Fast Minimum Entropy Autofocusing for ISAR Imaging

X. H. Qiu, [1] Y. Zhao, [2], Alice. H. W. Cheng [3]

[1] Department of Information. Eng,

Nanjing University of Post and Telecommunication, Nanjing 210003, China

[2] School of[1] EEE, Nanjing Normal University,Nanjing 210042, China

[3] Radar Research Center, DSO National Lab., 118230 , Singapore

Inverse synthetic aperture radar (ISAR) imaging is a powerful tool in microwave imaging for moving target. It provides high range resolution by transmitting wide-band signal and high cross-range resolution by coherently accumulating echoes, where phase compensation is one core technique for range-Doppler image formation. However, conventional autofocusing methods usually have problems to compensate the translational motion between radar and target with sufficient accuracy when the motion has high order or even random terms. To solve this problem, recently Li proposed a minimum entropy-based autofocusing method (Li et al, IEEE Trans. AES, Vol.35, p1240-1251,1999.), which can achieve much better aufocusing effect, but it only gives optimization principle theoretically, and no effective implementation is introduced yet about the algorithm. Moreover, it needs a huge computation for multi-dimensional searching and consequently, so it is not available in use. In this paper, we present a two-dimensional fast minimum entropy autofocusing(FMEA) approach. According to non-correlation relationship of phase error between each echo, phase optimization for each echo can be calculated to make two-dimensional entropy minimized. On the other hand from the point of two-dimensional image and entropy of range-Doppler imaging, error phase can be coupled together by image and entropy, and then they become correlative. As a result for each new iteration solution it can skip out from local minimum value of last iteration and approaches to the global minimum value. Simulation and real ISAR data processing have shown the validation and efficiency of our method, especially the algorithm processing is speeded up greatly compared with Li's method, as seen in Table 1. It is a cost-effective way that needs small computation with high convergence speed, good autofocusing effect as well as explicit formulation easily for practical use

Table 1 Computation resource comparison between two methods.

Method	time for each iteration (sec)	iteration number	total time cost
FMEA(t1)	1.16	50	58
Li's (t2)	242	250	60500
Data comparison*	0.48%	20%	0.09%

* Note: Data Comparison means percentage value from (t1 / t2) 100%