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基于喇曼散射的分布式光纤测温系统光接收机灵敏度的分析

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SENSITIVITY EVALUATION OF OPTICAL RECEIVER IN DISTRIBUTED FIBER TEMPERATURE SENSOR BASED ON RAMAN REJECTION

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摘要 在分布式光纤测温系统中,携有温度信息的喇曼散射光是极其微弱的,只有 n W量级,而温度变化引起的喇曼散射光的变化更加微弱。在对光接收机噪声分析的基础上,给出了该类应用条件下光接收机信噪比。指出了低信噪比下,AD的量化误差将随累加次数的增加而减小,同时 AD的有效位数将增加,给出了低信噪比下 AD有效位数的分析方法,并通过 MATLAB进行了验证,在此基础上,分析了光接收机的灵敏度,由此可以直接计算分布式光纤测温系统的测温精度

关键词： 光接收机 灵敏度 温度 信噪比

Abstract： This paper presents the sensitivity evaluation of an optical receiver in Distributed Fiber Temperature Sensor (DTS) based on Raman Backscatting whose energy is very weak in nW. First, the noise of the optical receiver is studied; a calculation formula of SNR is got, which is directly determined by the thermal noise. Then calculation and analysis show the relationship between the effective bit of the AD converter and accumulation number, and point out that the quantization error decreases with the increase of accumulation number while the effective bit of the AD converter will increase. At last, the authors put forward the calculation formula of the sensitivity evaluation of the optical receiver. Using this method, it 's very easy to calculate the temperature resolution of DTS and valuable to the analysis and design of this kind of sensor system.

Keywords： op t ical receiver sensit ivity temperature signal to no ise rat io

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