28 October 2019

Projects for summer students

Dr. Orit Braun Benyamin

1. **Development of the handle grip of a walker for hemiplegic post-stroke patients**

Stroke (CVA) is a major cause of physical disability among the adult population worldwide.

2. **Development of a system, which will allow toddlers with walking disability to ride a tricycle**

Toddlers with walking disabilities encounter difficulty while engaging in pedaling on tricycles. Every child deserves to experience the thrill of riding down the sidewalk. But for many years, children with disabilities were left out of this recreation equation because the adaptive equipment simply did not exist.

The objective of the proposed project is to design and build a low cost system, which will allow the toddler to ride a tricycle without pedals. The goal is to develop a mechanism, which will convert the swinging motion of the trunk back and forth with the turning of the bicycles wheels.

The students will gain the following skills and knowledge:

- Design skills (Solid works)
- Calculating the evolving forces and stresses
- Designing and building a feedback system
- Soft skills: the project involves teamwork with students in the laboratory

3. **Calculating Forces and Stresses on the Lower Extremity Joints During Balance Exercise Using OpenSim and Ansys**

The objective of the proposed study is to quantify the forces on the lower extremity joints during multiple variations of exercise to determine the evolving stresses.

The students will gain the following skills and knowlege:

- Motion capture techniques (APAS)
- Preforming reverse kinematics (OpenSim)
- Calculating the evolving stresses (Ansys)
- Good experimental design and results analysis

Dr. Orit Braun Benyamin and Ms. Navit Roth

4. **Accessibility of musical systems**

For most of us, the task of digital systems operation is carried out by using a keyboard, a mouse or a touch screen and is easy and an intuitive task. But, for people with motor and cognitive disabilities, this task becomes more difficult and sometimes almost impossible to do without adding accessibility aids.
Music is an inseparable part of our lives is considered a creative, emotional and artistic activity and is also used as a therapeutic method. However, creating music, whether in digital form or physically by playing musical instruments, requires a motor and cognitive level that exists partially in people with disabilities. Access to the operation of musical instruments and the ability to create music for people with disabilities is an important issue and after the first literary review it seems that there is a large gap in this area.

The project of Accessibility of musical systems is a continuous project that has started 3 years ago in our biomechanical lab and involves multidisciplinary aspects and R&D fields.
The objective of the proposed study is to build a musical system that will interact with previous and parallel control systems that are developed in the lab.

The students will gain the following skills and knowledge:

- Motion capture techniques (optical/sensors)
- Control systems
- Good experimental design and results analysis
- Team work

Prof. Isam Sabbah

5. **Accumulation and spreading of microplastics and associated wastewater pollutants**
   The main objective of this research is to develop a thorough understanding of microplastic (MP) occurrence and microplastic-facilitated transport of organic pollutants in wastewater

6. **GoJelly- A gelatinous solution to plastic pollution**
   Characterization & Quantification of MP in wastewater effluent:
   - *Samples clean-up of organic matter (enzymatic digestion)*
   - *Identification and quantification of MP (FTIR-ATR, mFTIR)*

7. **Exposure Risks of Pathogens and Disinfection Byproducts from On-Site Treated Rainwater and Drainage Water For Irrigation**

   This comprehensive study will determine the relative potential human health impacts of irrigation water used in urban and small farms in both dry climate (Israel and American South and Southwest) and temperate climate of American North and Midwest. The student will be involved in development of organic fractionation of disinfection by products using different chromatography methods.

Prof. Sarit Sevan, Department of Biotechnology

Dr. Samy Abu-Salih, Department of Mechanical Engineering

8. **Chemo-Electro-Mechanical Response of Ionic Hydrogel Structures**

Abstract: Ionic Hydrogels are considered smart polymers that can be stimulated by chemical solvent, or by electrical field. Electrical and chemical stimulations leads to swelling or deswelling of the hydrogel structure by intake or expulsion of surrounding solvent, respectively. The swelling and deswelling of hydrogel structures is been implemented in different applications such as actuating components in microfluidic systems, micro pH sensors or in drug delivery systems.

In ionic hydrogel structure the negative or positive fixed ionic groups are attached to its backbone. Exposing the ionic hydrogel to an acidic or base solvent, it shrinks or expands due to the so-called osmotic pressure that dependens on the concentration distribution of the mobile ions in and out of the hydrogel domain.

