



# Undergraduate Research Symposium May 17, 2019 Mary Gates Hall

## Online Proceedings

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### POSTER SESSION 1

MGH 241, Easel 143

11:00 AM to 1:00 PM

#### **UAS Operation and Navigation in GPS-Denied Environments Using Multilateration of Aviation Transponders**

*Helen Kuni, Senior, Aeronautics & Astronautics*

*Undergraduate Research Conference Travel Awardee*

*Mentor: Christopher Lum, Aeronautics & Astronautics*

This research involves the design of a system for an unmanned aerial system (UAS) to operate and navigate in an environment devoid of a Global Navigation Satellite System (GNSS) such as the Global Positioning System (GPS). The system operates by interrogating an aviation transponder (either mode C or S) that is carried by the UAS and measuring the time elapsed for the response to multiple, ground-based antennas and using triangulation (multilateration) to locate the transponder and by association, the UAS. The ground-based system then routes this position information back to the UAS via the UAS's data telemetry link. The autopilot then utilizes this position information for navigation in much the same way it would utilize a GPS-based position report. Our research focused on the system architecture to enable a UAS to operate in a GPS-denied environment. Flight test results are presented utilizing a customized version of the popular Pixhawk/ArduPlane avionics platform and demonstrate that the system is capable of guiding a UAS through a series of waypoints in the absence of GPS signals. Furthermore, the customized controller that was designed to consume this alternate source of position information performed well in highly unfavorable environmental conditions. This success illustrates the feasibility of the system as a practical alternative to GPS.

### POSTER SESSION 1

Commons West, Easel 26

11:00 AM to 1:00 PM

#### **Review of EMS Pre-Hospital Patient Protocols: Restraint and De-Escalation Use in Psychiatric Health Emergencies**

*Kosuke Kume, Senior, Public Health-Global Health*

*UW Honors Program*

*Mentor: Christopher DeCou, Psychiatry & Behavioral*

*Sciences, Harborview Injury Prevention & Research Center*

Pre-hospital patient protocols standardize medical procedures for EMTs and increase the quality of care for patients. In Washington state, these protocols vary by county and often contain a section for psychiatric emergencies with variant restraint protocols. The immediate use of restraints in these situations can be seen as dismissive to the patient and can lead to agitation and violence. Verbal de-escalation can enhance provider-patient relations and decrease likelihood of restraints, seclusion, and hospital admissions. The goal of this project was to explore restraint and de-escalation methods used in WA state county-level EMS pre-hospital patient protocols. To complete the project, a codebook was created with binary variables with definitions that determined whether the procedures listed in the protocol satisfied the definition. Using the codebook, each protocol was independently coded by 2 people and disagreements were reviewed by a third person. Finally, we created descriptive statistics from the restraint protocols and stratified based on rurality. Of the 39 counties in WA state, 77% of counties mentioned verbal de-escalation methods in their pre-hospital patient protocol. The de-escalation method with the highest proportion in all counties recommended reassuring the patient that the providers care for them (28%). The second highest proportion in all counties was to mention the use of de-escalation methods without explicit instructions (23%). Counties that do not have specific instructions and just mention the use of de-escalation methods can be confusing if the provider does not have de-escalation training or has not trained recently. These findings highlight the need for future research concerning the adherence of EMTs to these protocols and to see the what the outcomes are of the different protocols. More research can be done through contacting individual EMS agencies to see if internal protocols exist outside of county protocols.

