In liver transplantation, high overall fat content in donor livers contributes to poor graft function and lower patient outcomes. Currently, the surgeon’s impression is the main method for evaluating donor livers for fat. Since this is highly subjective, our lab is exploring a more objective method using ultrasound, specifically by measuring acoustic attenuation, which has previously been linked to fat content. This research project is focused on evaluating different output configurations of an acoustic caliper device to determine the optimal settings for measuring acoustic attenuation. The device includes transmit and receive transducers on opposite ends of a caliper and a gauge for measuring the distance between the transducer heads. Using LabVIEW, different waveform pulses can be applied at different frequencies from the transmit transducer through a sample. The transmitted signal is collected by the receive transducer at the other end of the sample. Acoustic attenuation is then estimated as the amount of signal loss in a sample relative to a reference measurement in water, which has negligible attenuation. Signal processing calculations were performed in MATLAB. This study evaluated the performance of two waveform types (chirped pulses and sinusoidal pulses) for measuring attenuation from 0.5 – 5 MHz in samples with thicknesses ranging from 15 – 50 mm. Measurements were performed in both a homogenous attenuation phantom and an inhomogeneous phantom that more closely mimics real tissue. For each phantom, waveform type, and measurement distance, attenuation measurements were repeated five times and the resulting data were analyzed statistically. Ongoing efforts with data collection and analysis will provide a basis for determining the most useful acoustic outputs for making accurate and repeatable attenuation measurements of tissue samples under ex vivo and in vivo conditions.
temperature had a negligible effect on water column respiration, while organic carbon stimulated oxygen consumption and was thus identified as a possible limiting factor. The study’s findings broaden our knowledge of factors regulating oxygen dynamics in coastal embayments of the Salish Sea and provide further insight into the potential effects of anthropogenic stressors and climate change on Salish Sea water quality.

**SESSION 2K**

**BIOMATERIALS AND BIOTECHNOLOGY**

Session Moderator: Qingxin Mu, Pharmaceutics

284 MGH

3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

**Effect of Stone Characteristics on Fragmentation of Kidney Stones Treated with Burst Wave Lithotripsy**

Madeline J. (Maddie) Hubbard, Junior, Civil Engineering

Mary Gates Scholar, UW Honors Program

Mentor: Adam Maxwell, Urology

Burst wave lithotripsy (BWL) is an experimental treatment for kidney stones, using ultrasound pulses to extracorporeally break stones into small, passable fragments. BWL has pressure amplitudes significantly lower than those used in shock wave lithotripsy (the most common kidney stone treatment in the U.S.), potentially minimizing injury to surrounding tissue. This study aimed to determine the effect of stone dimensions and hardness on fragmentation of stones treated with BWL. Cylindrical stone models of variable length (8-26 mm, 6 mm diameter), and diameter (4-14 mm, 10 mm length) were cast using two different plasters: BegoStone (Bego), which mimics hard stones, and Ultracal-30 gypsum (U30), which mimics soft stones. Stones were treated for 10 minutes using a 170 kHz focused ultrasound transducer. After exposure, stone fragments were weighed to determine the fraction broken and fragment size distribution by weight. Both types of stone models experienced fracturing and fragmentation when exposed to BWL. Cylindrical stone models of variable length (8-26 mm, 6 mm diameter), and diameter (4-14 mm, 10 mm length) were cast using two different plasters: BegoStone (Bego), which mimics hard stones, and Ultracal-30 gypsum (U30), which mimics soft stones. Stones were treated for 10 minutes using a 170 kHz focused ultrasound transducer. After exposure, stone fragments were weighed to determine the fraction broken and fragment size distribution by weight. Both types of stone models experienced fracturing and fragmentation when exposed to BWL, though U30 stones fragmented more. Smaller diameter stones tended to have the highest percent-by-mass fragmentation. For Bego stones, the smallest diameter had 75% fragmentation, whereas the largest had only 5%. U30 stones of variable diameter showed a similar trend, from 98% fragmentation in the smallest diameter to 52% in the largest. Most fragments from both types of stones were clinically passable (<4 mm). Length seemed to have less impact on fragmentation than diameter, as most length stones of both types had greater than 70% fragmentation by mass. Longer stones tended to produce fragments that would not be clinically passable, but this was likely due to the experimental setup rather than the treatment. While BWL can break both hard and soft stones, this study provides useful data to account for stone size and composition during treatment planning, so that stones can be reduced to small, passable fragments.

