Undergraduate Research Symposium May 18, 2018 Mary Gates Hall

Online Proceedings

Poster Session 2

MGH 258, Easel 183

1:00 PM to 2:30 PM

Lunar Swirls: Thermal Properties of Lunar Regolith and its Application

Shao Chih Ma, Senior, Earth & Space Sciences (Physics)
Mentor: Erika Harnett, Earth & Space Sciences

Since the Apollo era, the question has remained where lunar swirls (high albedo regions coincident with regions of surface magnetization) originated from. Different ideas have been proposed for their origin. Our study focuses on one of these ideas that the reason lunar swirls have a higher albedo relative to the surrounding regions is because it deflects incoming solar wind particles. This can result in darkened or weathered lunar surfaces. We have used spectro-imaging to observe the thermal properties of lunar regolith (fine grained material on the surface of the moon) in a high temperature environment via nichrome wire to simulate this occurrence. With the spectro-images we are able to observe to great magnification the physical properties of the regolith of two particular grain sizes. The nichrome wire is woven into a shape that can cover an area of lunar regolith. A current is run through the wire allowing it heat up quickly. The study thus far shows evidence of the lunar regolith possessing an amount of water, raising its heat capacitance, giving a more resistive property. The regolith itself is able to retain a considerable amount of heat after heating with nichrome wire and remains widely on the surface layer of the regolith. These properties are necessary to quantify prior to the alteration of the regolith simulant by a directed plasma beam. This study will provide a baseline to qualitatively assess the alteration relative to our study.

Session 2S

Hot Topics: Robots, AR, CV, AI

Session Moderator: Kurtis Heimerl, Computer Science and Engineering

JHN 175

3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

What Happens When You Take an Artificial Intelligence to a Music Studio?

Austin Abeyta, Senior, Computer Science & Software Engineering
Mentor: Erika Parsons, Computing and Software Systems

Music has been heavily dependent on computers since the 80's, and with each new advancement in computers, new advancements in music soon follow. I asked myself how will the future of pattern recognition affect the music industry? This paper explores how complex pattern recognition systems, specifically artificial neural networks, might affect the next advancements in music. Melodies from hundreds of popular songs from multiple genres were analyzed by a neural network. Everything from "Tiny Dancer" by Elton John to "I'm a Barbie girl" by Aqua were used to train the network. By having the neural network produce midi tracks, I was able to import them into a professional music producing program, named Logic Pro. The neural network's songs were then produced as if they were generated by an artist paying for studio time. The final song was uplifting, melodic and entertaining. This demonstrates the effectiveness of neural networks as a creative musical tool. The model I propose is an improvement on an existing model, an encoder to decoder neural network written in TensorFlow. Because of music's heavy dependency on previous events LSTM(Long Short Term Memory) cells were used. To improve preprocessing I considered transposing all of the songs to the same key, C-major, this restricts the model to track less notes by limiting the scale, while still maintaining the melody of the song. I found that working with a batch of short midi loops generated by the network worked best for creative output.

Poster Session 3

Commons East, Easel 55

2:30 PM to 4:00 PM

Investigating Garbage Collection Design in D

Jeremiah Michael De Haan, Senior, Computer Science & Software Engineering
Mentor: Erika Parsons, Computing and Software Systems

Garbage collection is a method of performing automatic memory management which generally leads to less complex and more maintainable source code, but it has a cost of performance hits and pause times. The D programming language

is a newer high-level general-purpose programming language which relies on a garbage collector for several language features, though it consistently receives criticism for this decision due to perceived loss in performance. To increase the efficiency of D's garbage collection procedures, two ideas are explored: using an alternate layout for objects in memory and eliminating the requirement for pause times under certain conditions. The first prototype explores storing objects in memory based on type and not by size, allowing the system to take advantage of type information while caching it at the same time. The second prototype takes this idea and then explores implementing a collection cycle in such a way as to run concurrently with the user program so long as the machine can continue to fulfill allocations. Both prototypes are compared against D's existing garbage collector using benchmarking tests provided by the language maintainers. These comparisons examine memory usage, allocation time, pause time, scan time, sweep time, and total running time, using an AMD R5 1600X 3.6 GHz and Intel core i7-6800 3.4GHz on Ubuntu 16.04, and an AMD R51600X 6-core 3.6 GHz and Intel i7-4790 4-core 3.6GHz on Windows 10. The findings will show if alternate memory layout allows for new optimizations for allocations and collection techniques and if preventing a total stop-the-world period is worth the overhead costs of synchronizing the garbage collector and program threads.

POSTER SESSION 4

MGH 258, Easel 188

4:00 PM to 6:00 PM

Estimating Small Mammal Density in Boreal Forests Using Camera Traps and Live Trapping Methods

Alishia Elizabeth Orloff, Senior, Environmental Science & Resource Management
Mentor: Mitchell Parsons, School of Environmental Forest Science
Mentor: Laura Prugh, School of Environmental and Forest Sciences

Abundance estimates are integral to wildlife management. In many cases however, abundance estimates are difficult to obtain due to excessive labor and costs. Alternatively, abundance indices can provide representative measurements of relative abundance. Furthermore, cameras are a convenient tool to obtain estimates of relative abundance using capture frequencies as indices, though are predominantly used on larger animals. Small mammal abundance is commonly used to measure for forest health, diversity, and prey availability, though is generally dependent on the use of live trapping. Broadening the application of camera traps can prove to develop better indices for abundance analyses. Through this study, we examine different indices of small mammal abundance to determine whether camera trap data can be used as an index of small mammal abundance. Using data collected from the field, an abundance estimate based on live trapping of mice, voles, and chipmunks is compared to our camera trap estimates of these three species. We tested three possible small mammal indices, two of which were camera based: proportion of cameras detecting a species, number independent detection events, and number of animals live captured on the first night. Each of the three indices that were tested gave an estimate of abundance which we compared with the live-capture density estimate to determine relative accuracy. The proportion detected estimate and the first night capture estimate were significantly correlated to the estimated population abundance of each species. The low population of voles influenced the results and are discussed further. This data may contribute meaningful data for future wildlife abundance analyses. By gaining an understanding of reliable indices, we are able to make better considerations for wildlife management decisions.