Estimating Soil Water Content with Color Calibration Method in the Image of Remote Sensing by Unmanned Aerial Vehicle

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From the previous research results, there are many methods for measuring soil water content (SWC), but most of the SWC measurement methods are destructive methods for soil structure. Moreover, it takes a lot of time and manpower. In recent years, the method of estimating SWC from digital images of unmanned aerial vehicle (UAV) is a novel and rapid for measuring SWC non-destructive. While estimating SWC in the field using digital images, the effects are produced sunlight and climates and setting of the camera white balance. While estimating the SWC by digital images, these influences will let these methods have a bias between the hue value of digital images and the color of actual soil. So, the purpose of this study is to add a color calibration method while the process of estimating to remove the influences of sunlight, climates and white balance of camera, to improve the accuracy of estimating SWC by digital images.

At first, this study collected the surface soil samples from 0 to 5 cm below the ground surface at the study site which is the sampling range of in-situ planning. A standard color card (ColorChecker) is placed at the study site as a basis for image color calibration. After that, this study used UAV to take a photo-shooting at 30 meters above the ground, and obtain the digital images of the study site. After the sampling is completed, the surface soil sample is obtained its gravimetric water content by thermogravimetry in the laboratory. Next, the digital images taken by the UAV is used to cut the study area and image color calibration using the image processing software.

Then, using Matlab 2018b software to calculates the hue value of RGB color space (Red (R), Green (G), and Blue (B)) of the digital images before and after the color calibration separately, and transforms them into other six color spaces (normalized RGB, HIS, I1I2I3, Lab, YCbCr, and Lch). At last, this study used multiple linear regression to establish the SWC estimation models separately, and then compare the influences which before and after color calibration.

The results of this study show the influences of sunlight, climates and white balance of camera make a significant bias when estimating SWC using the digital images before color calibration. However, this study which added color calibration improves the accuracy in the estimation of SWC by digital images. Finally, the achievements of this study can apply in reducing the number of water resources of the agriculture irrigation widely.

Keywords: Surface soil, Aerial photo-shooting, Digital image processing, Color calibration

