

论文

电离层GPS掩星观测反演技术

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摘要: 在电离层局部地区球对称假设下, 推导了利用双频和单频无线电掩星观测数据, 反演电离层电子密度剖面的两种方法. 双频反演的误差来自于载波相位的观测误差, 单频反演误差则主要由伪距的观测精度决定. 由于载波相位测量精度比伪距测量精度高两个量级, 因此双频反演的精度一般比单频反演的高些. 不过, 两载波信号L1和L2之间的传播路径差异会给双频方法带来误差. 利用三维射线追踪的程序模拟的无线电掩星数据来评估这些方法, 结果表明, 反演出的电离层剖面与给定的模式电离层非常吻合, 验证了两种方法的可靠性和准确性. 将这两种反演方法应用于处理实测的GPS/MET掩星观测数据, 均能获取合理的电离层剖面信息. 且单频方法得到的反演剖面与双频方法相当一致, 这为利用LEO星载单频GPS接收机进行电离层掩星观测提供了理论基础.

关键词: GPS/MET 双频方法 单频方法 电离层掩星

Inversion of ionospheric GPS occultation data

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Abstract: Based on the assumption of the local spherical symmetric ionosphere, we propose two inversion methods with which ionospheric density profiles are extracted from the dual frequencies and single frequency radio occultation data respectively. The estimation errors of the dual frequency method come from errors of the carrier phase measurements, while the errors of the single frequency method mainly are determined by the precision of the pseudo range measurements. Since the pseudo range measurements tend to be about 100 times noisier than those of the carrier phase, the retrieval precision with the dual frequency method may be generally higher than that with the single frequency. However, slightly different paths of carrier L1 and L2 will bring errors to estimations of the dual frequency method. The radio occultation simulation data with a 3 dimensional ray tracing program are used to evaluate these inversion methods. Results show that the inversion profiles agree very well with the given model ionosphere, which indicates reliabilities and accuracies of both methods. Then, two inversion methods are applied to the processing of GPS/MET ionospheric occultation data. The inversion results show reasonable ionospheric profiles. Inversion profiles with the single frequency method are consistent with those of the dual frequency method, which provide the theoretical inversion base for ionosphere radio occultation observations with a single frequency GPS receiver onboard LEO.

Keywords: GPS/MET Dual frequencies method Single frequency method Ionospheric occultation

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