**Ultrasound Methods for Improving Sizing Accuracy of Kidney Stones**

Anna J. (Anna) Mc Clenny, Senior, Pre-Social Sciences

Mary Gates Scholar

Mentor: Michael Bailey, APL

Although Ultrasound (US) provides an inexpensive, minimally invasive, radiation free method for the sizing of kidney stones, it is known to overestimate stone size so I explored using the acoustic shadow produced behind kidney stones as a possible form of more accurate sizing. Forty-three human kidney stones were used for this study and each stone was imaged with a software based US system at three different depths and with three different imaging modalities. These stone images were reviewed by four separate operators, all of whom were not told the true measurements of each stone. Each operator measured both the stone width and the width of the acoustic shadow behind the stone. The error in stone size was then calculated as the measured width minus the true width. The average error in stone size when the stone image was captured with the conventional B-mode modality was 1.4 ± 0.8 mm. The average error for spatial imaging was 1.6 ± 0.8 mm while for harmonic imaging the average error was 0.7 ± 0.8 mm. In comparison, the average error in stone measurement when the acoustic shadow width was measured was 0.2 ± 0.7 mm, 0.4 ± 0.8 mm, and -0.1 ± 0.9 mm, respectively. The error in measurement of stones increased with depth when the measurements were based on the stone image but not when based on the shadow. Through the use of this in vitro model, a method was developed to reduce stone overestimation to 1 mm. This method uses the stone’s acoustic shadow width as a source of size indication as well as harmonic imaging. By measuring the width of the acoustic shadows, a significant improvement of sizing accuracy was observed in comparison to the traditional method of measuring the stone width using conventional B-mode imaging.
POSTER SESSION 3
MGH 241, Easel 159
2:30 PM to 4:00 PM

Remotely-Sensed Evidence of Underwater Processes in the Columbia River Estuary
Nakul Malhotra, Senior, Computer Engineering
NASA Space Grant Scholar
Mentor: Craig McNeil, AIRS, Applied Physics Laboratory

I researched the plausibility of using remote sensing to find evidence of sub-surface processes occurring in the Columbia River estuary. An estuary is a place where fresh water from rivers mixes with saltwater from the ocean. It acts as a bioreactor, transforming organic matter and nutrients before they enter the ocean. The Columbia River estuary is a salt-wedge estuary, meaning that as the river empties into the Pacific Ocean – and because fresh water is less dense than ocean water – the fresh water floats on top of the salt wedge that tidal forces are pushing into the river. My research aimed to find remote sensing data, ranging from satellite images to camera images from the experiments that showed surface manifestations of the salt wedge pushing into the river. Using data collected by the autonomous underwater vehicles (AUVs) used in the experiments conducted in the last five years, I aimed to find periods of overlap between AUV data and the remote sensing data. Comparison of these data then allowed me to check whether the remote sensing results were supported by the AUV results. These data can be used to improve numerical models which will assist in plotting where the salt wedge is occurring in the estuary. Understanding the interactions between the salt wedge and fresh water is important not only for the marine ecosystem – as many species rely on these estuaries for food and as places to nest and breed – but also for the human community as people rely on these estuaries for recreation, food, and jobs. Comprehending the physics of why and how these salt wedges occur can allow insight into how the nutrients and organic matter in the buffer zone are processed, which in turn will affect the marine life feeding on those resources and thus human communities.