This project will focus on the chemo-electro-mechanical (CEM) response of micro hydrogel that is immersed in a chemical solvent. A coupled Multi-physics model is employed in order to accurately analyze the swelling phenomena of the hydrogel. The transient solution for the two different actuating methods is achieved by a numerical finite element solution (COMSOL MultiPysics 5) that couples the chemical, electrical and mechanical fields.

Methodology: The reseach tasks of the student will be focused on conducting experiment on the chemical stimulation (swelling and de-swelling) of ionic hydrogel. The results of the experiment will used for validating a numerical model of the CEM response. In addition, the student will be exposed to the numerical modeling aspects of CEM response

Sarit Sivan, PhD and Michal Amit, PhD

9. **Novel injectable biomimetic glycosaminoglycan analogues for intervertebral disc regeneration**

Intervertebral disc degeneration and accompanying low back pain impose a global medical and societal challenge. The objective of the proposed study is to test the ability of novel biomimetic GAG analogue hydrogels to function as mesenchymal stem cells (MSCs) carriers and promote the production of nucleus pulposus (NP)-like phenotype in both well-controlled in vitro and in vivo settings. To this aim, MSCs will be seeded in GAG analogues of different stiffness in the presence and absence of differentiation factors. Constructs will be tested for their mechanical characteristics, biochemical content, architecture of the tissue formed, cell viability and for the presence of NP-phenotype markers using gene expression. The ability of these GAG analogues to delay nerve ingrowth will also be determined.

Marcella Karpuj PhD and Sarit Sivan PhD

10. **Establishing the optimal Mycoplasma test to reach reliable cell culture studies.**

Cell culture research is a growing in the area of basic science as the preferred model to avoid costs and unnecessary animal testing. In the industry, cells are used in drug discovery processes, and often utilized as incubators in the course of drug production. The growing interest in stem cell research and tissue engineering also contributes to this general trend.

A major problem in cell culture is bacterial infection. Their presence in the host cell affects the cells physiology and metabolism. Moreover, the advance in next generation sequencing revealed that Mycoplasma infectivity has an effect on transcriptional patterns of the cells. Therefore, mycoplasma infectivity can lead to misleading interpretations, irreproducible results, and to undesired byproducts.

The Bacteria, Mycoplasma, is invisible to the naked eye due to their ability to adhere to the host cell surface and their lack in a cell wall. Therefore, establishing an accurate, quick, sensitive, reproducible and low cost test is valuable. Current self-testing products do not contain all these essential features. Moreover, there is only one place in Israel that provides only the testing service (Haylabs), and no one provides the combination of testing and treatment, Hence, there is a real need to establish such test and an efficient treatment. As soon as we succeed with these two specific aims, we could offer this product or service to other laboratories in Israel and worldwide.

DR. VICTOR CHERNOV, DEPARTMENT OF MECHANICAL ENGINEERING

11. **PROJECT TITLE: SIMULATION OF LAMINAR CO-FLOWING DIFUSSION FLAME IN OPEN-FOAM**

Laminar co-flowing diffusion flames are of great interest in combustion research. They provide the opportunity to understand basic interaction between chemistry and fluid dynamics in the flame. This project aims to simulate such a flame in an OpenFOAM package and to compare it with other experimental and computational results.

12. **FEASIBILITY OF ALAKALI METAL THRUSTERS FOR NANO-SATELLITES**

Nano-satellites are a fast growing segment of space industry. The simple CubeSat based satellites can be built using off-the-shelf products and are accessible enough even for some high-schools to launch. One thing that nano-satellites struggle with are propulsion systems. Those that exist are usually expensive themselves and have requirements (like relatively high power) that negate the use of the simplest systems for the satellite. For satellite operators that means either high costs or a satellite with not possibility for orbit correction.

The alkali thruster is based on the principle of violent reaction of alkali metals such as lithium, sodium and more with water. On touch hydrogen gas is released, which in theory can be used to propel the spacecraft. This project will look at the feasibility of such a thruster – expected performance, power, space and weight requirements, manufacturing methods, initial design and more.

Dr. Ayelet Goldstein

13. **Operation of Sterling engine and comparing the results to the theoretical model.**