Soil Parameter Estimation and Analysis of Bistatic Scattering X-Band Controlled Measurements

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To date only very few bistatic measurements (airborne or in controlled laboratories) have been reported. Therefore most of the current remote sensing methods are still focused on monostatic (backscatter) measurements. These methods, based on theoretical, empirical or semi-empirical models, enable the estimation of soil roughness and the soil humidity (dielectric constant). For the bistatic case only theoretical methods have been developed and tested with monostatic data. Hence, there still remains a vital need to gain of experience and knowledge about bistatic methods and data. The main purpose of this paper is to estimate the soil moisture and the soil roughness by using full polarimetric bistatic measurements. In the experimental part, bistatic X-band measurements, which have been recorded in the Bistatic Measurement Facility (BMF) at the DLR Oberpfaffenhofen, Microwaves and Radar Institute, will be presented. The bistatic measurement sets are composed of soils with different statistical roughness and different moistures controlled by a TDR (Time Domain Reflectivity) system. The BMF has been calibrated using the Isolated Antenna Calibration Technique (IACT). The validation of the calibration was achieved by measuring the reflectivity of fresh water. In the second part, the sensitivities of the bistatic surface scattering to soil moisture and surface roughness will be discussed. Then, the validation of the specular algorithm by estimating the soil moisture of two surfaces with different roughness scales will be reported. Additionally, a new technique using the coherent term of the Integral Equation Method (IEM) to estimate the soil roughness will be presented, as well as evaluation of the sensitivity of phase and reflectivity with regard to moisture variation in the specular direction.