

# Imaging Radar For Resources Surveys

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## Extraction of interest points by Harris interest operator for synthetic aperture radar image coregistration

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**Abstract:** In image coregistration of synthetic aperture radar (SAR) interferometry, a set of points is selected for tie point matching. Generally, some special points are possibly selected as tie points to improve the reliability of coregistration. However, special points cannot always be found in an image. Therefore points in grid form are commonly selected for image coregistration and this makes the results not as reliable as special points do. In this study, hence, a series of points detected by Harris interest operator (HIO) are used as tie points for SAR image coregistration. After wavelet decomposition of a SAR image, the basic energy is reserved in the low-pass subimage and this benefits the extraction of interest points conducted by HIO on the highest level. Three pairs of SAR image in Hong Kong area are used to prove the efficiency of the proposed method. For comparison, image coregistration based on grid points and interest points are implemented, respectively, in which different numbers of points are adopted. Based on the analysis of experimental results, it is found that the quality of interferogram is greatly improved by interest points and coregistration with interest points is more reliable.

### 1 Introduction

Interferometric synthetic aperture radar (InSAR) has gained increasing attention from researchers in a variety of areas because of its advantages on all weather conditional, rapid and accurate topographic data collection [1–4]. However, there are many critical factors that affect the accuracy and accuracy of InSAR technology. For example, atmospheric effects [5, 6], temporal decorrelation [4], baseline decorrelation [7] and interferometric processing of data [8] can limit its applications and development.

InSAR data processing consists of coregistration, interferogram generation, phase unwrapping and geocoding. Each step will influence the quality of the final product, that is, digital elevation model (DEM) [9–11]. Since coregistration is the first step, hence, it will seriously affect the reliability of results generated at each following step and result in significant effect on the quality of DEM. Image coregistration is a fundamental task in image processing used to match two or more pictures taken at different time from different sensors or from different viewpoints [12]. Some different methods of image coregistration are surveyed by Manjusha and Lidhav [12]. In this study, coregistration of SAR images is achieved by transforming the pixels on one image to the coordinate system of the other by a mathematical function. The

coefficients of such a mathematical function are determined by using a set of tie points, which are a set of selected conjugate image points on both images. The points with special feature should be selected as tie points possibly, such as intersection, airport, turning point of a river, an island in a lake [13] or points with known coordinates, which will benefit coregistration. However, such defined feature points cannot always be found in an image. Therefore the intersections of grid cells are normally selected as tie points for coregistration [14, 15]. It is natural to think that the connotation of feature point should not be limited to the conventional concept. It might be defined in an extended domain so that a new kind of feature point could possibly be extracted for a reliable coregistration. Harris interest operator (HIO) is a popular interest point detector because of its strong invariance to: rotation, illumination variation and image noise [16, 17]. Therefore HIO might be an effective method for such a project. This paper aims to extract interest points by HIO for image coregistration of SAR interferometry.

The introduction is followed by the description of procedures of SAR image coregistration. After that, the extraction of interest points by HIO is described in detail. Then, the effects of interest points on reliability of image coregistration are analysed. Finally, some conclusions are made.

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