A Supervised Machine Learning Approach for the Inversion Process to Retrieve Soil Moisture

Himangi Srivastava [(1)], Dr. Mehmet Kurum* [(1)]
(1) Mississippi State University, Mississippi State, MS 39762

In this paper, a forward model followed by an inversion modeling approach is implemented to retrieve soil surfaces parameter namely soil moisture for the given set of corn vegetation data. We apply the methodology to the field data acquired during the entire growth cycle of a cornfield in 2012. The data set contains information about the vegetation and ground parameters as well as microwave brightness temperature observations. The significance of this methodology is that inversion algorithm can provide desired and a similar resolution estimate of soil moisture and having a proper estimation of soil moisture with good resolutions are required for efficient hydrological modeling and improved soil wetness forecasts.

The forward model algorithm is based on the first order radiative transfer that takes various inputs such as vegetation geometrical and dielectric values, and ground moisture and roughness values. It utilizes the formulations that describe the relationship of different input parameters of the vegetation with the theoretical representation of absorption and scattering within the canopy and thus provides the evaluation of the derived emissivity for corn canopies. The inversion model is based on few parameters that are the vegetation water content, emissivity values, and the effective scattering albedo.

Our first task is to obtain the set of effective scattering albedo after we train the inputs of the corn in-situ data into the forward model. We will obtain a set of effective scattering albedo generated for horizontal and vertical polarization respectively for each vegetation stage. We will then execute the inversion process.

Our first step of the inversion process would generate the single value of effective scattering albedo for each vegetation stage that will be acting as an input for the final step. For the final stage, we would be using the output obtained by the previous step along with the data provided by the experiment that is namely vegetation water content, and emissivity value. These two steps will use various supervised machine learning like multiple layer perceptron and regression analysis to give the estimate of soil moisture as our final output.

The multi-layer neural network (NN) architecture is implemented to retrieve this single value of effective scattering albedo. The single value fits all the obtained effective scattering albedo values derived by simulating the forward model for each vegetation separately. We will be presenting the value of the single value of effective scattering albedos that will be obtained for each vegetation stage, and we will show the contributions of the methodology to improved soil moisture retrieval over the dynamic agricultural field.