or model system to study the unique aggregation process or to assess the morphology and extent of fibrillation caused by various mutations and contribution of individual amino acid to the amyloid fibril core. The main aim of this project is to understand the aggregation mechanism of TGFBIp in the cornea. We have sought different approaches to understand the disease pathology and mechanism of protein deposition. The drug discovery approach is to identify small fragments or compounds that can bind to the TGFBIp and modulate the protein thereby delaying the aggregation process. The lead compound identified is to be tested if it can alter the thermodynamic stability of the protein and thereby delay the formation of toxic oligomers or fibrils.

Name	Yu-Hang Liu
Level of Study	Graduate
Name of School / College / Institution	National University of Singapore
Department / Division	Department of Electrical & Computer Engineering

Title of Abstract	An integrated therapeutic intervention (CtDCS-PSS) for hyperacute ischemic stroke
Authors	Yu-Hang Liu, Aishwarya Bandla, Nitish Thakor, Lun-De Liao

Abstract

Ischemic stroke is a neurological deficit caused by a reduction in the blood supply to tissue, and is the fourth leading cause of death in Singapore. Currently, the most well-known therapeutic agent for stroke recovery is recombinant tissue plasminogen activator (rtPA), but it is viable for only a small portion (i.e., approximately 3.6%) of ischemic stroke patients and may cause tissue damage by weakening the blood vessel walls. Therefore, a supportive/alternative intervention applicable to most of the ischemic stroke patients is highly needed. We propose a potential therapeutic intervention by using the integration of cathodal-transcranial direct current stimulation (C-tDCS) with peripheral sensory stimulation (PSS) during the hyperacute phase of stroke. We evaluated the neural responses (e.g., somatosensory evoked potentials (SSEPs)) of the rat cortex following ischemic insult. A rat model of photothrombotic ischemia (PTI) was employed to induce a local injury at the forelimb region of the primary somatosensory cortex (S1FL) for simulating the clinical ischemic condition. Besides, histological methods (e.g., 2,3,5-Triphenyltetrazolium chloride (TTC) staining) were also included to evaluate the infarct volume and neuroprotective effects of this treatment. The results of SSEPs showed the peak-to-peak amplitude can be recovered greater than the baseline value (i.e., 109.67 ± 87.4% of the baseline) when the proposed therapeutic intervention was applied, while the infarct volume was largely decreased (i.e., 5.12 ± 1.41% of the ischemic hemisphere). Overall, the results demonstrate that the proposed therapeutic intervention when administered immediately following ischemia induction can significantly promote neuroprotection via inhibition of cortical spreading depression (CSD) and reversed cortical neurovascular functions, suggesting effective recovery. In the near future, photoacoustic imaging will be induced to evaluate the hemodynamic functions after ischemia, for a holistic evaluation of hyperacute ischemia.

BES9SM / Postgraduates / Poster Presentation

Name	Luis Hernandez
Level of Study	Graduate
Name of School / College / Institution	National University of Singapore
Department / Division	Biomedical Enginering
Title of Abstract	Differences in biomechanics between proficient and less proficient soccer players during heading
Authors	Luis Hernandez, Yeow Chen-Hua
Abstract	Soccer is one of the most popular sports, and it is played by millions of people around the wprld. However, there is a lack of research examining the biomechanical differences between proficient subjects and non-proficient subjects. There are some basic skills in soccer such as: kicking, throw-in and heading. This study sought to investigate these differences using subject's kinematics and kinetics when subjects attempt to hit specific targets, during the heading. In heading a player intentionally strikes the ball using his head, and the technique therefore involves a significant impact to a delicate part of the body. Five recreational subjects were recruited and instructed to perform a soccer heading. A motion capture system and force plates were used to obtain kinematics and kinetics data respectively. One white board with one target location was used to obtain subject's accuracy. It is hypothesized that proficient subjects will exhibit greater flexion and extension of lower extremity joint during the header. The angular velocity data showed considerably differences ($P<0.005$) in the dominant ankle joint between the means of proficient (2.02(0.59) °/s) and non-proficient subjects (3.43(0.89) °/s) as well as for maximum moment at the non-dominant ankle (1.94(0.22) Nm/Kg and 1.56 (0.38) Nm/Kg). Key findings include the importance of the arm swing during the header skill, and how this aids propulsion motion and successful completion of the skill. Prior reports suggest that the implementation of and arm swing improves jump height by increasing the height and the velocity of the body's center of gravity. Proficient subjects generally exhibited more desirable characteristics during each trial, representing an overall greater ability in implementing the skills. These results may be useful considerations in developing a neuromuscular training program to increase the proficiency of heading a ball to hit a specific target during a soccer game