Wavelets for SAR Speckle Noise Filtering

Jaan-Rong Tsay [1*]

[1] Associate Prof. Dr.-Ing., Department of Geomatics, National Cheng Kung University(NCKU), No.1,

University Road, Tainan City 701, Taiwan (R.O.C.)

*tsayjr@mail.ncku.edu.tw

ABSTRACT

About 60 days are suitable each year for taking clear aerial images in Taiwan. Spaceborne or airborne Synthetic Aperture Radar(SAR) might provide state-of-the-art and applicable technology and a good solution for acquiring high-resolution spatial data and information on the terrain surface in Taiwan, especially in some emergent areas damaged e.g. by typhoons, earthquakes, heavy rainfall, or landslide, when clear aerial images cannot be taken due to improper weather and atmospheric conditions. This autonomous research and development is thus motivated. The fundamental principles such as SAR image formation and its speckle noise will be then reviewed concisely. Also, the well-known filters for reducing SAR speckle noises will be reviewed. The reason causing the cross-like pattern which often appears in the SAR images after speckle filtering e.g. by using the Goldstein filter will be given and analyzed. In order to reduce SAR speckle noises properly and reserve SAR image features with better performance, this paper will present an algorithm developed at NCKU for filtering Synthetic Aperture Radar (SAR) speckle-noise based on wavelets. Orthogonal wavelets, e.g. Haar wavelets, asymmetric Daubechies wavelets, and least asymmetric Daubechies wavelets, are used to perform 2D FWT(=Fast Wavelet Transform) for SAR images. The determined wavelet coefficients are then utilized to reduce SAR speckle noise. Tests are done by using both simulated and real SAR images, respectively. Test results will be shown and evaluated utilizing some statistical quantities. Concluding remarks will be drawn, too.

Keywords: Synthetic Aperture Radar(SAR), speckle, noise, filtering, 2D discrete wavelet transform(DWT)