Public Abstract

First Name:Keyden
Middle Name:Kriens
Last Name:Turner
Adviser's First Name:John
Adviser's Last Name:Bowders
Co-Adviser's First Name:
Co-Adviser's Last Name:
Graduation Term:FS 2015
Department:Civil Engineering
Degree:MS
Title:Predicting Surface Water Profiles in Sand

Electromagnetic (EM) wave methods are used in many civil engineering applications for non-destructive investigations such as locating reinforcing steel and voids in concrete, sinkholes, buried utilities, the groundwater table, seepage through dams and determining the thickness of pavements. All of the applications depend on knowing the velocity of the EM wave through the material of interest. The velocity of EM waves through a vacuum is equivalent to the speed of light; however, as a material's ability to hold a charge increases (ability to be a capacitor), the velocity of the EM wave is slowed through that material. The relative permittivity (dielectric constant) of a material is a measure of a material's ability to hold a charge. Knowing the relative permittivity enables one to calculate the velocity of an EM wave through the material. The goal of a larger research program is to predict the relative permittivity of soils. A principal factor determining the relative permittivity of soil is the water content of the soil. In order to predict accurate relative permittivity for a soil, the water content of the soil must be known. The objective of the research project reported in this thesis was to choose a method to predict the water content of a soil and to quantify the accuracy of the method.
The focus of the larger project is on the earth's near subsurface, 0 to about 1 m below ground surface. This depth is often characterized by alternately wet (saturated) to dry pores within the soil and is referred to as the vadose zone. Knowing the soil water condition at any time is paramount to being able to predict the relative permittivity and

subsequently the velocity of EM waves through the soil. A computer code was selected to be used to predict the soil water along a vertical profile in the vadose zone. WinUNSAT-H, a Windows®-based version of the code UNSAT-H was used to model the subsurface and predict vertical soil water profiles as a function of time. Inputs into WinUNSAT-H include soil properties and atmospheric conditions. The code was used to predict soil water profiles for a column of sand which was constructed in the laboratory where physical experiments were performed to alternately saturate and then drain the water from the sand column and measure the actual soil water profile. The results of the predicted soil water were then compared to the measured water profile for the sand column.
The code was used to predict the soil water profile during draining (drying or dewatering) of the sand column. The sand had a saturated hydraulic conductivity of 0.04 cm/second which is a high hydraulic conductivity and leads to rapid drainage of water from the column of sand. The saturated volumetric water content of the sand was 0.35 (all pores in the sand are filled with water) and the residual volumetric water content was 0.05 (volumetric water content at which no further water will drain from the sand under gravity, i.e., a pressure must be applied to the sand to force any more water from the sand). After the sand was saturated with water, the water source was removed and the water in the pores of the sand was allowed to drain. The 160 cm column of sand drained to nearly the residual volumetric water content within 15 to 30 minutes. After two hours of drainage, the column of sand was essentially at the residual volumetric water content throughout the entire column.