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Detecting slowly moving infrared targets using temporal filtering and association strategy

Key words: Temporal target detection, Slowly moving targets, Graph matching, Target association

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Motivation

- Detecting slowly moving targets in infrared sequences is very useful for many vital tasks, such as low-altitude air defense, air traffic control, and infrared surveillance.
- The special features, such as fewer pixels, shapeless edge, low signal-to-clutter ratio, and low speed, make the detection of small targets rather difficult.
- Some related methods have been proposed in the past few years, they mainly pay attention to suppressing noise and clutters of infrared images. However, these methods rarely consider the association information of targets in consecutive images.

Main idea

- In the first stage, the temporal filtering, temporal target accumulation, and cross-product filtering are combined to suppress heavy noise and clutters in infrared images.
- In the second stage, the association strategy is used to associate the detections obtained from consecutive images and suppress false alarms further.

Method

1. Suppress complex background based on temporal max filtering and temporal median filtering, enhance the targets by the temporal target fusion scheme, and reduce false alarms based on cross-product filtering.
2. Associate the temporal detections, and suppress the false alarms further based on graph matching model and target association strategy.
3. Carry out real data experiments and comparison with several baseline methods.

Major results

- Compared with five methods, our method considers the association information of temporal detections, and obtains better detection performance.

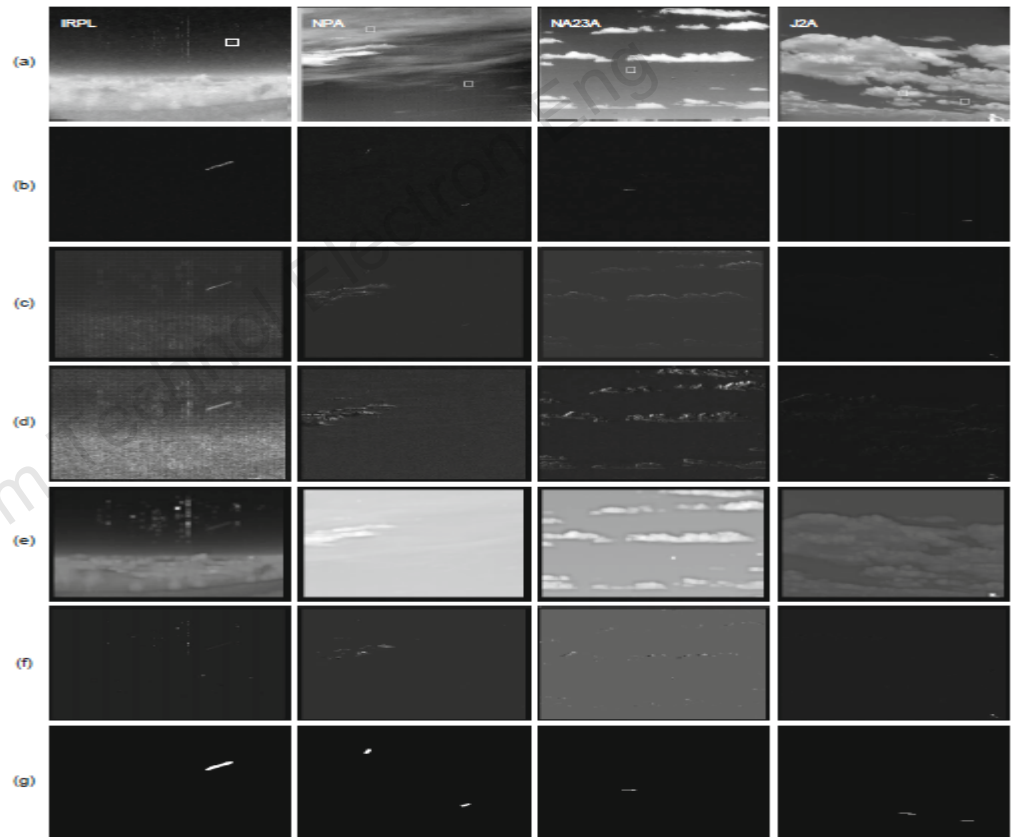


Fig. 3 Comparison of detection results of the proposed method and five baseline methods on four sequences (IRPL, NPA, NA23A, and J2A): (a) original images; (b) nonlinear adaptive filtering (NAF) method; (c) spatial-temporal local contrast (STLC) method; (d) temporal contrast (TC) method; (e) local contrast (LC) method; (f) patch-image (PI) method; (g) our proposed method

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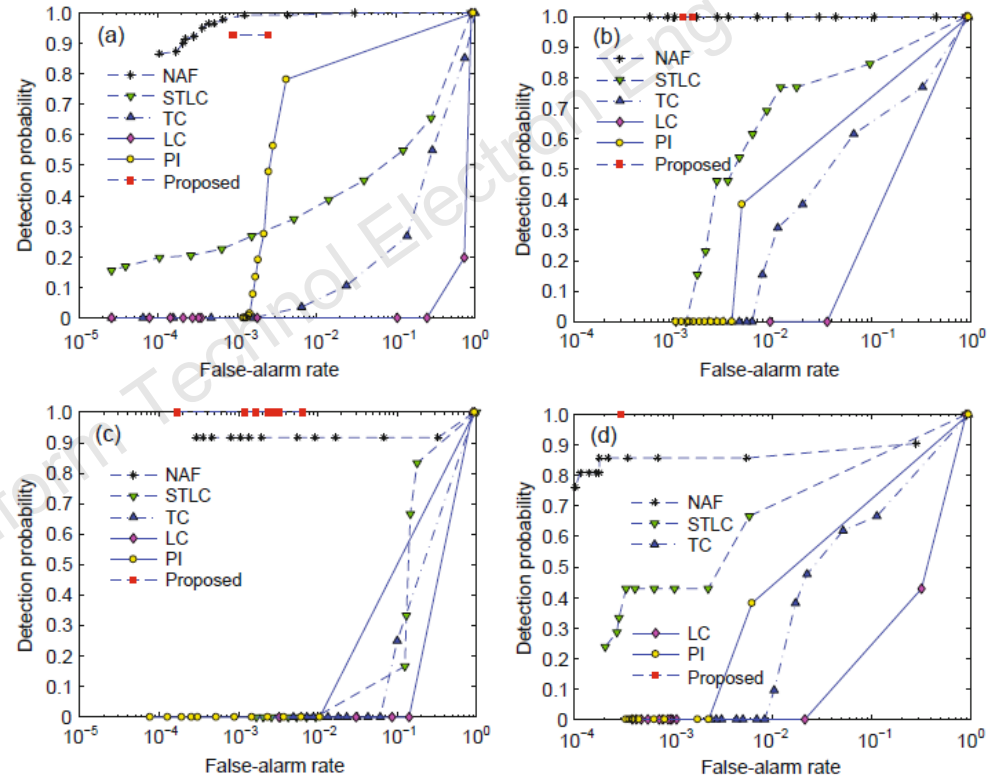


Fig. 4 ROC curves of the proposed method and five baseline methods obtained from sequences IRPL (a), NPA (b), NA23A (c), and J2A (d)

Conclusions

- In this paper, an infrared target detection algorithm based on temporal filtering and target association has been proposed.
- Bright cloud clutter and strong noise is suppressed based on the proposed temporal target detection model, and false alarms can be further reduced using the target association method.
- Real data experiments show that the proposed method has better detection performance in comparison with several baseline methods.