Iterative model reconstruction for phase unwrapping

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Abstract

Phase unwrapping is one of the most important steps we have to consider in DEM generation using SAR interferometry. The phase of the radar echoes may only be measured modulo 2PI, but the whole phase at each pixel is needed to obtain an elevation map. Furthermore some of the phase data may be not reliable because of the presence of a certain amount of noise. The method for phase unwrapping we have implemented is based on a global analysis of the interferogram, and works in an iterative way. An approximate model of the unwrapped phase is generated and then tested by calculating the "residue image": this image is, by definition, the difference between the interferogram and the model. If there are residual fringes in the residue image, then the model must be improved. In order to construct the model, we subdivide the interferogram into squares and then, for each square, the local slopes in azimuth and range are estimated by means of the power spectral density (PSD): the maximum of the PSD should be proportional to the local slopes. Using the local slopes and a least-squares algorithm (Gauss-Seidel relaxation) the values of the model in the vertexes of the grid are obtained, and then by bilinear interpolation the phase at each pixel can be evaluated. If an improvement of the model is needed, the entire process is repeated with as the input image the residue image as a "new" interferogram. The program stops when a certain condition is reached. The method allows one to assign weights to each square, associating to each square a weight proportional to the signal-to-noise ratio in that square.
Prelimanary results using synthetic and real data interferograms are shown.

Keywords: Phase unwrapping, Iterative model reconstruction