POSTER SESSION 3
MGH 241, Easel 160
2:30 PM to 4:00 PM

Resolving and Analyzing Vertical Water Velocities in the Southern Oceans
Jesse Ashworth, Senior, Mathematics (Comprehensive), Physics: Comprehensive Physics
Mary Gates Scholar, NASA Space Grant Scholar
Mentor: James Girton, Applied Physics Laboratory
Mentor: Byron Kilbourne (bkilbour@apl.washington.edu)

Horizontal ocean currents are well-documented, but vertical movement of seawater is an important physical aspect of the ocean that is difficult to measure directly. Accurate vertical water velocity (\(W_w\)) data provides better quantitative understanding of internal waves and ocean circulation—both of which have important roles on Earth’s climate system. To shed more light on these phenomena, I researched the ranges of \(W_w\) that occur in the ocean around Drake Passage using data from five EM-APEX floats—robotic instruments that move vertically by adjusting their density relative to that of seawater. I investigated the float parameters that optimize \(W_w\) measurements, the distribution of optimized vertical velocity values, and the internal wave frequencies of \(W_w\). I used pressure and time data from the floats to compute float vertical velocities (\(W_f\)), modeled still-water vertical float velocities (\(W_s\)) using an equation balancing drag and buoyancy, and calculated \(W_w\) by subtracting \(W_s\) from \(W_f\). I then tuned the \(W_s\) model by numerically optimizing the float compressibility and piston expansion coefficients. I found that \(W_w\) values were normally distributed about 1.1 mm s\(^{-1}\) downward on average with a mean spread of approximately 1.1 cm s\(^{-1}\) across all floats, which agrees with past results. The reason(s) behind the negative bias in \(W_w\) values require further investigation, and could be due to potential float ballasting procedure errors or to a signature of gradual downward motion in large-scale oceanic currents. I also determined that the frequencies of \(W_w\) were very close to \(N\), the maximum internal wave frequency. The similar \(W_w\) frequencies to \(N\) confirm that the internal waves responsible for the vertical velocities oscillate primarily in the vertical direction, as expected. Vertical ocean velocities can be further studied by applying a different buoyancy model and integrating ocean data from elsewhere in the world.

POSTER SESSION 4
MGH 241, Easel 160
4:00 PM to 6:00 PM

Shock Wave Propagation through Plasma of Exponentially Increasing Density
David Beckman, Freshman, Software Engineering, South Seattle College
Chayanat (Luke) Wanitthananon, Sophomore, Aerospace Engineering, South Seattle College
Mentor: Anna Markhotok, Sciences, South Seattle College

Past studies have shown that plasma created in air can effectively be used to modify the velocity and shape of atmospheric shock waves. The aim of the research is to assess the effect of plasma density distribution on the shock front development, or more specifically to study the effect exponentially increasing density within the sphere will have on the shape and velocity of the wave. For this, the problem was first solved analytically and then numerical simulations were performed to demonstrate the effect in a range of shock ve-
locities and varying conditions within the plasma region. The results of these findings can find potential use in Astrophysics for shock waves generated within the stellar interior, Magnetohydrodynamics as well as for aerodynamic flow control in trans- and supersonic flights by creating plasma around a moving vehicle.

**Poster Session 4**

**MGH 241, Easel 161**

4:00 PM to 6:00 PM

**Comparative Studies of the Shock Refraction on Thermal Inhomogeneity**

Phayrithy Sreng, Sophomore, Civil Engineering, Computer Science, Mechanical Engineering, South Seattle College

Thanh Le, Sophomore, Computer Science, South Seattle College

Mentor: Anna Markhotok, Sciences, South Seattle College

After a shock wave crosses an interface with plasma, the shock speed along with its shape change. These changes are dependent on the geometry of the interface and the plasma temperature. The goal of this project is to comparatively study how the shock dispersion on thermal inhomogeneity is affected by a plane and spherical geometries of the interface. The results of new findings can be used in for aerodynamic flow control in supersonic flights by creating plasma around a moving vehicle, in the detonation theory and combustion through the control of the ignition conditions, and for environmental improvements through sonic boom reduction.