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Math Department Talk

Title: Application and Use of Vegetation and Radiometric Indices for Vegetation Analysis

Abstract:

Radiometric and vegetation indices are widely used as a way to monitor vegetative health. The most common index for assessing vegetative health is the normalized difference vegetation index (NDVI) which simply represents the ratio of the difference between the red and near infrared portions of the electromagnetic spectrum (EMS). NDVI is calculated as follows:

$$NDVI = \frac{NIR - R}{NIR + R}$$

where NIR and R equal the spectral reflectance measurements acquired in the near-infrared and red portions of the EMS. Due to the nature of the calculation, NDVI values range from -1 to +1. In this talk, we will discuss the use of NDVI, as well as the use of several other indices. One of the largest drawbacks of most currently used vegetation indices is their reliance on using the NIR portion of the EMS. This is in large part due to the fact that leaf cells re-emit solar radiation in the NIR portion while absorbing in the R portion of the spectrum. The result is that live green plants appear “bright” in the NIR portion of the EMS. A significant drawback to these techniques exists in the limitation of sensors typically equipped on out of the box Unmanned Aerial Systems (UAS). To that end, we will present several NON-NIR based vegetation indices suitable for use with UAS systems and discuss the pros and cons of each one. The last index we will discuss is the Visible Vegetation Index (VVI), and some modifications that we have made to increase its effectiveness while using high-resolution UAS imagery. The original VVI takes on the form:

$$\mathrm{VVI} = \left[\left(1 - \left|\frac{\mathrm{R} - \mathrm{R}_o}{\mathrm{R} + \mathrm{R}_o}\right|\right)\left(1 - \left|\frac{\mathrm{G} - \mathrm{G}_o}{\mathrm{G} + \mathrm{G}_o}\right|\right)\left(1 - \left|\frac{\mathrm{B} - \mathrm{B}_o}{\mathrm{B} + \mathrm{B}_o}\right|\right)\right]^{1/w}$$

where R,G,B are the Red, Blue, Green components of the image, RGB_o is a vector of the reference green color (RGB_o (30, 50, 0), and w is a weight exponent to adjust sensitivity of the scale. (PHL, 2017). Vector values were determined for satellite imagery, and needed modification to work with high resolution models. Ponti (2015) has suggested vectors of 40,60, and 1o, and w=1. We will finish by discussing modifications to the VVI formula for use specific to high resolution UAS imagery.