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Research paper

Analysis and tracking of animal movements through granulation of temporal domain (GTD)

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Abstract

Thanks to technological advancement in tracking systems, observing the moving patterns of a population is easier now. Capturing the movement patterns is mostly done through various tracking technologies like GPS, GIS etc. but these tracking systems basically require one or more combination of the same, and also, a node or tag to be placed on the moving object. Tracking of movement patterns basically employs a motion model which describes how the image of the object might change in different possible positions of the object during video surveillance. To track multiple objects without deformation during movement, the granulation of temporal domain (GTD) is proposed.

GTD method is for demodulation of granule adaptation of video image segmentation on the basis of granular computing methodology. In image segmentation, i.e., image granulation through temporal domain, it improves the quality of surveillance important for wild-life protection, and decision making in terms of security.

Keywords: *Video Surveillance; Image Granulation; Background Subtraction; Granular Computing; Temporal and Spatial Domains.*

1. Introduction

While detecting objects [2], [19], the proposed model tracks a single-target object continuously, and accurately measures the distance moved by the target. The objective of single-target tracking is to associate targeted object to the consecutive video frames identified by the video- frame sequences [17]. Real-time processing is required to track the object successfully and effectively, in order to further increase its quali- ty and reduce the quntity of data to be either stored or transferred.

Our work's aim is to detect moving objects which are in the foreground and through the pixels from motion and time-duration, define these objects [7-8]. Our algorithm segments group of pixels consistently according to motion points. These motion points correspond to moving targeted objects [9-10] that may further process from the projection of those moving points and its neighborhoods [11].

The algorithmic approach has been discussed in section 2 of the operational work in methodology. Firstly, the motion of camera is comput- ed so that images can be rectified in step 1, which is finally converted into frames. Background detachment will be inclusive in the flow of the algorithm. And comparison of various frames will be in the matrix form individually. Section 3 elaborates the respective

Framework for the proposed algorithm. Section 4 shows the granular technique concept, image granulation, followed by object granulation in Section 5, with effective results in Section 7. The object in the image streams is finally tracked for further processing, analysis of motion and movement.

2. Methodology

Operational work: While executing the program, a video camera records the area where animals are the objects for input video to detect the movement. By RGB2GRAY, a pre-defined proce- dure that converts colorful video to gray. Then, frames digitize the gray level video output, i.e., the software analyzes individual frames from various background-subtraction algo- rithms so that objects are easily tracked from the background [3], [19]. The proposed method creates motion image from con- secutive pair of frames. For this, moving object extracts from frame 1, as at frame 0 there is no reference image [4]. Through this continual process, motion would be estimated based on previous image. Then transformation matrix will be aligned and both the images will be processed. The whole program will be repeated until the animal schedule on the basis of time domain may not be found. Finally, the result will be stored, observed and compared. The whole methodology automatically constructs a background model through a time domain for effective detec- tion, and finally frames a temporal schedule for those animals. Here, the image matrix, which is, generated (algorithm step 12-

13) To maintain the correlation of objects over time until each moving object is detected and analyzed. The overall architecture is shown in Fig. 1.

2.1 Algorithm

Step 1: Open/ Read the video file.

Step 2: Divide the video file into frames and count the number of frames (say n).

Step 3: For (i = 1 to n)
Read the frame one by one and store into an array of record (say r).
Step 4: Convert each frame into an image.
Step 5: Convert a series of filename with .bmp extensions.
Step 6: Store each frame into files
Step 7: Background would be given as bkground.bmp.
Step 8: Now separate moving object from individual frames.
Step 9: For (i = 1 to n)
Mobject[i] =filename[i].bmp-bkground.bmp.
Step 10: Now create a matrix of moving object after comparing each one.
Step 11: For (i = 1 to n-1)
For (j = i+1 ton) Motion[i] [j] = Obj_Cmp(Mobject[i], Mobject[j])
Step 12: Repeat entire process for each day at the same time interval t-to-t+1 and store the result in another mo- tion matrix
Step 13: Two comparing function
Mot_Row_Compare (entire rwo) and Mot_Column_Compare(en- tire column) for analyz- ing the motion of an object.

3. Proposed architecture for image granulation

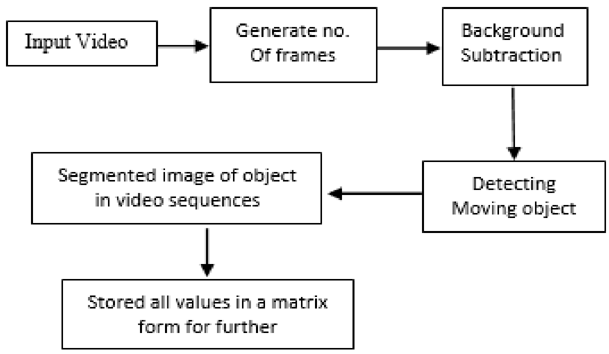


Fig. 1:

