Paper Number: 1754

Fully polarimetric ALOS PALSAR data to aid geological mapping in densely vegetated areas

Engelbrecht, J.[1]

[1]CSIR Meraka Institute, Meiring Naude Road, Pretoria, South Africa, jengelbrecht@csir.co.za.

The analysis of image data from space-borne or airborne sensors has been widely used to aid geological mapping. The advantages of using remotely sensed data are numerous and include the fact that large areas can be observed in a single observation. Satellite data are generally used for base-map creation prior to field mapping campaigns. Furthermore, the data can be used to identify areas with a high potential of being mineralised and, in this way, aids with mineral exploration campaigns. Generally, remote sensing investigations for the extraction of geological information involves the use of multispectral data captured in the visible and near infrared (VNIR), shortwave infrared (SWIR) and thermal infrared (TIR) portions of the electromagnetic spectrum (EMS). Sensors capturing SWIR and TIR data are considered to be ideally suited for geological interpretations since, at these wavelengths, the reflection of radiation is dependent of the chemical composition of the surface being observed. Therefore, characteristic absorption and reflectance patterns for specific wavelength ranges can be diagnostic of specific rocktypes.

The biggest limitation of using visible to infrared wavelengths for geological information extraction is that cloud-cover as well as dense vegetation can impede our ability to extract geological information from these datasets. To overcome these limitations, the use of long wavelength synthetic aperture radar (SAR) data has been considered to extract geological information in densely vegetated regions, as well as regions where persistent cloud cover limits the use of multispectral data. Spaceborne SAR data is captured at wavelengths of between 3 and 23 cm. The active radar transmits microwave radiation where it interacts with the surface and, depending on surface properties, a portion of the radiation will be backscattered to the sensor where it is recorded. The amount of radiation backscattered towards the sensor is dependent on the physical properties of the surface object being observed including the dielectric constant of the feature, the shape of the feature, the orientation of the surface as well as the surface roughness (or texture). Consequently, if the textural properties of different lithologies are sufficiently different, radar data can provide information based on which geological information can be extracted.

To test the ability to extract geological information from SAR data, fully polarimetric L-band data was obtained for a densely vegetated area in Madagascar. Various polarimetric decompositions and filtering operations were performed to distinguish between surface scattering and scattering derived from vegetation. The long-wavelength L-band data ensured that the backscatter from the surface beneath the vegetation was maximised. Although single polarisation data was found to be useful for identifying textural variations of different rocktypes, the data was limited in information content, especially where limited background information was available. Fully polarimetric data on the other hand provided an increase in information content by providing mechanisms to identify the scattering behaviour of the surface in question. Where surface scattering dominated, the variation in surface backscatter could be attributed to textural variations in different lithologies. Although the information enabled the extraction of lithological boundaries, the SAR backscatter variations could not be considered to be diagnostic of a particular lithology. Therefore, the combination of SAR and multispectral data would still be needed as complimentary sources of data and is recommended for investigation requiring geological mapping and lithological differentiation.

References:

[1] Engelbrecht J, Musekiwa C, Kemp J and Inggs MR (2014) Trans. Geosci. Remote Sens., 52(3): 1572–1582 [2] Engelbrecht J (2013) Parameters affecting interferometric coherence and implications for long-term operational monitoring of mining-induced deformation," University of Cape Town.
[3] Engelbrecht J and Inggs MR (2013). South African J. Geomatics, 2(2): 82–93, 2013.