### POSTER SESSION 2

Commons West, Easel 6

1:00 PM to 2:30 PM

### **Method Development for Measurement of Diesel Exhaust Particulate Matter in Household Dust**

*Mae Belle Coker, Senior, Public Health-Global Health*

*Mentor: Christopher Simpson, Environmental & Occupational Health Sciences*

*Mentor: Michael Paulsen, Environmental and Occupational Health Sciences*

Short-term exposure to diesel exhaust particulate matter can cause headaches, dizziness, and irritation of the nose, throat, and eyes. Prolonged exposure has been shown to increase the risk of developing cardiovascular disease, respiratory disease and lung cancer. Because heavy machinery is often fueled by diesel, occupations such as coal miners, truck drivers, railroad workers, and construction workers are at high risk of exposure. Non-occupational exposures are also of concern, especially in locations impacted by high volumes of vehicle traffic. A potential way to determine diesel exhaust exposure is by measuring the amount of nitrated polycyclic aromatic hydrocarbons (NPAHs) in household dust. There is no current method for measuring NPAHs in dust. We conducted a literature review of methods for measuring related chemicals in household dust and measuring NPAHs in other matrices. We tested three different methods before establishing the optimized sample preparation and cleanup process using silica gel solid phase extraction followed by analysis using high performance liquid chromatography with tandem mass spectrometry detection (HPLC/MS/MS). To evaluate method performance we analyzed replicates of spiked and unspiked household dust and silica gel. The method was used to analyze 42 household dust samples collected in two communities – one with expected high and one with expected low traffic-related air pollution. Future research should include comparisons between dust NPAH measurements and other measures of diesel exhaust exposure, including NP (nitropyrene) metabolites in urine, air filter NP, or *a priori* predicted exposure based on home location.

### **POSTER SESSION 3**

**Commons West, Easel 13**

*2:30 PM to 4:00 PM*

#### **Access to Crisis Intervention Resources and Outpatient Psychotherapy via Community Mental Health Clinics in Washington State**

*Margaret Dujuan (Maggie) Gallagher, Junior, Psychology*

*Mentor: Christopher DeCou, Psychiatry & Behavioral Sciences, Harborview Injury Prevention & Research Center*

Mental illness is a national concern; for rural residents, the availability of mental health services magnifies the problem. The 2017 National Survey on Drug Use and Health found close to 1.5 million non-urban residents had psychiatric illness or serious thoughts of suicide during 2017. Hypothesis: In Washington State, there is less access for outpatient

mental health services in rural areas than in urban areas. The 2018 Washington State Directory of Certified Mental Health, Substance Use Disorder, and Problem & Pathological Gambling Services contains 503 entries of mental health facilities. Using the Office of Community Health Systems Series on Rural-Urban Disparities, facilities with available information were categorized as urban or rural. Statistics were calculated to characterize the availability of individual therapy, and crisis intervention information via public-facing websites for included clinics. The association between rural-urban status and the availability of outpatient psychotherapy and crisis intervention contact information was tested via the chi-squared test of independence. Approximately half (n=131, 50.6%) of clinics with available information regarding outpatient psychotherapy indicated that these services were available. Similarly, nearly half (n=120, 46.1%) of clinics with available information had crisis lifeline information presented via their public-facing website. There was no significant association between urban-rural status and availability of outpatient psychotherapy services ( $\chi^2=0.21$ ,  $p=.647$ ), nor between urban-rural status and publicly available crisis lifeline information on mental health clinic websites ( $\chi^2=0.80$ ,  $p=.371$ ). Washington State rural clinics are not significantly different from urban clinics with respect to saying they provide outpatient psychotherapy and crisis lifeline information. Limitations include methods relying on public reporting of services and limited scope, not allowing the study of other factors that might affect rural residents, such as distance traveled to obtain care. Rural counties in Washington State do not differ from urban counties with respect to the presence of clinics providing outpatient psychotherapy.

### **POSTER SESSION 4**

**Commons East, Easel 60**

*4:00 PM to 6:00 PM*

#### **Modeling Firn Densification to Improve Paleoclimate Research and Predict Sea Level Rise**

*Tova Samantha Beck, Junior, Architectural Design*

*Mary Gates Scholar, NASA Space Grant Scholar, UW Honors Program*

*Mentor: Edwin Waddington, Earth And Space Sciences*

*Mentor: Christopher Stevens, Earth and Space Sciences*

The study of firn is integral to determining past climate from ice cores and calculating present and future melt runoff from ice sheets. The Herron and Langway model is a semi-empirical firn densification model. While the model's simplicity makes it easy to use, it assumes constant temperatures and accumulation rates, but Earth's climate is changing. The goal was to recalibrate the model by adding data from new ice cores to a gap in the model's dataset to create more accurate depth-density curves. Preliminary results show the recalibration is a better fit for 57 percent of depth-density profiles. The

recalibration could help determine melt runoff, informing sea level rise forecasts. The recalibration could also increase the precision of timing between past CO<sub>2</sub> and air temperature changes.