光学精密工程 » 2015, **Vol. 23** » Issue (5): 1443-1449 DOI: 10.3788/OPE.20152305.1443

用于快速星跟踪的双向递推匹配识别

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Bidirectional selective rule out matching recognition of fast star tracking

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全文: PDF (1387 KB) RICH HTML NEW

输出: BibTeX | EndNote (RIS)

摘要

针对星敏感器跟踪过程的稳定性对星敏感器整体性能的影响,讨论了如何利用跟踪过程中前后两帧星图上的星点位置信息进行匹配识别的问题。为了使跟踪过程具有较高的稳定性,分析了现有星跟踪过程中匹配识别方法的优缺点,提出用"先排序后双向递推匹配"的方法来获得在"参考星邻域内出现多颗观测星"时的成功匹配能力,从而增加每一帧快速星跟踪时被成功跟踪恒星的数目;同时通过引入先确定视场边缘区域,再选取有效参考星进行匹配的思想,有效地减小误匹配发生概率,进而保证匹配的有效性。在外场对某星敏感器从初始姿态运动到最终状态的跟踪进行了实验,对蒙特卡洛法生成的全天球100个视轴方向进行星跟踪的对比分析结果表明:在姿态运动角速度较大时,利用本文提出的匹配识别方法,平均可实现约91.44%的快速星跟踪;而利用相应的对比方法,平均只能实现77.18%的快速星跟踪。分析显示本文提出的匹配识别方法具有重要的工程应用价值。

关键词 : 星敏感器, 星跟踪, 星图识别, 跟踪算法, 匹配识别

Abstract :

In consideration of the effect of stability of star tracking processing on its overall performance, how to track the stars in the current visual field according to the star information identified in the previous moment is discussed. To obtain a higher stability in star tracking, the advantages and disadvantages of existing star tracking algorithms are analyzed, and the method of "sorting before bidirectional selective rule out matching" is proposed. The first step selects the effective reference star on the basis of determining the marginal area of the FOV(Field of View), which effectively reduces the probability of mismatching and ensures the validity of matching. Following that it uses bidirectional recurrence idea to obtain the successful matching capacity that "there are more observation stars within the neighborhood of the reference star", so as to increase the number of stars successfully tracked in each frame of rapid star tracking. A tracking experiment was performed in a outdoor field for a star sensor. The comparison experiments on start tracking in 100 directions generated by Monte Carlo method show that when the attitude movement has a very large angular velocity, the proposed method can achieve about 91.44% fast star tracking. However, it just is 77.18% by other traditional methods. The proposed method has a significance to improve the overall performance of the star sensor.

Key words : star sensor star tracking star pattern recognition tracking algorithm matching recognition

收稿日期: 2014-05-21

中图分类号: V448.22

基金资助:

国家自然科学基金青年基金资助项目(No.61008046)

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引用本文:

李欣璐, 杨进华, 张刘, 金光, 支帅. 用于快速星跟踪的双向递推匹配识别[J]. 光学精密工程, 2015, 23(5): 1443-1449. LI Xin-lu, YANG Jin-hua, ZHANG Liu, JIN Guang, ZHI Shuai. Bidirectional selective rule out matching recognition of fast star tracking. Editorial Office of Optics and Precision Engineering, 2015, 23(5): 1443-1449.

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