

Tracking Spatio-Temporal Changes in Coastal Wetlands of Lakes Using High-Resolution Remote Sensing and Machine Learning

The project delivered several significant outcomes that advanced the understanding of wetland boundary dynamics near Fish Lake and other surrounding lakes. During the training and validation process, the Random Forest classifier was optimized by identifying the ideal number of trees based on accuracy, ensuring the model's robustness and reliability in distinguishing between wetland and non-wetland areas. Temporal analysis of changes in wetland boundaries from 2015 to 2023 revealed trends in land cover through visualizing the counts of water and land pixels, offering valuable insights into the impacts of environmental and anthropogenic factors. Additionally, feature importance analysis ranked spectral indices, such as the Normalized Difference Water Index (NDWI), by their contribution to classification accuracy, with NDWI emerging as the most influential feature and demonstrating its utility in wetland delineation. Furthermore, reflectance statistics, including minimum and maximum values, were assessed to ensure data quality, highlighting the integrity of the input data and its suitability for machine learning applications. Collectively, these results showcased the effectiveness of combining satellite imagery with machine learning for large-scale ecological monitoring and provided a solid foundation for informed wetland conservation and management efforts.

The project successfully met its primary objectives of developing a machine-learning model and quantifying wetland boundary changes. The use of high-resolution satellite imagery allowed for better spatial resolution, addressing the limitations of conventional field observations and photo interpretation. While challenges arose, such as processing large datasets and ensuring model accuracy, these were mitigated through iterative model training and validation with high-quality ground truth data.

Additionally, the project fostered collaboration between myself and my mentor, leading to innovative solutions for algorithm development and data visualization. The use of Fish Lake as the study site provided valuable insights into how anthropogenic and environmental factors influence wetland dynamics.

Participating in the Undergraduate Research Scholarship program has been an incredibly enriching and awarding experience. My mentor provided me with ample support throughout the duration of my research experience, fostering an environment that encourages exploration, experimentation and learning. This mentorship was instrumental in my development as an academic, as it offered me the guidance and feedback I needed to navigate my first experience in research.

One of the most rewarding aspects of my URS experience was the opportunity to apply the knowledge I gained from my computer science courses to practical scenarios. This application not only deepened my understanding of theoretical concepts but also enhanced my problem-solving skills which are key to a computer scientist. I was able to tackle real-world challenges and see the direct impact of my work, which was both motivating and fulfilling.

Additionally, my mentor encouraged me to broaden my horizons in various fields where computer science can be applied. The exposure allowed me to explore interdisciplinary connections and appreciate how my skills can contribute to different domains. It was eye-opening to realize that the principles of computer science are not confined to traditional boundaries; they extend into areas such as machine learning, data analysis, environmental science, and beyond.

The practical experience I gained through this program has been invaluable. It equipped me with essential skills and insights that will undoubtedly benefit my future endeavors, both academically and professionally. I feel more prepared to face challenges in my career, knowing that I can leverage my knowledge in diverse ways. Overall, my URS experience has been transformative, providing me with the support, knowledge, and practical experience that I will carry forwards in my journey as a computer scientist.