Online Proceedings

POSTER SESSION 1

MGH 241, Easel 140

11:00 AM to 1:00 PM

Refit and Construction of a Rotating Detonation Engine Laboratory

Chinmay S. Upadhye, Senior, Aeronautics & Astronautics, Physics: Applied Physics
Andrew Jacob, Senior, Civil Engineering
Andrew Joseph Milligan, Junior, Aeronautics & Astronautics
Mentor: Carl Knowlen, Aeronautics & Astronautics
Mentor: James Koch, Aeronautics and Astronautics

The University of Washington High Enthalpy Flow Laboratory (HEFL) has constructed a purpose built laboratory for experimental research on Rotating Detonation Engines (RDE). This refit included the rebuilding of the lab apparatus, the assembly of the RDE and supporting equipment such as downstream piping, vacuum system, gas handling plumbing, and the redevelopment of the experimental instrumentation. The assembly of the lab apparatus consisted of the construction and mounting of fuel, oxygen, and nitrogen lines for the RDE, and the assembly of back pressure controlled exhaust tubes leading to a dump tank and an optical imaging port. A stand for the engine apparatus itself as well as much of the plumbing support equipment was also constructed. The assembly of the RDE consisted of the assembly of the various engine parts, followed by the connection of the various instruments such as pressure sensors, temperature sensors, ion probes to the engine itself. The hardware and software components of the instrumentation systems were also redeveloped to allow for very high instrument density for pressure and temperature sensors on the RDE. The software component of the instrumentation involved developing MATLAB scripts for valve actuation, data acquisition, and sensor calibration. The hardware aspect of the instrumentation involved selecting the sensors to be used on the engine based on their signal conditioning, as well as designing and building power supply and signal processing circuits to connect the sensors to a rebuilt data acquisition computer system.

POSTER SESSION 1

Commons East, Easel 61

11:00 AM to 1:00 PM

Energy Conservation: The Enigma of a More Complete Explanation of the Universe

Dang Dang, Sophomore, Physics, Shoreline Community College
Mentor: James Sloan, Physics, Shoreline Community College

The idea of energy, matter, and motion has perplexed many philosophers and physicists from antiquity to modern physics, from Plato to Einstein. New and developing physical theories raise different interpretations of energy and matter but no complete theory of everything exists at present. However, there is a law we can almost take for granted - the Law of Conservation of Energy, it simply states that energy cannot be created nor destroyed although it can be transformed from one form to another. With an up-to-date history of the first law of thermodynamics, physicists in the field can have a sense of what has been done and what not. A complete overview of the rudimentary law would also provide a continuous timeline in which one can identify flaws in current theories. After establishing the foundational theory and history of conservation of energy, this literature review aims to provide a comparative study between the concept of mass and energy in two of the most profound physical theories - Quantum Mechanics and General Relativity. Subtle implication of numerous laws of thermodynamics and mass-energy equivalence like Dark Energy, Dark Matter, Higgs Mechanism and Blackhole Thermodynamics is studied in an introductory manner for potential history and correlate direct and indirect links to energy conservation.

POSTER SESSION 1

MGH 241, Easel 160

11:00 AM to 1:00 PM

Orbital Fracture Computed Tomography (CT) Analysis

Annamarie Christina Lahti, Senior, Neurobiology
Innovations in Pain Research Scholar
Mentor: James Phillips, Oto-HNS
Mentor: Sarah Akkina, Otolaryngology

Traumatic fracture of the bone surrounding the eye (the orbit) can result in functional impairment of vision. Double vision, diplopia, is one such sequelae. The cause of diplopia in orbital fracture patients has most commonly been attributed to loss of orbital volume caused by an open fracture that allows the contents of the orbit to shift. However, in cases where

