APPLICATION OF SAR REMOTE SENSING DATA TO LITHOLOGICAL MAPPING: A CASE STUDY IN RAILWAY GEOLOGICAL SURVEY

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ABSTRACT

Application of remote sensing technology to engineering geological mapping of railway investigation and surveying in China has over 50 years. Lithologic mapping potentially can provide information crucial to diverse issues. Traditionally, approaches for extraction of lithological information usually consist of interpretation of optical remote sensing images, which directly characterize lithology on the basis of composition. In contrast, SAR data has the capability to map structural and gross geomorphology. However, due to the unique characteristics of coherent imaging, the difficulties of understanding the information content of SAR data, and the lack of accessible computer software and hardware, SAR data applications to engineering geological survey of railway construction in China were in rare cases during the past decades. Till now, most of the technological constraints of using SAR data have dissipated. Moreover, the new generation of polarimetric, multi-frequency SAR data provides more powerful capability for extracting lithologic information.

To evaluate the utility of imaging radar data for engineering geological survey, we experimented the applicability of SAR remote sensing data to lithological mapping in an undeveloped mountain area for railway investigation. In the experiment, SIR-C L- and C-band polarimetric SAR data obtained in October 1994, were used to identify different rock types and map the lithological distribution in the north part of Xinjiang Province, China, dominated by bare rocks with little or no vegetation cover. After preprocessing and correction with DEM, the multi-frequency and multi-polarization data were used to produce the false color composite image with σ^0_{Lvv}, σ^0_{Chv}, σ^0_{Lhv} represented as R, G, B channels respectively for visual interpretation. Based on the image interpretation results, we established classification system for rock types in the test site. Then, we performed lithological classifications based on improved multi-layer perceptron neural network classifier using two different SAR input data subsets. One data subset only included the conventional multi-band and multi-polarization SAR data ($\sigma^0_{Lvv}+\sigma^0_{Lhv}+\sigma^0_{Chv}$). Another data subset included the conventional SAR data and derived polarimetric information. Both subsets were inputted into the same computer neural network classifier respectively. With the classification results, nine classes including seven rock types were labeled. The overall accuracy of the conventional SAR data classification was 51.57%, but for the latter, the overall accuracy was 62.6% with maximum producer's accuracy of 88.5% for Porphyrite Class and maximum user's accuracy of 99.1% for Sandstone Class. An obvious increase about 11% in classification accuracy was achieved when combining with polarimetric SAR data and derived information as input.

This case study indicates that the false color composite image with multi-band and multi-polarization SAR data was satisfactory for visual interpretation of lithology mapping in engineering geological survey for railway investigation. Polarimetric SAR data contain much more information about the

materials on the earth's surface. It is much better for computer classification than conventional SAR data. It is expected that classification accuracy will be further improved when combining polarimetric SAR data with optic remote sensing data.

Keywords SAR Remote Sensing; Image Interpretation; lithological classification

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