The architectural model shows the granulation of an image from a video sequence. To identify the moving objects from that part of video frame, we simply use the basic approach of background sub- traction. Through the entire process, the most challenging part is to develop an effective background subtraction algorithm, so that, dur- ing the image illumination, it should be robust. To resolve this, the model classifies the image pixels on the basis of granules, and then groups them together according to their schedule, in order to iden- tify object time domain. Generally, background segmentation tech- niques result into some bitmap image, where 0 is considered to be the background and 1 to be foreground. Merging these bitmaps is actually called the process of object extraction. An image matrix is generated from these consecutive image frames, and a counter ad- vances whenever movement is detected at a particular location with respect to time domain in a frame. Finally, the method proceeds until the image granulation of temporal domain observes the mov- ing object to make it ready for further analysis and observation.

4. Concept of image granulation through rough sets

Let us consider an information system, say P ≤ Z1, where Z1 rep- resents the universe and P, set of attributes [12].
Suppose Q ⊆ P, then the set {z ε Z1: |z|Q ⊆ Z2} would be Q-lower of Z2 i.e., QZ2 which will always be the subset of Z2. Similarly, the set {z ε Z1: |z|Q ≠ Φ} represents Q-upper of Z2 i.e., QZ2 that indicates a non-zero interaction with Z2.
Here, |z|Q represents equivalence class of object z ε Z1. Rough- ness of any set Z2 with respect to Q will be

Rimage = I – (QZ2 / QZ2).

If the universe, Z1 of any image I of size AXB consists of pixels, then subsets of Z2 would be over-lapping window images of une- qual size. Each window would be considered as a granule of that image which is further approximated by rough sets depending upon the granulation process [1]. To detect the object, we need to form granules by plotting the pixels of an image on gray-level similarity as of limited discernibility. Figure 2 illustrates the set of granules with upper and lower approxima- tions of the pixels of an image.
In this approach, granular sets applied to various areas of image processing rather than on video processing. Here, our focus is on granule sets. Granular Computing Approach simply handles ambi- guities and uncertainties of video images and show effective results. Unlike the conventional methodologies which deals with object tracking from previous frames and consumes large memory, our ap- proach requires less memory, as only in- formation is stored in ma- trix form from the previous two frames

Fig. 2:

5. Object tracking and granulation

The initial step is to find the object from a video sequence as a com- pound granule in the frame. The object can be protruding from its background on the basis of its spatial and temporal like- liness. In this section, we show how the proposed approach di- vides spatial and temporal data for reconstructing the object movement from the targeted frame in the whole tracking pro- cess. Through ths inter- section of both the data, may get the re- gion of the object which may common to both [13][14]. The discernment of an image from moving object depends on its effective granulation. To segment any image, object granulation can be a useful tool [16][18]. The basis notion underlying the granular sets from object granulation is to contrive extent to which a given set of objects approximates another object of interest [14][20]. Object granulation could be of different types with granules of equal or unequal size on the basis of applica- tion, even though unequal granules would be more genuine to the real life world. From this point of state, we need to change the gran- ule parameters (either equal or unequal size) to clandes- tine the object pixels with the smallest granule. So we measure each param- eterized granule as:

$$T\,(n\,(p, q, r, s)) = \frac{O1}{O1 + O2}$$

Where O1 is the total object pixels within each granule, and O2 is the total number of pixels in the image background.

6. Results and discussion

The results obtained from object tracking estimations through gran- ulation of time domain (GTD) are the non-deterministic qualities. The image patterns from video sequences are shown in Figure 3, where large samplings of pixels are not experimented to obtain granulated images. After converting granulated imag- es into frames, we get two sets of images shown in Figure 4(a) and 4(b), respectively, that show motion images from consecu- tive frames. As foresaid, each moving object image would be the difference be- tween the two consecutive frames in the input vid- eo for detecting

movement. The suggested approach for detec- tion and tracking of objects are implemented and examined on various image se- quences. For illustration of results, we are con- sidering two video sequences and 4-5 frames from each se-
quence in Figure 5, which fuel complete picture
of proposed methodology. The object is shown in Figure 6 with the detailed dimensions of the image reference point of pixels. From the results shown, much more effective results of tracked and de- tected objects are found.

Fig. 3:

Fig. 4: a.