the orbit is surgically repaired and orbital volume is restored, some continue to have diplopia. Our hypothesis in these cases is the anatomy of extraocular muscle pulleys is affected by the trauma. The aim of this study is to test this research question by analyzing computed tomography (CT) scans. Patients were selected from a previous study of orbital fracture patients in which all patients had CT scans available for review and consented to be part of a research study on orbital fractures. Locations of the extraocular muscle pulleys were measured relative to the center of the orbit in the lateral, anterior and superior directions. Pulley location was determined by a tangent plane drawn where the optic nerve meets the orbit and crosses the muscle. The measurements were input into Orbit, simulation software, to produce a prediction of visual changes in Lancaster plots. The Lancaster plots were compared to the data from the patient's clinical visual testing to determine the accuracy of the prediction at each point in the visual field. Our results showed that the accuracy of our prediction varied, as the location of the pulleys is not the only factor that contributes to diplopia. Other factors that may contribute include weakened muscle, entrapment and damage that is not visible on CT. More research is needed to determine how the muscle pulley system is affected in orbital fracture, and to determine how clinical interventions including surgery may help improve diplopia.

POSTER SESSION 1

Commons East, Easel 62

11:00 AM to 1:00 PM

Comparative Biological Studies: The Use of Vortices in Locomotion

Willow Strey, Sophomore, Physics, Animation, Shoreline Community College
Mentor: James Sloan, Physics, Shoreline Community College

Biomimicry as a practice has generated a plethora of innovative technologies. By observing key processes that evolution has converged upon, we can improve and evolve manmade mechanisms. This literature review addresses the importance of vortices in biological systems and compares their locomotive purposes across a wide range of animal phyla. The development of particle image velocimetry (PIV) has enhanced our ability to study the vortex mechanics of remarkably fast or efficient animals. Such experiments have made great contributions to the human understanding of flow and kinematics. Vorticity studies, for example, have produced results that contradict the paradigm for animal motion– particularly in how the inherent low-pressure zone associated with vortices can allow animals to maneuver through a fluid. Lampreys and jellyfish have shown to use vortex-based locomotive techniques to "suck" themselves through the water. Additionally, the "hyper-pitching" process of the zooplanktonic sea butterfly is controlled by pressure fields generated by leading edge vortices. Such findings have interesting implications for the future of biomimetic water and air travel, as the utilization of pressure as opposed to thrust may facilitate the creation of more efficient vehicles. Furthermore, comparative biological studies allow for a more in-depth interpretation of animal kinematics that have been difficult to study due to lack of proper technology. By creating qualitative analogies between air travel and water travel, we can reexamine how airborne creatures move.

SESSION 1J

UNDERSTANDING OUR WORLD: DATA-BASED APPROACHES

Session Moderator: Walter Andrews, Near Eastern Languages and Civilization

MGH 251

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Impact of Perceived Government Legitimacy on the Use of Taliban Court Systems

Damien Jacoy Willis, Junior, Political Science
Mary Gates Scholar
Mentor: James Long, Political Science

After the establishment of a new democratic government following the US invasion in 2001, the Taliban has provided a parallel court system across Afghanistan. Rebel forms of justice may appear highly coercive, but prove particularly appealing to civilians if they are quicker, more straightforward, easier to access, or more in line with their preferences than formal state courts. Under what conditions are citizens more likely to support the legal authority of the formal government's judicial systems compared to rebel groups' alternative forms of law? In this research, I expand the framework of competitive governance by focusing on the decision of individuals to support various legal institutions based on views of government legitimacy founded in the evaluation of public service provision. I hypothesize that as individuals view the government as more legitimate, they demonstrate support for the formal courts, and as they view the government as illegitimate, they are less likely to support the formal judicial system. I address this question by analyzing two data sources. First, I have identified active Taliban courts by district from 2011-13. Second, I have access to the ANQAR survey data, an extensive nationwide survey addressing perceptions of government legitimacy and rule of law. Preliminary findings suggest a zero-sum dynamic between the institutions - that successful rebel governance may not only increase compliance with the rebels, but may actually decrease civilian compliance with state institutions. The policy impli-

cations of this research are twofold. First, this informs formal governments that building a judicial system is not just a function of strength and access, but rather that civilians are assessing the government's service capacity as a whole. Secondly, understanding civilian behavior and preferences will assist nascent democracies in determining how it is most efficient to spend their limited resources to increase the support of the civilians.

