Integration of ALOS PALSAR and Landsat-7 ETM+ data for buried lineaments extraction at the Farafra Oasis, Egypt

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In the last few years, ALOS/PALSAR (L-band) (HH, HV, VH and VV) images have been widely used due to its ability to penetrate the surface in certain conditions for example of low moisture or dry friable sandy soil. Images from ALOS-1 sensor have been applied to delineate subsurface structures. Optical images such as Landsat-7 ETM+ data are used to discriminate between scatterings from earth surface and subsurface materials. Thus, Farafra desert is an optimal environment for L-band microwave penetration. Therefore, this research involves mapping and interpretation of lineaments, surface and subsurface structures. The interested four spots at Farafara sand sheets display many structures that not have been traced in the Egyptian official geological maps.

Speckle noise is found in radar images due to many reasons, for example, when an object strongly reflected between itself and the spacecraft causing noise. Refined LEE Filter (RLF) is applied for speckle noise reduction; speckle noise near strong edges is not strongly filtered, leaving the center of the pixel unfiltered, so, this procedure is an essential step in processing of polarimetric data to improve the accuracy of the data and enhance resolution. ALOS/PALSAR data are processed into circular polarization for providing the best viewing of morphological and subsurface lineaments. The ellipse shape governed by two axes; semi-major axis ‘a’ and semi-minor axis ‘b’. Orientation angle(ψ) is measured from positive horizontal axis X counter clockwise direction, orientation angle range from 0° to 180°. Ellipticity (χ) is a shape parameter defined by the degree of oval shape, defined by $\chi = arctan b/a$ and can take values between -45° to $+45^{\circ}$. As, the circular polarization yielded best outputs of subsurface structure in different trends, full polarimetric ALOS/PALSAR images (PLR) are transformed into circular polarization, by changing both angles into orientation angle $\psi = 0^{\circ}$ and elliptical angle $\chi = 45^{\circ}$. Full polarimetric images are represented in Pauli RGB. Landsat-7 ETM+ data are freely uploaded with the same date and location of ALOS/PALSAR images. Bands 1, 2, 3, 4, 5 and 7 are merged together, then bands (R:2, G:4, B:7) are changed to obtain best spatial resolution. Landsat-7 images have some gap areas, which is essentially be filled with Landsat-7 data acquired at the same time of the year by histogram matching technique to fill the missed pixels of the interested target scenes according to Landsat 7. The obtained rose diagram shows two trends of dominant and secondary; the most dominant direction is North West (NW 330˚), while the secondary trend is North (North 10°). This result is confirmed by the field survey. The dominant direction of lineaments extracted from ALOS/PALSAR images is well fitted with the secondary direction of the geological structure in the study area.

This work represents a stage of achievement in detecting buried lineaments covered by sand sheets by using ALOS/PALSAR and Landsat-7 ETM+. Surface and subsurface lineaments that can be extracted in Farafra formations. May be due to its geological nature and spatial resolution that well fit to ALOS/PALSAR radar wave. Extracted orientation of the lineaments; especially in sand sheets proved great correlation with the secondary trend of the geological structure at Farafra map. Ground penetrating radar can easily support confirmation of ALOS/PALSAR result at the traced interested spots; alternatively, consuming time and budget in exploring the whole area. In addition, parameter analysis of soil samples from field survey will be carried out, if possible.

Keywords: ALOS/PALSAR , Landsat-7 ETM+, subsurface lineaments

