



Undergraduate Research Symposium May 17, 2019 Mary Gates Hall

Online Proceedings

POSTER SESSION 1

MGH 241, Easel 131

11:00 AM to 1:00 PM

Mathematical Modelling of Downhill Mountain Biking

Mack Raymond, Senior, Physics: Applied Physics

Jacob Aaron Logue, Senior, Physics: Applied Physics

Mentor: Matt Miller

The tools of mathematical modelling have been applied to many sports where athletes are searching for strategies to improve their performance. Downhill mountain bike racing is a sport that could benefit from mathematical modelling. My research is aimed at developing a computer algorithm that uses mathematical modelling to simulate downhill mountain biking. In a mountain bike race, racers compete for the fastest time to individually ride down a trail with turns and obstacles. The fastest riders are the most efficient at converting their potential energy to kinetic energy. These riders accomplish this by optimizing the amount of their energy expended on braking and friction so they are just below the borderline of crashing throughout the entire trail. The finishing times of the top 10 riders are often very close, indicating that they are approaching a physical time limit to complete the trail. By using mathematical modelling and the GPS profile of a downhill trail as input, I aim to develop an algorithm that optimizes braking at every point on the trail and outputs the minimum time to complete the trail. The results from this algorithm would provide insights into how a rider could improve their performance. In my work, I show that mathematical modelling can accurately simulate the motion of a downhill rider, explain the challenges in developing a computer algorithm that optimizes braking, and discuss the results of an experimentally tested algorithm.

POSTER SESSION 1

Balcony, Easel 90

11:00 AM to 1:00 PM

Developing Tissue-Specific *swsn-4* Rescue Constructs for *Caenorhabditis elegans* in Hydrogen Sulfide

Silvia Antonia Rus, Senior, Environmental Health

UW Honors Program

Mentor: Dana Miller, Biochemistry

Mentor: Chris Braden, Biochemistry

Hydrogen sulfide (H_2S) is a common cause of workplace injuries and deaths for industrial workers. In our project, we use *Caenorhabditis elegans* (*C. elegans*) as a model organism for investigating how cells behave under an environmental stressor and the long-lasting effects of that behavior. Previous work in our lab has shown that early exposure to low H_2S (50 ppm) enable *C. elegans* adults to survive a much higher subsequent exposure by forming a cellular memory known as a “bookmark.” Bookmarked animals survive at high H_2S (150 ppm), while animals without previous exposure do not. In a genetic screen, we identified various epigenetic factors that are involved in this process; however, it is still unclear when in the “life” of the bookmark and where in the animal these factors are required. The required bookmarking gene *swsn-4* is part of the SWI/SNF complex, a group of proteins that regulate compaction of DNA and thus the accessibility of genes. We are interested in assessing the spatial requirements for *swsn-4* by rescuing mutant animals that lack this chromatin-remodeling factor. For the first part of the project, we use Gateway recombination cloning technology to enable tissue-specific expression of *swsn-4*. In the next part of the project, we test whether introducing *swsn-4* in specific tissues rescues bookmark retention. A recent study identified *hif-1*, a transcription factor, to be broadly needed to rescue animals exposed to both low and high H_2S , suggesting that the response is needed in most cells to ensure survival of the animal. Because *swsn-4* is also present broadly in the body of *C. elegans*, we predict it will be needed in a similar way to *hif-1*. We hope that our investigation would lead us to discovering methods in which we can utilize the properties of H_2S as a chemical messenger to help patients.

POSTER SESSION 2

Commons East, Easel 78

1:00 PM to 2:30 PM

The Effect of Age on Spectro-Temporal Modulation Sensitivity

Erica Joanne Eng, Senior, Speech and Hearing Sci (Com Disorders)

Mentor: Christi Miller, Speech and Hearing Sciences

Individuals with hearing loss have a much greater difficulty understanding speech in noisy environments than their normal hearing counterparts, leading to reduced participation in communicative activities and a lower quality of life. Audibil-

ity explains some of the difficulty this population experiences, but even with audibility recovered by hearing aid amplification, impairments exist in spectral and temporal processing. The extent of spectral and temporal processing impairment is captured in detection of spectro-temporal modulations, which is closely related to speech understanding in noise. This study explores the potential effect age has on STM sensitivity, while controlling for severity of hearing loss. In order to investigate, we measured STM sensitivity in participants with a hearing loss across a wide age range. In the STM test, they are asked to listen to two sounds, a broadband noise and the same broadband noise with spectro-temporal modulation applied, and identify which sound contained modulations. The modulation applied will adaptively change based on response accuracy until the listener can no longer discriminate between the two sounds. A multiple linear regression model is used to analyze the data, with predictors of hearing loss severity and age. We expect to see a decline in STM threshold with age, independent of hearing loss status. The results are discussed in terms of potential for future clinical application and the ability to better the quality of hearing aided listening.