SESSION 1J

UNDERSTANDING OUR WORLD: DATA-BASED APPROACHES

Session Moderator: Walter Andrews, Near Eastern Languages and Civilization
MGH 251
12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Human Smuggling, an Element of Migration and Organized Crime
Jessica Phung, Senior, Political Science (Political Economy)
Mentor: James Long, Political Science

With more than a million arrivals in Europe in 2015, the mass migration has impacted the continent politically, economically, and socially. According to Europol, a law enforcement agency, in 2016 more than 90% of migrants going to the European Union have experienced some kind of smuggling during their journey. Many articles aggregate human smuggling with human trafficking. However, there is a lack of empirical examination and of different types of smuggling. In this study, I focus on migrant smuggling. Nevertheless, human smuggling is often seen as a crime that is organized, where a new "service" gets added to their principle activity (drug smuggling, money laundering...), as stated by Finckenauer, and performed by people who have never been involved in transnational criminal organizations. I assess this puzzle: How does human smuggling differ from human trafficking and organized crime, by examining primary and secondary sources such as scholarly literature and local newspapers? I argue that human smuggling has some traits of organized crime; however, considering entirely as it, limits the study of smuggling, as a business activity, and limits the prevention of illegal immigration. Human smuggling has traits of organized crime: the structure, the persistence, and violence have shown that these elements are not voluntarily present in the activity of smuggling. Nonetheless, the main purpose of this activity is treated as a business: where demand and supply meet and where price fluctuates depending on these factors. Migrant smuggling needs to be seen as a mutually consenting act between a migrant and a smuggler: the migrant is looking to flee because of instability in his/her country for the hope of a better life while the smuggler is considering smuggling as a business. This project aims to give a nuanced understanding of human smuggling to better intervene at the source of this mass migration.

SESSION 1M

HEALTHCARE

Session Moderator: Geoffrey Gottlieb, School of Medicine
MGH 284
12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Evaluating the Dynamic Visual Acuity Test as an Indicator of Surgical Outcomes in Orbital Fracture Patients
Aliya Shabbir, Sophomore, Pre-Sciences
UW Honors Program
Mentor: Sarah Akkina, Otolaryngology
Mentor: James Phillips, Oto-HNS

Orbital fractures are one of the most common facial fractures and often result in functional deficits if not treated appropriately. No prior reports have assessed dynamic visual acuity (DVA) in these patients, which is critical in visually tracking objects during head movement. Our research seeks to determine the effect of orbital fractures on DVA and assess whether DVA will change over time in those who undergo surgical reconstruction of the orbit. We hypothesize that DVA is adversely affected in orbital fracture patients and improves after surgical reconstruction. We designed a prospective pilot study at a Level I trauma center. Adult patients who presented with an orbital fracture between November 2017-January 2019 without prior ocular history were eligible. All enrolled subjects underwent static visual acuity (SVA) and DVA testing twice: once within one month post-injury before surgery, and another at least ten days following surgery. SVA was assessed using a mobile Snellen eye chart. DVA was measured by having the subject rotate their head at a standard frequency while again reading a Snellen chart. DVA is defined as abnormal if acuity falls more than two lines on the Snellen chart compared to SVA. Eleven patients have been enrolled and tested. Four(36%) patients exhibited abnormal DVA prior to surgery, compared to two(18%) after surgery. For all patients, the mean change in visual acuity (DVA logMAR minus SVA logMAR per subject) before surgery was 0.17 (SD=0.09). Following surgery, the mean difference in visual acuity across all patients was 0.07 logMAR (SD=0.07). Our data shows that, surprisingly, the majority of orbital fractures patients tested did not have abnormal DVA. In patients that did demonstrate abnormal DVA, half improved after surgery. The mean difference in visual acuity of all patients also improved after surgery. A larger

study is needed to determine the prevalence of abnormal DVA in this patient population.

