Correlating Surface Water Quality and Spectral Reflectance with small Unmanned Aerial System (sUAS)-Collected Imagery[1]

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Abstract: Remote sensing is the science or art of obtaining information about an object on Earth's surface without encountering it. Every object has a unique spectral signature, which is determined by measuring the amount of solar energy reflected off the surface of the object (spectral reflectance). This information can be used to examine vegetation health, surface water quality, and land cover characteristics. The purpose of this project was to correlate the spectral reflectance of surface waters in passive treatment systems (PTS) to the measured *in-situ* water quality at the time of flight, with the goal of developing statistical models capable of predicting *in-situ* surface water quality thus minimizing the need for laborious and costly surface water quality sampling and analyses. The specific sUAS utilized for this research was the Aerial Technologies International (ATI) AgBot, paired with the MicaSense RedEdge Multispectral sensor. This sUAS can operate autonomously and capture extremely high-resolution (centimeter scale) multispectral imagery at five discrete bandwidths within the electromagnetic spectrum. As part of a larger project, the sUAS was used to evaluate surface water quality in two PTS located in the Tri-State Lead-Zinc Mining District: Mayer Ranch and Southeast Commerce Passive Treatment Systems (MRPTS and SECPTS), respectively. Thus far, the correlation coefficients (R) for interpolated water quality (e.g., aluminum, iron and lead concentrations) and spectral reflectance ranged from -0.49 to 0.61. Linear models produced regression coefficients (R^2) of 0.31, 0.13, and 0.23 for aluminum, iron, and lead, respectively. These relationships represent preliminary results and will be improved as future work is completed. Future work for this study includes examining varying pixel window size (e.g., how many pixels are represented by a single surface water sample), determining an appropriate time window, performing a more extensive *in-situ* sampling event, and investigating the correlation within all components of the PTS.

Additional Key Words: Remote Sensing, Passive Treatment Systems, Statistical Models, Interpolation

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