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A Soil Moisture Estimation Using Multiple Color Spaces in Digital Image Analysis

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Many researchers investigate time-efficient methods for soil moisture measurements, such as image analysis through reflectivity and remote sensing. However, when such methods are applied in soil moisture estimations, the obtained data are not always precise and specified. A recent study employs the distributions of different soil particle sizes in such estimation models in order to improve their accuracy (Ghanbarian et al., 2015). Nevertheless, this methodology leaves space for development; therefore, it presents different advantages and weaknesses for each model. This study evaluates two different categories of soil particle sizes so to estimate soil moisture with a digital imaging method for deducing seven color spaces (Fatemeh, 2018).
Specifically, this research uses two soil samples of #60 sieve (0.420 – 0.250 mm), and #100 sieve (0.250 – 0.149 mm) in different particle sizes as two categories for moisture analyses. First, each soil sample of two categories is soaked in water until saturation. Then, put in a darkroom with a fixed light source to dry naturally. The soil moisture of the samples are measured by the loss of the weight; the frequency of weighting is every ten minutes until the weight presents a stable condition. At the same time of weighting, images of soil samples are taken by using a digital camera. Finally, the obtained images are analyzed by means of picture parameters of 21 elements from 7 color spaces (RGB, normalized RGB, HIS, I1I2I3, Lab, YCbCr, and Lch). And higher elements which have high correlations between soil moisture and hue values were taken to put in the estimated model to do training and testing. After the training process, this research put another non-repetitive data into the equations to check the results. And that these results compared with using three existing models (Zheng et al., 2005; Magnus, 2005), GBHS, RGB, and SV models.
Compared to existing models, non-existing models still have its accuracy and it let this study more feasible in different kinds of soil type. In addition, the sample of particle size #60 sieve and mean of hue obtains the best correspondence to estimate the soil moisture. However, the results of #100 sieve are equally well, and both two kinds of samples confirm the feasibility of this methodology.
By proving the feasibility of digital imaging for soil moisture measurements, this research can provide valuable results in this research field. Moreover, the promising benefits in time and resource efficiency could be a further study to investigate more different kinds of soil types.

Keywords: Digital imaging, Color differentiation analysis, Remote sensing, Soil moisture