POSTER SESSION 2

Commons West, Easel 21

1:00 PM to 2:30 PM

Effect of Levodopa on Fentanyl Oral Self-Administration in Rats

Janet Suhjung Lee, Senior, Neurobiology
UW Honors Program
Mentor: Paul Phillips, Psychiatry & Behavioral Sciences
Mentor: Ryan Farero, Psychiatry and Behavioral Sciences

Drug addiction is a neuropsychiatric disease characterized by compulsive and uncontrolled drug use. Rodent self-administration models can represent certain aspects of substance abuse in humans. Studies have shown drug use and drug-associated cues increase dopamine transmission. Data from the Paul Phillip's Lab demonstrated rats that escalated in their cocaine intake had a decrement in dopamine release to cues in the nucleus accumbens. Administration of Levodopa (L-DOPA), the molecular precursor to dopamine, decreased cocaine consumption to pre-escalated levels. However, we have not yet confirmed whether the impact of drug-associated stimuli and its dopamine-mediated aspects can be generalized to opioid use. Thus, the current study investigates if increased dopaminergic signaling via L-DOPA decreases consumption of fentanyl, a highly potent synthetic opioid. We tested L-DOPA's effect in two separate behavioral assays. The first assay is a two-bottle choice paradigm in which the animal is given 3-hour access to liquid fentanyl (50μg/mL) and water. Additionally, animals were trained to self-administer fentanyl, in which rats were required to nose poke for liquid drug delivery. Preliminary data shows intraperitoneal injection of L-DOPA significantly decreases overall fentanyl consumption in both two-bottle choice ($p<0.05$) and in the instrumental task ($p<0.05$). These data imply that dopamine release is regulating opioid consumption. A second aim of the current work is to characterize drug-taking patterns in animals self-administering fentanyl orally. Permitting animals to extended access to drugs of abuse is known to induce escalation of drug intake. Utilizing this paradigm we provide six hours of liquid fentanyl access and examine intake patterns of individual animals across sessions. Future studies will utilize electrochemical detection techniques to examine subsecond changes in dopaminergic signaling during oral self-administration. Overall, this work provides evidence that dopaminergic signaling regulates fentanyl consumption and treatment with L-DOPA can stabilize and reduce drug intake.

SESSION 2E

ANIMAL RESPONSES TO THEIR ENVIRONMENT

Session Moderator: Jay Parrish, Biology

MGH 238

3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

The Effects of Chronic L-DOPA on Operant Responding for Alcohol in Rats

Kayla Wang, Senior, Psychology
Mentor: Nathan Holtz, Psychiatry and Behavioral Sciences
Mentor: Paul Phillips, Psychiatry & Behavioral Sciences

Dysregulation of the dopamine system is a central mechanism driving substance use disorders. Our laboratory has shown that chronic cocaine consumption decreases dopamine release in the nucleus accumbens of the rat, which is a brain area that is important in reinforcement learning. This study also found that restoring dopamine transmission through the administration of the dopaminergic drug, L-DOPA, decreased their cocaine consumption. Recently, we have also shown that acute administration of L-DOPA decreases ethanol (EtOH) intake. Thus, the present study sought to examine the effects of chronic L-DOPA on operant responding for EtOH in adult male rats. Rats were presented with a 2-bottle choice between an EtOH (20%) solution or water, daily for 21 days. Next, animals made nose poke responses (FR1) for 0.2 mLs of an EtOH (20%) solution over 1-h daily sessions for 35 days. On Days 26-35, rats consecutively received either vehicle or L-DOPA (30 mg/kg) for 5 days, counterbalanced across days, and L-DOPA decreased operant responding for EtOH compared to VEH. We are presently examining the effects of L-DOPA on dopamine release during operant responding for EtOH. Together, these data may suggest the efficacy of L-DOPA as a treatment for patients with alcoholism.

SESSION 2M

MCNAIR SESSION - FROM CHAOS TO ORIGAMI: ADVANCES IN MATH, PHYSICS, CHEMISTRY AND ENGINEERING

Session Moderator: Therese Mar, OMAD and Department of Environmental and Occupational Health Sciences

MGH 288

3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

Homotopy Type Theory and the Foundations of Mathematics

Jordan Leoron Charles Brown, Junior, Mathematics (Comprehensive)
McNair Scholar
Mentor: James Morrow, Mathematics

We investigate recent developments in the foundations of mathematics, particularly homotopy type theory, to determine their viability as foundations of mathematics. Related foundations such as Martin-Löf type theory, topos theory, and category theory are also discussed. We evaluate the possible benefits of a type-theoretic formulation of mathematics and the nature of constructive axiomatic foundations. The research involves a review of the existing literature in these areas and a comparative analysis of the methods used across frameworks. This research is the first step towards the development of languages easily used by computers and mathematicians which incorporate the power and flexibility of non-standard deductive procedures.

