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星图的稀疏表示性能

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Performance on sparse representation of star images

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摘要 图/表 参考文献 相关文章 (15)

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摘要 分析了星图在不同表示方法下的稀疏性能,以便将更好的稀疏表示应用于星敏感器压缩成像过程中。采用两种方式对星图的稀疏性进行了分析:第一种方法利用离散余弦变换(DCT)、离散傅里叶变换(DFT)和离散小波变换(DWT)构造完备正交基,考察星图在不同完备基下的稀疏性;第二种方法则是通过选择DCT完备基构造超完备字典及训练学习字典来分析星图在不同表示方法下的稀疏性。仿真结果表明,在完备基表示下,星图相比一般场景图像的平均峰值信噪比(PSNR)值高出15~20 dB,超完备字典和学习字典稀疏表示能够在各稀疏度下进一步提升峰值信噪比(PSNR值)2~20 dB;对于星点的重构质量,各表示方法在10%以上稀疏度时基本能够保证星点重构成功率高于95%。得到的结果证明星图的稀疏性满足压缩成像的要求,其稀疏重构能够在很大程度上保持适用于姿态确定的星点质心位置,从而验证了压缩感知在星敏感器应用中的稀疏前提及可行性。

关键词 : 恒星图像, 稀疏表示, 压缩感知, 恒星敏感器

Abstract : The sparsity of a star image was explored in different representation approaches to apply better sparse representation to the compressive imaging process of a star tracker. The sparsity of star image was analyzed in two ways. In the first way, the Discrete Cosine Transform (DCT), Discrete Fourier Transform (DFT) and the Discrete Wavelet Transform (DWT) were used to construct complete representation bases and to examine the sparsity of star image in different complete representation bases. In the second way, the DCT complete basis was selected to create the overcomplete dictionary and learning dictionary to analyze the sparsity of the star image in different representation approaches. The simulation result shows that the average Peak Signal to Noise Ratio(PSNR) of the star image is 15-20 dB higher than that of the common scene image by complete based representation, while the overcomplete dictionary and learning dictionary based representations improve the PSNR by 2-20 dB with different sparsities. Regarding the quality of star point reconstruction, the rate of successful reconstruction is mostly higher than 95% when the sparsity is more than 10% in different representation approaches. The results verify that the star image has the preferable sparsity and meets the requirement of compressive imaging.The reconstruction of the star image maintains the position of star centroid position suitable for attitude determination to a large extent,which verifies the sparse precondition and feasibility for applying the compressive sensing in star trackers.

Key words : star image sparse representation compressive sensing star tracker

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