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信息科学

复杂背景成像条件下运动点目标的轨迹提取

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摘要： 为改进空间目标天基实时监视能力,研究了美国在空间中段实验卫星上搭载的对空间目标进行在轨检测与跟踪的信号处理器的工作方案。针对该处理器在目标运动轨迹提取阶段采用的先二元速度滤波再能量累积判决的"筛选-确认"解决方案,提出了两点改进方法:一是在"筛选"阶段增加运动速度约束条件,二是在"确认"阶段增加样本均差约束条件,使其在降低虚警概率的同时提高检测概率,从而普遍适用于复杂背景成像条件下运动点目标轨迹的提取。最后,利用实际获取的云层背景图像数据库仿真生成了包含多运动目标的时序图像序列,并以此作为输入信号源分析比较了原算法与改进算法的性能差异。仿真实验结果表明:改进算法在二元速度滤波后候选条痕减少到原算法的50%以下,处理器运行时钟周期数从8.0×10^6次降低到7.1×10^6次;最终检测结果显示,改进算法判决门限的合理取值范围增加到20左右,可以实现对多运动目标的实时检测。

关键词： 点目标检测 二元速度滤波 能量累积判决 运动目标 图像序列 轨迹提取

Trace extraction of moving point targets in complex background images

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Abstract: This paper investigated the working scheme of a spaceborn signal processor applied to the USA Midcourse Space Experiment (MSX) for target detection and tracking. The moving target indicator in the MSX performed the trace extraction in two stages, namely, "nominator-confirmer" procedure. the first stage used a binary matched filter to "nominate" streak paths which looked like they might actually contain signals and the second one did a energy accumulation decision to "confirm" the nomination of the first stage. Based on the study of above procedure, an improved method was proposed to detect moving targets. In "nominator" stage, the velocity restraint condition was introduced to binary matched filter for reducing the probability of false alarm. In "confirmer" stage, the criteria of "minimum sample mean difference" were added to that of "maximum sample mean" for improving the probability of detection. The improved method could be widely used in complex background images. Finally, an experimental method was designed to analyze the algorithm performance of two different methods. The experimental results show that the number of streak paths filtered by improved method is lower than 50% compared with that former method, and number of clock cycles is reduced from 8.0?10^6 to 7.1?10^6. Improved method can effectively detect multi-moving targets in real time by expanding the reasonable range of threshold to nearly 20.

Keywords: point target detection binary matched filter energy accumulation decision moving target image sequence trace extraction

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