

星载SAR原始数据压缩引起的目标辐射误差机理研究

李信^{*①②③} 祁海明^{①②} 华斌^{①②} 雷宏^① 禹卫东^{①*}

^①(中国科学院电子学研究所 北京 100190) ^②(微波成像技术国家重点实验室 北京 100190) ^③(中国科学院研究生院 北京 100039)

Theoretical Analysis on Target Radiometric Error Resulting from Spaceborne SAR Raw Data Compression

Li Xin^{①②③} Qi Hai-ming^{①②} Hua Bin^{①②} Lei Hong^① Yu Wei-dong^{①*}

^①(Institute of Electronics, Chinese Academy of Sciences, Beijing 100190, China) ^②(The National Key Laboratory of Microwave Imaging Technology, Beijing 100190, China) ^③(Graduate University, Chinese Academy of Sciences, Beijing 100039, China)

摘要

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摘要 目标的辐射误差是影响SAR图像质量的重要因素。该文提出了一种解析求解SAR原始数据分块自适应量化引起的目标辐射误差的方法。该方法考虑系统热噪声的影响,采用符号函数描述分块自适应量化过程,并通过第1类贝塞尔函数恒等式将回波相位分解为倍频项叠加,经过频域匹配滤波最终推导出目标辐射误差的解析表达式。该文仿真了在已知热噪声条件下,不同幅度的单点和多点目标回波分别采用8:4, 8:3, 8:2, 8:1压缩比压缩时引起的辐射误差,验证了解析表达式的正确性。该文的分析结果为星载SAR系统原始数据压缩方案的选择及地面辐射校正处理提供了重要的理论参考。

关键词: 合成孔径雷达 分块自适应量化 符号函数 第1类贝塞尔函数 辐射误差

Abstract: Target radiometric error deteriorates SAR image quality. A method is proposed in this paper to analyze theoretically target radiometric error resulting from SAR Block Adaptive Quantization (BAQ). Meanwhile, thermal noise is taken into consideration. During the analysis, first, the process of BAQ is described by sign function. Second, the output signal from BAQ is expanded into harmonics by Bessel function of first kind. Third, the harmonics are processed by matched filter in frequency domain, and finally the analytical expression of target radiometric error is obtained as expected. Numerical experiments of single point target and multi-point targets with thermal noise are implemented to verify this method, and BAQ compression ratios in the experiments are 8:1, 8:2, 8:3 and 8:4. Analytical results derived in this paper could be quite useful for the decision of BAQ compression ratio and the process of target radiometric correction.

Keywords: SAR Block Adaptive Quantization (BAQ) Sign function Bessel function of first kind Radiometric error

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通讯作者: 李信 Email: sherry_lixin@yahoo.com.cn

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