The Near-air Infrared Object Tracking Dataset

CHENYUAN ZHENG, YUANZENG CHENG and QIANG FU

ABSTRACT

In recent years, the tracking methods for near-air infrared objects have been developed rapidly, but there is no dataset for the evaluation of these methods. In view of this, a series of near-air infrared sequences was collected by the aircraft, then the dataset for near-air infrared object tracking was accomplished. The dataset is aimed at various challenges of the short-term single-object tracking, and it followed the VOT-TIR2015.

INTRODUCTION

With the progress of science and technology, image processing and computer vision technology have been rapidly developed. As one most important part of image processing and computer vision technology, object tracking has attracted significant attention. In the past two decades, ICCV, ECCV and CVPR, which are high profile conferences, have accepted a large number of papers on motion and object tracking every year. However, there are a few effective benchmarks or datasets for these tracking methods, so it is difficult to assess the developments of this field. Recently, some researchers focus on the challenges of visual tracking, and have established various datasets to evaluate the tracking algorithm’s performances. At the same time, we can find that there are so many researches pay attention to the visual tracking and have published some datasets, such as VOT-2015 [1]. As for the infrared object tracking, we only know VOT-TIR2015 [2].

In recent years, with the characters of long distance, anti-glare interference, all-weather ability, strong covert and can identify hidden targets, infrared thermal imaging system has been widely used in military and civil areas. Actually, as the infrared thermal imager makes images by the heat of the object radiation, so there is only a little texture information about the target. Similarly, using sensor may lead the obtaining images with noise, and the targets may be submerged in the background. The problems above have a strong impact on the target tracking, and restrict the development of infrared thermal imaging system [3]. So collecting infrared sequences with mixed and different tracking challenges, and then building the dataset by these sequences is meaningful, since the dataset is the base to learn the infrared target and study the tracking method. If not, the research on the infrared target tracking is often fall into talk theory only but not for practical problems due to the lack of necessary supporting data.

Chenyuan Zheng, Yuanzeng Chegn, Qiang Fu. Ordance Engineering College, Shijia zhuang 050003, China.
The VOT-TIR2015, proposed by Michael Felsberg et al, with ground targets (such as car, human, animals and so on) and their tracking challenges (such as occlusion, size change, motion change and so on). So it provides an effective tool in studying the tracking method for the targets in the ground. However, there is no dataset for the near-air infrared object tracking specially, since it is difficult to acquire the relevant sequences and the annotation process is cumbersome. For all this, establishing a certain near-air dataset that with various tracking challenges is significantly important.

Aiming at this problem, we use the aircraft to collect various infrared object sequences in the near-air field, and establish the dataset for the near-air infrared object tracking in this paper. The content of this paper is as follows: in part 2, we analyze the challenges in infrared object tracking; in part 3, we describe the near-air infrared object tracking dataset; and in part 4, we give a summary for our work.

THE CHALLENGES IN INFRARED OBJECT TRACKING

By receiving infrared radiation from the target and the background, the infrared thermal imaging device generates real-time infrared images that corresponding to different temperature distribution. So if we can extract the target position in the image, the object tracking is realized. However, the cameras, the targets, and the background in the image acquisition process, are all will affect the images’ quality we collect, and in turn will affect the tracking results. According to the state and the relationship between the cameras, the targets, and background, we can divide the object tracking challenges into the following three aspects [3,4].

Noise and clutter. When using the infrared sensors to collect images, there may be noise on the infrared images. And when there are strong light, there may be clutter on the images.

Blur. The camera lens residual rain, the fast relative movement between the camera and the object are all may lead to blur in the image.

Motion. The relative motion between the target and the camera affects the target’s position and shape in each frame. The distance changing between the target and the camera affects the size of the target in the image. The relative motion between the camera and the background affects the background in the image. Apart from this, the light intensity and the light unevenness of the backgrounds also can affect the tracking results.

In view of the above, we annotate collected sequences based on these challenges in this paper. According to these, we may further improve the tracking algorithm and realize the accurate and real-time tracking. As for the annotation, the global attributes and local attributes in the part 3 has clearly introduced.

INTRODUCTION OF THE INFRARED DATASET

In this paper, we collect various challenges infrared object sequences by using certain type of aircraft as the object and a certain type of infrared thermal imaging system to acquire the images. Example frames from four sequences are shown in Fig. 1. The length of the sequences ranges from 243 frames to 448 frames. And all the frames in these sequences have a resolution of 382*268 pixels. In addition, the distance changing between the target and the camera has resulted large changes to the
object’s size in the images. As for different size targets, the tracking algorithm may show different performances. Given to these, there define that a point target within 100 pixels, a small target with count of 100 ~ 1000 pixels, and the big target count above 1000 pixels. From this definition, the annotation of the datasets will be more perfectly.

The annotations in this dataset are in accordance with the VOT-TIR2015 annotation process and have been done manually. One object within each sequence is annotated in each frame with a bounding box that encloses the object through-out the sequence. The bounding box is allowed to vary in size but not to rotate. In addition to the bounding box annotations, global attributes are per-sequence annotated and local attributes per-frame annotated [2,4].

Global attributes. The per-sequence global attributes from VOT-TIR2015 have to be adapted to the properties of the near-air infrared object tracking in order to be useful. It concludes two aspects as follows.

Introducing dynamics change and temperature change. Dynamics change indicates whether the dynamics is fixed during the sequence or not. Temperature change refers to changes in the thermal signature of the object during the sequence.

Blur and motion. The camera motion, object motion, background clutter, aspect ratio change, object deformation, scene complexity and blur due to motion, rain or water on the lens. Notably, basing on its size, we regard the object as point target, small target or big target.

Local attributes. The local, per-frame annotated attributes are: camera motion, occlusion, size changes, motion change and so on. These attributes can be used to evaluate the performance of the method on frames with specific attributes.

Figure 1. Snapshots from six sequences included in the near-air infrared object tracking dataset. The annotated bounding box is marked in red.
Since there are some pixels occupied in the small target and the big target, the tracking algorithm can be evaluated by calculating the distance between the center of the tracking box and the center of the ground truth [5]. As for the point targets, there are only a few pixels occupied, so it is unreasonable to evaluate the algorithm as above. In the real sequences, especially the sequences with size changes, the size of the object may change between point target, and small target. Therefore, the characteristics of point targets and small targets must be taken into account when choosing which indexes work. Here, we decided to evaluate the performance of these algorithms with two indexes: ① the distance between the center of the tracking box and the center of the ground truth; ② the overlap between the tracking box and the ground truth box.

SUMMARY

The near-air infrared object tracking dataset plays an important role in the process of developing tracking for the near-air infrared object. And we also get that there are many challenges in making the dataset with a certain scale. On the other hand, finishing the establishment is an urgent problem to be solved if we want to study the tracking method in further. In this paper, we collect near-air infrared object sequences by using certain type of aircraft as the object and a type of infrared thermal imaging system to acquire the images. Based on the sequences, we finished the near-air infrared dataset for short-term and single-object tracking, and then made a detailed introduction to the dataset. It can be believed that this dataset will improve the study in the image processing for the near-air infrared objects. Of course, it is a long-term work to complete the dataset perfectly. In the further, adding more complex scenarios, and multi-objective sequences into the dataset can be considered.

REFERENCES

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