



STUDENT RESEARCH DAY

Student Research Conference

Online Oral Abstract

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➤ **Natural Sciences**

Natural Sciences

Michelle Mohr, Graduate Student

Tree - Ring Growth Response of Pinus Ponderosa (PIPO) to Climatic Variability in Prescott National Forest, Arizona

Faculty Mentor: Parveen Chhetri, Earth Sciences

Warming temperatures across the Southwestern U.S. have posed a significant threat to the future of our forest ecosystems. Climate change has altered forest populations around the globe, with a record-breaking fire season currently taking place across the Southwestern U.S. An increase in fire activity, season length, and intensity in the region has been attributed to an extended dry spell that has produced some of the hottest days on record. Trees across the region are responding to these extended periods of aridity with high mortality rates, as well as changing annual radial growth patterns. To understand how detrimental these extreme conditions have been to the forest ecosystem, study plots were established in Prescott National Forest, Arizona, to collect tree-ring cores. These cores were analyzed using the standard dendrochronology procedures of collection, measurement, cross dating, and statistical analysis in order to determine the impact that severe droughts have had on the Ponderosa pine (*Pinus ponderosa*) population of the Southwest. Dendrochronology has long been used to understand forest dynamics, therefore using tree rings from Ponderosa pine (PIPO), one of the most populous tree species in the American Southwest, we can understand how this unprecedented era of climate change has impacted radial growth and the ultimate longevity of forest productivity.

Stacy Zamora, Graduate Student

Neurobiological Correlates of Substance Use Disorder: Disrupted Δ FosB protein expression in the PFC and NAc of Ethanol and Cocaine-Exposed Male and Female Rats

Faculty Mentor: Philip Viera, Psychology

Substance Use Disorder (SUD) is a chronic relapsing disease associated with long-lasting neurobiological alterations in the brain's mesolimbic reward pathway. In particular, alcohol is widely abused throughout the world, attributing to 3 million deaths a year, an increased societal financial burden, and poor health outcomes in alcoholics. Additionally, the rate of cocaine abuse, has been rising in the USA, creating an economic and healthcare burden. The exact mechanisms behind SUD are still being investigated. However, as sex differences in SUD expression exist, it is of importance to determine the interaction of molecular factors with biological sex. To understand the pathogenesis of SUD, we focused on a neuronal transcription factor implicated in drug abuse called Δ FosB. Ongoing research has shown that Δ FosB is involved in long lasting alterations of neural pathways that support the chronic and relapsing nature of SUD. We focused on two subregions of the reward pathway, the prefrontal cortex (PFC) and the nucleus accumbens (NAc). To measure Δ FosB, we first obtained brain tissue from adult male and female Sprague-Dawley rats that were exposed to cocaine under four different conditions: control (saline), acute intoxication, short-term withdrawal, and long-term withdrawal. We isolated two subregions of the reward pathway, the prefrontal cortex (PFC) and the nucleus accumbens (NAc), by taking 50 μ m coronal sections of the brain. We then performed immunohistochemistry on these sections to label neurons possessing Δ FosB. Sections were then imaged under epifluorescent microscopy and automated cell counting was performed on the images taken using ImageJ. In each group, the number of Δ FosB -positive neurons was assessed within the ventrolateral PFC, ventromedial PFC, and the NAc. When performing a single factor ANOVA, we observed a difference in the amount of Δ FosB -positive cells in all experimental groups ($p = 0.05$). Additionally, when comparing the amount of Δ FosB - positive cells in the regions themselves, there was a statistical difference observed only in the ventromedial PFC ($p < 0.01$). Post Hoc testing was performed and confirmed statistical differences for amount of Δ FosB -positive cells in the ventromedial PFC. These preliminary results indicate that there is an association between cocaine use and the amount of Δ FosB present in the mesolimbic pathway. Further analysis will be performed to compare sex differences in the number of Δ FosB -positive cells in the different treatment groups. Overall, these new insights can lead into possible treatments that target transcription factors in those suffering from SUD.

Shinaola Agbade, Graduate Student

Efficient Greedy Algorithm for Virtual Network Function Placement

Faculty Mentor: Bin Tan, Computer Science

Recent advances in virtualization have allowed for networking solutions to be far more scalable than traditional solutions which were widely in use. These solutions required the use of middleboxes in order to implement network function. With virtualization, these solutions, termed virtual network functions, are much more cost effective relative to traditional middleboxes.

Placement of virtualized network functions within a fat tree data center topology is useful in today's technological climate as more network functions are becoming virtualized, thanks to containerization. In this study, a greedy virtual network function placement method is proposed and compared to the previously established random placement. It is observed that the total cost of the greedy method has been less than the random placement and that the performance improves as the amount of placement increases relative to random placement. This can be attributed to the greedy method always choosing the location which results in the lowest possible amount of hops. When paired with the communication frequencies of the pairs, it will guarantee that the total cost of the greedy placement will be either equal to or less than the random placement of the VNF. While the greedy placement of the VNF within a fat tree topology was investigated, it would be interesting to see the performance of both approaches with other proposed topologies.

Sterling Abrahams, Graduate Student

SAM: Maximizing Service Function Chain Availability in Cloud Data Centers

Faculty Mentor: Bin Tang, Computer Science

Service function chaining (SFC), which consists of a sequence of virtual network functions (VNFs), provides effective and flexible network service management in a cloud computing environment. Due to the vulnerabilities of software-implemented VNFs, existing research has introduced VNF backup servers to achieve the fault-tolerance of VNFs and to improve the availability of SFCs. However, they either do not consider the failures of backup servers or do not aim to maximize the availability of the entire SFC. In this paper, we study how to maximize the availability of an SFC considering that both VNFs and backup servers can fail. We refer to the problem as SAM: service function chaining availability maximization problem. Given an SFC and a set of backup servers placed inside a cloud data center network, the failure probabilities of the VNFs and the backup servers, the goal of SAM is to assign backup servers to VNFs to maximize the availability of the SFC while satisfying the backup capacity constraint of the servers. We design a suite of optimal and efficient algorithms to solve SAM. Via extensive simulations with different network parameters, we show that our work outperforms the existing research by up to 21.7%, demonstrating the effectiveness of our algorithms in achieving high SFC availability in cloud data centers.