Simple motion compensation algorithm for Unfocused Synthetic Aperture Radar

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ABSTRACT

Synthetic Aperture Radar (SAR) is a technique used to obtain high-resolution radar images. It can be carried out in two ways: Focused SAR or Unfocused SAR. Although the first method gives better resolution, it requires more computational power. The second method bases on less complicated computations and can also ensure satisfactory results. Since the aircraft's path is not ideal in real situations these two techniques require motion compensation. A simple motion compensation algorithm for Unfocused SAR presented in this paper is computationally effective and gives good results.

Keywords: Synthetic Aperture Radar, motion compensation, digital signal processing

1. INTRODUCTION

Synthetic Aperture Radar is a technique used to improve radar's resolution. This article focuses on the application of this technique in pulse radars. SAR bases on the relative motion between the radar's platform (for example an aircraft) and the target. The consequence of this motion is the Doppler effect. It provides additional information about the position of targets, which is essential to improve the resolution. There are two main ways of extracting this information from the radar signal: Unfocused SAR using a low-pass filter and Focused SAR that bases on a matched filtration [1]. These two techniques will be briefly presented below.

Apart from the movement used to improve the resolution, there is also an unwanted component of movement, which blurs the output image. This problem will be discussed in the further part of this article.

2. CONCEPT OF SYNTHETIC APERTURE RADAR

The radar placed on an aircraft transmits short impulses of electromagnetic waves in regular time periods. The received signal reflected from the targets is sampled and processed by a quadrature detector [2]. In this way further processing can be carried out on complex samples, so it is possible to use information about amplitude and phase of the input signal. The input data can be organised in a matrix, where the columns correspond to the consecutive range cells and the rows represent the consecutive pulses.

Assuming straight-line motion of the radar's platform and a non-rotating side-looking antenna the signal's frequency from one range cell reflected from a point target has the form presented in figure 1.