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基于最小熵的多通道SAR系统相位误差估计与补偿

胡建民^{1,2}, 王岩飞¹, 李和平¹

1. 中国科学院 电子学研究所, 北京 100190;
2. 中国科学院研究生院, 北京 100039

Phase Error Estimation and Compensation for Multi-channel SAR Systems Based on Entropy Minimization

HU Jianmin^{1,2}, WANG Yanfei¹, LI Heping¹

1. Institute of Electronics, Chinese Academy of Sciences, Beijing 100190, China;
2. Graduate University of Chinese Academy of Sciences, Beijing 100039, China

摘要

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摘要 采用多通道合成的方法来增加信号带宽,是提高合成孔径雷达(SAR)系统距离分辨率的一种有效技术手段。针对多通道间相位失配的问题,建立了通道相位误差的频域多项式模型,提出了一种基于最小熵的通道相位误差估计与补偿方法。以距离向压缩脉冲图像的信息熵作为目标函数,误差多项式系数为估计变量,基于最小熵准则建立了相位误差的最优化估计模型。该方法能有效弥补内定标或外定标方法的不足,且不依赖于成像场景的地物类型,只需抽取少量回波数据作为误差估计的样本,具有耗费存储空间少、收敛速度快、不损失信噪比的优点。对不同场景的八通道实测数据进行了处理,实验结果验证了本文方法的有效性和稳健性。

关键词: 多通道SAR系统 相位误差 最小熵 估计 补偿

Abstract: To improve the range resolution of a synthetic aperture radar (SAR) system, one of the effective technological approaches is to increase signal bandwidths via multi-channel synthesis. In view of the issue of channel phase mismatch among multi-channels, a method based on the principle of entropy minimization is proposed to estimate and compensate for channel phase error, which is modeled as a polynomial in the frequency domain. By adopting the image information entropy of a range compressed pulse as the objective function and taking the polynomial coefficients as the estimated variables, an optimal estimation model for channel phase errors is established based on the principle of entropy minimization. Characterized by independence from the surface feature of the imaging scene, this method effectively makes up for the insufficiency of internal or external calibration; meanwhile, it just requires a small amount of raw data as the sample for error estimation, which results in the advantage of no loss of SNR, few storage consumption and fast convergence speed. The validity and robustness of the method are demonstrated by the experimental results of eight-channel raw data processing from different scenes.

Keywords: multi-channel SAR system phase error entropy minimization estimation compensation

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Corresponding Authors: 王岩飞 Email: yfwang@mail.ie.ac.cn

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