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Polarimetric SAR Data And Crop Monitoring

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Abstract

The aim of this paper is to make a review of the agricultural remote sensing applications using SAR data. The advancement of remote sensing technology is advantage for conducting efficient crop classification and mapping efficiently.The fundamental aim of application of remote sensing in crop monitoring is to conclude crop characteristics by examining the data included in the dispersed signal.SAR data is used to monitor the plant growth and estimate the plant's biomass.Polarimetric SAR data and Crop Monitoring plays an important role in ecosystem mechanisms.Polarimetric data analysis is use to obtain a number of polarimetric parameters. These parameters represent and bring out the scattering properties of the various features of the earth. C -band polarimetric SAR and crop classification is estimated by observing or measuring several different properties or applications processes.The study facilitated us to learn about the use of the polarimetric SAR to perform a crop monitoring over agricultural areas.

This paper outlines some of the remote sensing based techniques for crop mapping and reviews briefly the status of some recent methods. Synthetic Aperture Radar (SAR) systems have become increasingly popular in the field of crop monitoring and classification.

Keywords: Polarimetric SAR data, Crop growthmonitoring

1. Introduction

Microwaves were chosen for remote sensing applications due to their numerous advantages. This part of the spectrum has unique capabilities for remote sensing objects in the day as well as night.

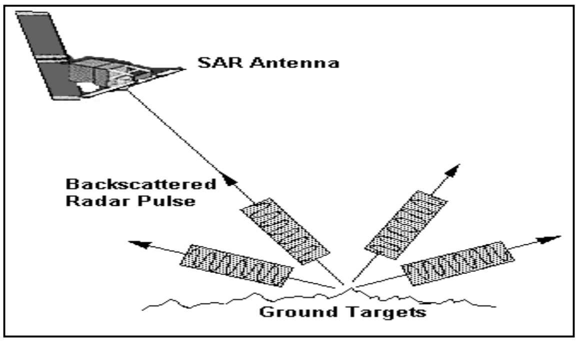

Fig.1.*Radar transmits a pulse measures a reflected eco,Satellite measures reflected echo(backscatter).*

These waves can penetrate through clouds and penetrate, acquiring images in any weather. Not only they can transmit through water but can penetrate vegetation canopy which is useful for studying surface water or flood extent. The microwave ranges are often referred to as the different frequencies bands: S, C, X, Ku, K, Ka (IEEE radar band)[1].

Remote sensing is a technique to observe the earth surface or the atmosphere from out of space using satellites (space borne) or from the air using aircrafts (airborne). Remote sensing uses a part or several parts of the electromagnetic spectrum. It records the electromagnetic energy reflected or emitted by the earth's surface. The amount of radiation from an object (called radiance) is influenced by both the properties of the object and the radiation hitting the object (irradiance). Remote sensing is a technique of obtaining information about objects through the analysis of data collected by special instruments that are not in physical contact with the objects of investigation.

Remote sensing imagery has many applications in mapping land-use and cover, agriculture, soils mapping, forestry, city planning, archaeological investigations, military observation, and geomorphological surveying, land cover changes, deforestation, vegetation dynamics, water quality dynamics, urban growth, etc.[2].

The field of remote sensing has a long history of image classification [3].

It is driven by the need for high accuracy maps and, more fundamentally, for the development of conceptual and predictive models for understanding Earth's system processes [4,5].

Synthetic Aperture Radar (SAR) is a space borne radar which gains a photograph of the ground below using transmission and reception of electromagnetic energy. A SAR system fabricates a two-dimensional image of the electromagnetic scatters within a scene wherein each pixel in the image has corresponding assortment and cross-range values. SAR images are that the quality of image does not depend on specification or light conditions and images can be taken at any part of the day and in any specification [6].

Crop identification and crop planting area mapping are the most basic applications of agricultural SAR remote sensing. Locations and distributions of crops are essential for many applications, such as crop parameters estimation and crop forecasting, as well as drought, flood and disease risk analysis.Synthetic aperture radar (SAR) is an effective and important technique in monitoring crop and other agricultural targetsbecause its quality does not depend on weather conditions. SAR is sensitive to the geometrical structures and dielectricproperties of the targets and has certain penetration ability to some agricultural targets. The capabilities of SAR foragriculture applications can be organized into three main categories: crop identification and crop planting area statistics, cropand cropland parameter extraction, and crop yield estimation.With the increasing availability of SAR imaging modes(e.g., PolSAR, Compact SAR, PolInSAR, Two-station/Multi-station SAR, TomoSAR, and 3D/4D SAR), the SAR data sources available for agricultural remote sensing are increasingly growing. The new generation of SAR can solve many problems that the traditional SAR faced, such as a long revisit cycle, a low spatial resolution, and only obtaining the backscattering information.SAR remote sensing can use different imagingparameters, such as the incident angles and the polarization configurations of the sensor, to obtain a wealth of information. The cropland parameters extracted using SAR remote sensing are mainly the cropland surface roughness and soil moisture. Surface roughness is an important parameter for distinguishing different crop types [7-10].

2. Literature Review

Detection and recognition of plant illness and preparation for efficient manage estimations are important to sustain crop production. One of the possible appliances of remote sensing in farming is the estimation of crop acreage and recognition of crop situation because of either water stress or pest. Vigorous plants provide an elevated reflectance in the near-infrared area and an inferior in the observable area. Illness influenced plants demonstrate an elevated reflectance in the perceptible band and a minor in infrared area. This theory can be employed in discerning vigorous and infected crop. With the aid of satellite and digital imaging methods, it is simple and also price efficient in planning and observing the crop situation [11].

