UNIVERSITY of WASHINGTON

Undergraduate Research Symposium May 17, 2013 Mary Gates Hall

Online Proceedings

Poster Session 1

Commons East, Easel 72

11:00 AM to 12:30 PM

Acoustic Evaluation of Hepatic Steatosis

Ameen Tabatabai, Sophomore, Bioengineering
Mentor: Wayne Kreider, Applied Physics Laboratory
Mentor: Yak-Nam Wang, APL
Mentor: Michael Bailey, APL
Mentor: Adam Maxwell, Urology

Liver transplantation is a widely performed treatment for patients with end stage liver disease. Each day, the liver transplant waiting list grows longer due to a shortage of acceptable organs. Hepatic steatosis in donor livers is an increasing problem that contributes to discarding otherwise-transplantable livers. Numerous studies and surgeries have shown that high fat content in livers correlates with poor graft function and lower patient survival. Longer waiting lists are causing transplant centers to consider moderately steatotic livers as a part of extended donor criteria. However, a method is needed to objectively quantify fat content in livers in order to select suitable organs. Many studies over the past 30 years have characterized a correlation between fat content of livers and acoustic properties such as sound speed and attenuation. This research seeks to employ an acoustic caliper device to acquire acoustic measurements that can be used to quickly, accurately, and noninvasively evaluate the fat in transplant donor livers. Sound speed and attenuation were measured by transmitting short pulses of ultrasound at frequencies from 1-10 MHz through excised pig and cow livers. Liver thicknesses were measured with a dial caliper to permit sound speed estimates, and reference measurements were taken in water to calculate the additional attenuation created by the presence of the liver. In addition, a thermocouple was used to take precise temperature measurements in liver and water, since sound speed varies with temperature. Although fat content was not quantified, sound speed and attenuation did correlate with the presence of visually observable fat. However, significant variabilities between measurements were also found with regard to the preparation of the liver samples and tissue inhomogeneities. This work has led to ideas for an improved acoustic caliper device and for testing lipid emulsions as tissue phantoms for evaluating measurement capabilities.

Poster Session 2

MGH 241, Easel 169

12:45 PM to 2:15 PM

The Use of Echolocation in Southern Resident Killer Whales in Regards to Underwater Noise Pollution

Breanna Lee (Breanna) Walker, Sophomore, Aquatic & Fishery Sciences
Mary Gates Scholar
Mentor: Kristin Laidre, Polar Science Center/APL and School of Aquatic and Fishery Sciences

The Salish Sea is critical habitat for the endangered population of Southern Resident Killer Whales (SRKW). One of the primary threats to SRKW recovery is underwater noise pollution from boat and ship traffic. Killer whales rely on acoustics to communicate, navigate, and to forage in their underwater environment. The increasing levels of underwater noise have the potential to mask the SRKW calls and echolocation clicks, resulting in compensation (i.e. increasing the loudness of calls and using echolocation more or less frequently). This study investigates the potential effects that boat and ship traffic may have on SRKW echolocation. If SRKWs are experiencing masking while actively using echolocation, it is expected that there will be a significant difference between echolocation click rates in a quiet underwater environment and click rates produced in an underwater environment filled with noise pollution. Passive acoustic monitoring was used to record SRKW acoustics and measure the received levels (RL) of underwater noise. Visual boat and ship counts were conducted during acoustic recordings to quantify the amount of traffic in the study area (Whale Watch State Park, San Juan Island, WA). These data sets are being tested to determine if there is a significant correlation between the RL of underwater sound and boat and ship traffic, and if echolocation click rates change in respect to the RL of underwater sound. The anticipated results are that boat and ship traffic will be directly connected to the increases in RL of underwater sound and that masking will be impacting SRKW use of echolocation. Southern Resident Killer Whale population recovery is faced with a number of threats, however underwater noise pollution is one that we, as a society, can directly impact. Consequently, it's extremely important for us to understand how underwater noise pollution can affect this endangered population of killer whales.

POSTER SESSION 2

MGH 241, Easel 158

12:45 PM to 2:15 PM

Subzero Growth, Metabolism, and Protein Expression of the Polar Marine Bacterium *Colwellia psychrerythraea*

Krystal Slattery, Fifth Year, Biology (General), Earth & Space Sciences (Biology)

NASA Space Grant Scholar, Undergraduate Research Conference Travel Awardee

Mentor: Karen Junge, Polar Science Center, Applied Physics Laboratory

Mentor: Karen Cameron

The mechanisms that enable bacteria to be metabolically active at subzero temperatures are of considerable interest to studies of polar microbial ecology, astrobiology, climate and cryopreservation. The true nature of these mechanisms in marine bacteria remains elusive. Previously, protein synthesis within the sea ice bacterium *Colwellia psychrerythraea* str. 34H has been observed down to -20C (and possibly lower) after being flash frozen with liquid nitrogen (Junge et al 2006). Here we report on the results of a long-term study of subzero metabolic activity, growth and protein expression of 34H cells not impeded by possible flash-freezing artifacts. 3H-Leucine- and Thymidine incorporation in addition to shotgun proteomics techniques were applied to 34H cultures incubated for up to 8 weeks at -1, -5, -10, -15, -20, and -196C. Protein synthesis rates were found to be significantly higher without flash-freezing, in particular as temperatures dropped below -5C. Furthermore, maximum protein synthesis and growth rates were observed at -1C and -5C. Evidence for growth cessation with continued protein synthesis at -10C, and possibly below -10C, were also obtained. Triplicate detailed proteomic profiling using tandem mass spectrometry are in progress and will help elucidate specific metabolic pathways that are selectively turned on or upregulated in order to facilitate the observed metabolic activities and growth at subzero temperatures. These combined efforts contribute to solving the critical puzzle concerning the establishment and maintenance of life in saline ice formations as well as provide valuable insight into low temperature cell physiology and adaptations for life in ice with significance to sea-ice ecology and seasonal transitions.

POSTER SESSION 4

Balcony, Easel 96

4:15 PM to 5:45 PM

Wave Energy to Electricity: Maximizing Load Change for Ocean Wave Energy Conversion

Curtis John (Curty) Rusch, Junior, Mechanical Engineering

Mentor: Jim Thomson, CEE/APL

Waves carry a significant amount of energy, but this energy has not been thoroughly explored for human use. There are a myriad of different ways to harness this energy. One very promising method is through the vertical oscillation of a buoy as waves pass beneath it. The Applied Physics Lab (APL) has teamed up with Oscilla Power to test an APL buoy design paired with an Oscilla power generator. This pairing has been tested over a matter of months on Lake Washington, just off of Sand Point. The buoy itself is anchored to the bottom of the lake by three anchors, and a weight consisting of two railroad wheels hangs in the water column beneath the buoy. The Oscilla Power energy-generating device attaches mid-line above the hanging weight. There are a number of data acquisition devices onboard measuring the motion of the buoy via accelerometers, the loading on the tether, and electrical output of the Oscilla Power device. The results of this test show a relation between wave height and power output via tether loading, verifying the buoy design. Optimal power output coincides with optimal wave heights and frequencies, and the results of this test and subsequent data analysis reveal these values. This information is crucial to the design of future moorings for wave energy conversion devices. This work may be scaled up to provide power to open ocean research buoys, extending the battery life of these devices. If these tests are promising, additional uses for this energy on a larger scale could be explored.