POSTER SESSION 3

Commons East, Easel 51

2:30 PM to 4:00 PM

Accuracy of Reporting of Primary Care Physicians in Medical Research

Abhinav Santosh Agnani, Senior, Biology (Physiology)
Harish Sivakumar Thoppe, Senior, Biology (General)
Angela Yang, Junior, Public Health-Global Health
Andrea Mai (Andrea) Diep, Senior, Public Health-Global Health
Mentor: William Phillips, Family Medicine

Primary care (PC) is the foundation of healthcare. Family physicians (FPs) are specialty trained and certified in PC and provide most PC services in the US. General practitioners (GPs), a separate group with no specialty training, are commonly confused with FPs despite differences in demographic, professional and service characteristics. Medical researchers commonly ignore this distinction and report the two groups together. Our study aims to document the rate that research in major medical journals separates or lumps GPs and FPs. We selected 23 journals on impact factor, US focus and relevance to primary care across MedLine categories of primary health care, general internal medicine, pediatrics, public health and health services. Using a MedLine search, we sought all papers published in these journals in 2017-18 that met inclusion criteria: original research, done in US, studying FPs and/or GPs and/or primary care physicians. Two researchers reviewed each article to determine inclusion, study characteristics and whether it lumped FPs with GPs or reported them separately in results. Literature search retrieved 440 total studies, with 104 (23.6%) meeting inclusion criteria. Among these, 42 (40.4%) included family physicians only, leaving 62 (59.6%) that also included GPs. Among studies including GPs, only 3 (2.9%) separated GPs from FPs. Another 23 (22.1%) lumped the GPs and FPs together. In 36 (34.6%) the reporting of GPs, FPs and others was unclear. We identified no studies on GPs only. Further analysis will examine FP-GP lumping vs. splitting by journal type, author specialty and source of specialty information. In key medical journals, most studies lump together GPs and FPs, masking differences between these distinct groups of physicians. Most research reports fail to explain how they classify PC clinicians. Research reports need to accurately study FPs and primary care in the US.

POSTER SESSION 3

Commons West, Easel 30

2:30 PM to 4:00 PM

Characterizing the "Stress-Reward" Pathway: The Effect of α-CRF Injection on Decision-Making Behavior in Male and Female Mice

Kevin Haokun Li, Senior, Economics, Biochemistry
Mentor: Paul Phillips, Psychiatry & Behavioral Sciences
Mentor: Rapheal Williams, Psychiatry and Behavioral Sciences, University of Washington Neuroscience Graduate Program

Major Depressive Disorder (MDD) has the largest life time prevalence (17%) of mood and anxiety-related disease. The prevalence of MDD is also 1.7 times greater in women than men. Chronic stress and anhedonia are the primary symptoms of depression, and decisions are affected. Our laboratory has shown that corticotropin releasing factor (CRF), the stress hormone, potentiates dopamine release in the core of the nucleus accumbens (NAc), suggesting a relationship between stress and reward processing. While it is known that an individual's decision making is altered in a depressed state, the precise neurological pathway between stress and reward processing in the brain is unclear. To characterize this "stress-reward" pathway, I used a novel decision-making framework where a cohort of male and female mice performed an operant concurrent-choice task choosing between 0.1M sucrose solution or water. Mice were injected intracranially with α-CRF, a non-selective CRF antagonist, or vehicle in the NAc prior to performing the task. I measured task performance. I hypothesize that mice injected with α-CRF demonstrate less appetitive and reward-seeking behavior compared to the vehicle group, implicating a lower sucrose nosepoke percentage, sucrose choice percentage, and higher sucrose latency during the decision-making task. I also hypothesize that females have a greater reward sensitivity system than males, resulting in an augmented decline in appetitive and reward-seeking behavior compared to males. If these results indicate a significance in further elucidating the "stress-reward pathway" through the decision-making task, this can pave way for po-

tential new treatments targeting this pathway for depression.