Synthetic aperture radars and multispectral sensors revolving around earth capture information in different ranges of the electromagnetic spectrum and offer complementary information about the area being imaged. Therefore, SAR-optical image fusion is an important research topic in the field of remote sensing. Spatial/ spectral distortions and misregistration are the major challenges in this field. Image fusion methods are specific to a data set and require fine tuning of parameters of the fusion algorithm because of differences in sensor geometry, polarization, frequency and resolution [12].

Polarimetric parameters had a far greater influence than linear polarizations, because that with clear physical meanings, these parameters are sensitive to crop biophysical parameters.

SAR sensors tend to capture ground targets' structural characteristics (e.g. height, bulk amount, and texture) which are distinctive amongst crop classes during the peak biomass stage. Accurate and timely information on the distribution of crop types is vital to agricultural management, ecosystem services valuation and food security assessment. Synthetic Aperture Radar (SAR) systems have become increasingly popular in the field of crop monitoring and classification [13].

Fully polarimetric SAR systems transmit and receive both horizontal and vertical waves. This allows to measure the radar cross section (RCS) of the illuminated target that characterizes the backscattering property of the target: it's size, shape and orientation. Polarimetric SAR responses are an effective way to characterize the polarization properties of microwave backscattering. The polarimetric response is interpreted according to the contributing scatterers. Extraction of polarimetric responses was used to interpret and recognize the scattering mechanisms of different natural and manmade targets. Both the copolar and crosspolar responses are powerful tools to provide information on the dominant scattering mechanism. In the copolar case the same polarizations are used for transmitting and receiving, while in the cross polar case, the receiving polarization is orthogonal to the emitted polarization [14].

Due to the polarimetric radar sensors (ENVISAT ASAR, ALOS-PALSAR, TerraSAR-X and RADARSAT-2), it is now shown that the accelerated advancement of POLSAR techniques is of direct relevance and of priority to local-to-global environmental ground-truth measurement and validation, stress assessment, and stress-change monitoring of the terrestrial and planetary covers. POLSAR and POLINSAR remote sensing techniques offer efficient and reliable means of collecting information required to extract biophysical and geophysical parameters about the Earth's surface and have found successful applications in crop monitoring and damage assessment, in forestry clear cut mapping, deforestation and burn mapping, in land surface structure (geology) land cover (biomass) and land use, in hydrology (soil moisture, flood delineation), in seaice monitoring, in oceans and coastal monitoring (oil spill detection) etc ….

The PolSARpro v4.0 Software establishes a foundation for the exploitation of Polarimetric techniques for scientific developments and stimulates research and applications developments using PolSAR and PolInSAR data [15].

Polarimetric SAR (PolSAR) is a well established technique, which allows the identification and separation of scattering mechanisms in the polarization signature for purposes of classification and parameter estimation [16].

The polarimetric parameters in the C-band were not very relevant to the characterization of the soil surface over bare agricultural areas.The primary surface soil moisture retrieving approaches use SAR data in the C-band because of the high availability of spatial SAR images in this radar band frequency (ERS-1/2, RADARSAT-1/2 and ASAR). Several studies have shown that the best estimates of soil moisture over bare soil surfaces are obtained with SAR images that are acquired at both low and high incidence angles or by using polarimetric SAR data [17-20]

SAR sensors are available in an array of wavelengths within the microwave region of the electromagnetic spectrum, the most common being the X-, C-, L-, and P-band frequencies. The use of the microwave region has many advantages for land cover classification applications, such as monitoring vegetation with fast growing cycles, especially with the fine spatial resolution and short revisit times available now with the newer sensors. As a sensor's microwaves reach all parts of a plant, unique information about the size, shape, and orientation of the plant can be derived.

Remote sensing provides an ideal platform for gathering empirical data, such as global climate change mapping, to aid decision-makers and support policies that ensure a suitable balance between land development and environmental protection.Polarimetric C-band SAR was originally only acquired using airborne sensors, which limited the use and scope of these data (Cable et al. 2014). With the introduction of space-borne sensors such as RADARSAT-2, fully polarimetric C-band data are now more readily available to a larger user community .The C-band is generally helpful in discriminating between crop types.The backscattered SAR signal is dependent on sensor parameters such as polarisation, incidence angle frequency, and wavelength, and on surface parameters such as topography, surface roughness, and the dielectric properties of the target. The change in backscatter depending on the roughness is more exaggerated by the longer wavelength (L-band) than the shorter wavelengths (C- and X-bands). Soil moisture also has an important effect on the resulting radar signal strength. As soil moisture increases under wet conditions, the radar signal response generally increases [21-26].

3. Result and Discussion

This study is to investigate the capability of SAR data for crop classification, crop mapping, crop growth monitoring.The application of high-resolution SAR data can improve the accuracy and application range of crop identification, and the application of high time-resolution SAR data can improve the timeliness of crop growth monitoring. This paper mainly tries to point out the principal potential of polarimetric SAR Data and the advantages of it in the field of agriculture.

4. Conclusion

SAR remote sensing is sensitive to the dielectric and geometrical characteristics of the plants. In the field of agriculture, Crop Classification reflects the healthy condition of a crop ecosystem. Therefore, the studies of Polarimetric SAR data and Crop Classification have received extensive attention in agricultural remote sensing. The crop growth status acquired through remote sensing can provide a reference for the establishment of agricultural product regulation and control policies.

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