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现代应用光学

基于氧气吸收被动测距技术的近程实验

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摘要： 利用高光谱成像光谱仪作为测量设备，卤钨灯作为目标，设计了近程实验方案以验证基于氧气吸收的被动测距技术。介绍了基于氧气吸收的被动测距技术的基本原理和实验方案；根据测距原理和假设前提，选择了实验设备和实验目标，在外场近程条件下对该被动测距技术进行了测试验证。实验证明了该技术在目标辐射情况未知、大气状况未明情况下的测距能力，显示了该测距技术的可行性和优越性。通过软件仿真曲线和模型拟合曲线对实验数据进行了解算，得出实验条件下模型测距误差为4.26%，仿真测距误差为6.23%。实验结果表明：依托实验数据的模型拟合曲线不仅可以较高精度地反演目标距离，而且可以通过曲线外推实现远程目标的距离解算。

关键词： 被动测距 氧气吸收 高光谱成像 基线强度

Short-range experiment of passive ranging by oxygen absorption

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Abstract: By using an acousto-optic tunable hyperspectral imaging spectrometer as measurement equipment and a halogen as the target, a short-range experimental program was designed to verify the passive ranging technology based on oxygen absorption. The basic principles and experimental program of the passive ranging technology based on oxygen absorption were introduced. Then, experimental equipment and a target were chosen based on ranging principles and assumptions, and the passive ranging technology was tested and verified under short-range conditions. Experimental results proof that this passive ranging technology also has the ranging capability when the target radiation and atmospheric conditions are unknown, which shows the feasibility and advantages of this ranging technology. The measuring range is solved by a software simulation curve and a model fitting curve, and the results give that the 4.26% ranging error comes from the model fitting curve and 6.23% ranging error from the software simulation curves. This result demonstrates that the model fitting curve based on experimental data not only can invert the target range in higher accuracy, but also can solve the measuring range of a far-range target by the curve extrapolation.

Keywords: passive ranging oxygen absorption hyper-spectral imaging baseline strength

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参考文献：

[1]张岩, 段民征, 韩志刚,等. 氧气A吸收带大气遥感应用研究进展[J]. 遥感技术与应用, 2010， 25(2):288-295. ZHANG Y, DUAN M ZH, HANG ZH G, et al.. Review of oxygen a-band research [J]. Remote Sensing Technology and Application, 2010, 25 (2):288-295. (in Chinese) [2]张岩, 吕达仁, 段民征. 两种氧气A吸收带云顶高度反演算法的理论比较与实测结果验证[J]. 遥感技术与应用, 2010, 25(2):288-295. ZHANG Y, L D R, DUAN M ZH. Two kinds of cloud top height retrieval methods with oxygen a-band comparison by simulated data and verification with experimental results in China [J]. Remote Sensing Technology and Application, 2010, 25(2):18-32. (in Chinese) [3]HAWKS M R. Passive ranging using atmospheric oxygen absorption spectra[D]. Air Force Institute of Technology (AU), 2005. [4]冯国强，邹强，李伟仁. 单站双波段红外被动测距算法研究[J]. 红外技术，2005，27（4）：295-298. FENG G Q, ZOU Q, LI W R. Algorithm of passive ranging by single station [J]. Infrared Technololy, 2005, 27(4):295-298. (in Chinese) [5]付小宁,牛建军,刘上乾. 红外双波段单站被动测距算法研究[J]. 红外与激光工程, 2006, 35(6):648-651. FU X N, NIU J J, LIU SH Q. IR passive mono-station ranging algorithm using dual-band radiation [J]. Infrared and Laser Engineering, 2006, 35(6):648-651. (in Chinese) [6]路远,凌永顺,时家明. 双波段红外成像系统对空中点目标测距的方法[J]. 光学 精密工程, 2004, 12(2):161-164. LU Y, LING Y SH, SHI J M. Measurement of aerial point target distance using dual-band infrared imaging system [J]. Opt. Precision Eng., 2004, 12(2):161-164. (in Chinese) [7]王刚, 禹秉熙. 基于对比度的空中红外点目标探测距离估计方法[J]. 光学 精密工程, 2002,10(3):276-280. WANG G, YU B X. Approach to estimate infrared point target detection range against sky background based on constrast [J]. Opt. Precision Eng., 2002,10(3):276-280. (in Chinese) [8]路远，冯云松，凌永顺,等. 红外三色被动测距[J]. 光学 精密工程, 2012,20(12):2680-2085. LU Y, FENG Y S, LING Y SH, et al.. Infrared three-color passive ranging by colorimetric method[J]. Opt. Precision Eng., 2012,20(12): 2680- 2085. (in Chinese) [9]JOEL R, LOUIS M, BRANDON R, et al.. Monocular Passive Ranging[D]. Air Force Flight Test Center (AU), 2009. [10]ANDERSON J R. Monocular Passive Ranging by an Optical System with Band Pass Filtering[D]. Air Force Institute of Technology (AU), 2010. [11]VINCENT R A. Passive Ranging of Dynamic Rocket Plumes

Using Infrared and Visible Oxygen Attenuation[D]. Air Force Institute of Technology (AU), 2011. [12]HAWKS M R, VINCENT R A, MARTIN J, et al.. Short-range demonstrations of monocular passive ranging using O2 (X3∑ g-→ b1∑g+) absorption spectra [J]. Applied Spectroscopy, 2013, 67(5): 513-519. [13]宗鹏飞, 王志斌, 张记龙, 等. 基于红外被动测距的基线拟合算法研究[J]. 激光技术, 2013, 37(2): 174-177. ZONG P F, WANG ZH B, ZHANG J L, et al.. Study on baseline fitting