GRLT DETECTION OF MOVING TARGET BY ALONG TRACK SAR INTERFEROMETRIC SYSTEMS

Alessandra Budillon[1], Massimo Ciaramello[2], Annarita Evangelista[2], Vito Pascazio[1], Gilda Schirinzi[1]

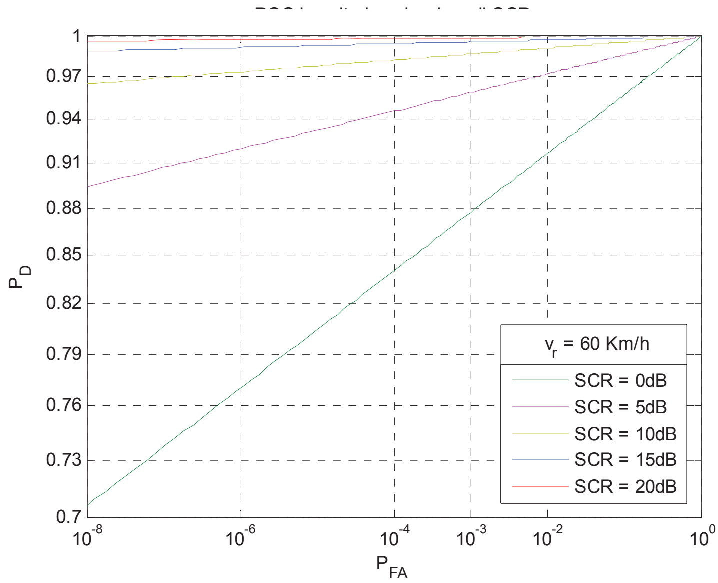
[1]Dipartimento per le Tecnologie- Università di Napoli "Parthenope"
Centro Direzionale di Napoli, Isola C4
80143 Napoli (Italy), ☎ +39 081 5476725, Fax +39 081 5474777
email: {alessandra.budillon, vito.pascazio, gilda.schirinzi}@uniparthenope.it

[2]DAEIMI - Università di Cassino
via Di Biasio 43, 03043 Cassino (Italy), ☎ +39 0776 2993654, email: annarita.evangelista@unicas.it

Synthetic Aperture Radar Along Track Interferometric (AT- InSAR) [1] systems have proved excellent capabilities of estimating ocean waves velocity [1]. Recently they have been applied also for ground moving target indication, and in particular for estimating ground targets radial velocity [2,3]. Conventional AT-InSAR systems are based on the acquisition of two images by two SAR antennas separated along the flight direction by a distance called *baseline*. The information about the target radial velocity is estimated from the interferometric phase obtained by beating the two SAR images. For this applications, contrarily to the ocean surface case, the moving target is usually smaller than the resolution cell, so that the received signal is due to the superposition of the moving target signal and the stationary clutter signal, which can impair the target radial velocity estimation performance [4]. Anyway, for sufficiently high values of the signal to clutter ratio (SCR), the target radial velocity estimation accuracy is satisfactory for a wide range of velocity values [5].

In this paper we consider the problem of the detection of a ground moving target, and we propose a method exploiting a Generalized Likelihood Ratio Test (GRLT) [6], and based on a Gaussian model for the target response, for the stationary clutter and for the additive thermal noise in the receiver. The GRLT test requires a preliminary step for the Maximum Likelihood (ML) estimation of the target radial velocity and of the SCR, obtained starting from the two complex images. These parameters values appears in the log-likelihood ratio and influences its probability density function (pdf). Then, we compute the log-likelihood ratio pdf in closed form, both in the hypothesis of presence of target and absence of target. The pdf closed form has been found by considering that the log-likelihood ratio can be expressed by the difference of two hermitian quadratic forms obtained from Gaussian vectors. Once obtained the pdf closed form, the log-likelihood ratio can be evaluated in correspondence of the estimated velocity and SCR values, and the optimal threshold, with which the log-likelihood ratio has to be compared to obtain a given probability of false alarm (P_{FA}), can be easily evaluated. The corresponding values of the probability of detection (P_D) are then evaluated. The moving object detection capability will depend essentially on the target radial velocity, on SCR and on CNR (the clutter to noise ratio, defined as the ratio between the power received from the stationary clutter and the thermal noise power) and on clutter coherence, that in the case of Along Track systems can be considered equal to one.

The detection performance evaluation has been performed using the TerraSAR-X parameters [7]. The analysis has been performed for different SCR and velocity values, showing very satisfactory results for radial velocity values larger than 10 km/h and SCR values larger than 5 dB. As an example, the Receiver Operating Characteristics (ROC) obtained for a radial velocity value v_r=60 km/h, CNR=10 dB and for different SCR values, is shown in Fig. 1. A complete performance analysis will be shown in the final paper.



ROC for different values of SCR

P_D Values	
P_{FA} = 10^{-3} - v_r = 60Km/h	
SCR [dB]	P_D
0	0,8755
5	0,9588
10	0,9866
15	0,9957
20	0,9986

P_D values Vs. SCR values

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