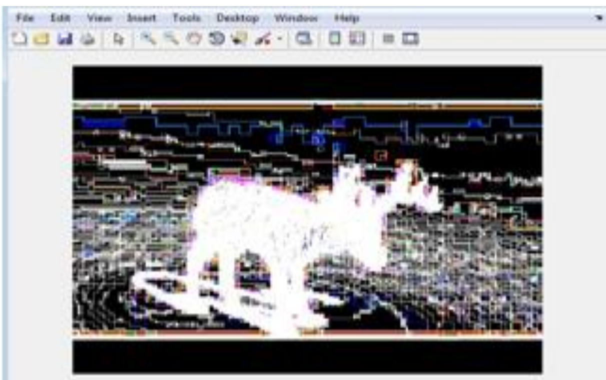
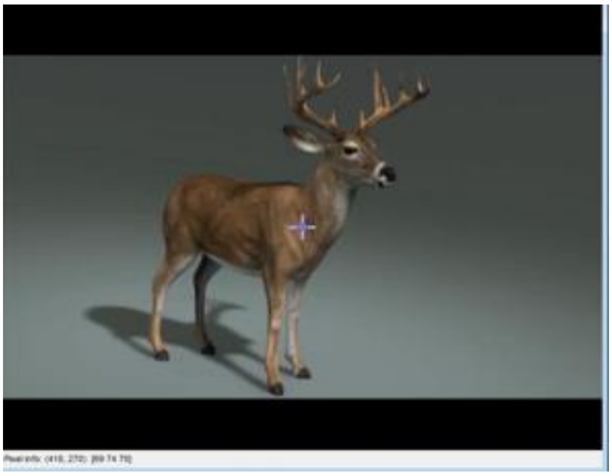


Fig. 4: B.

Fig. 5:



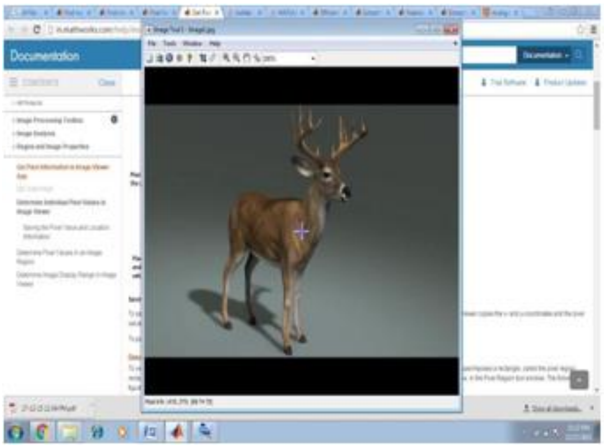


Fig. 6:

7. Aim, application and conclusion

Two situations are encountered while detecting and tracking of ob- jects independently from the background as:

- -Stationary Cameras (fixed viewpoint)
- -Moving Cameras (moving viewpoint)

Object motion can be measured by change in speed vector of an object and object movement by sensing physical movements in given areas. Broad applications of our approach could be as fol- lows:

Surveillance Applica- tions	Control Applications
• Security Cameras • Traffic Monitoring • Population counting	• Object Avoidance • Automatic Guidance & Con- trolling • Head Tracking for Video Con- ferencing

While using static camera, simple frame difference of two imag- es shows moving objects for comparison in reference to back- ground image. Further, comparison has been done between tar- geted or current image with reference image pixel by pixel, through which differences and similarities are identified and observed. So, this par- ametric value makes it less memory inten- sive. In this way, the model copes also with multi-model back- ground distributions.
But, comparatively, our approach may provide various frame- works which comparatively sound effective and useful via its ap- plications.
Our aim is to coordinate the different frames for effective analysis and to iteratively refine them to obtain object statistics,
so granular set on the basis of time domain is finally achieved as demonstrated in Figure 8.

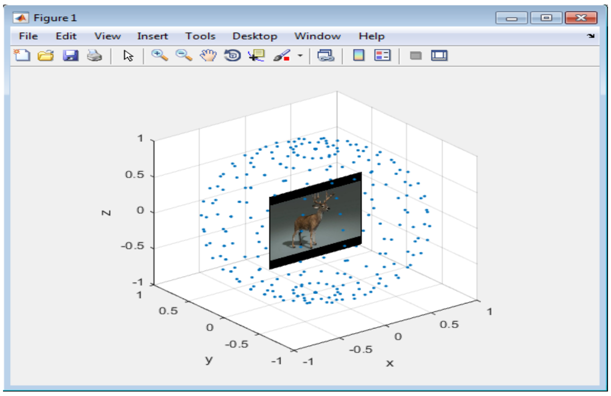
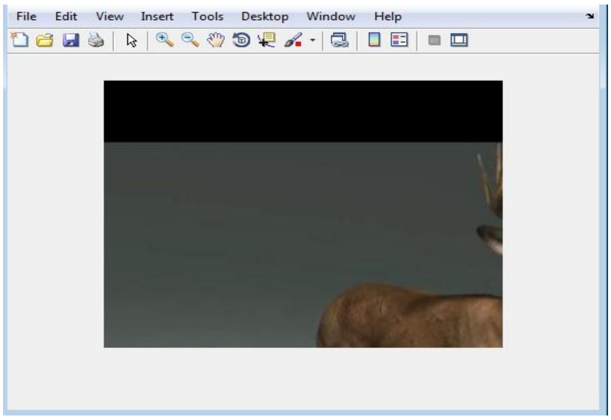


Fig. 7:



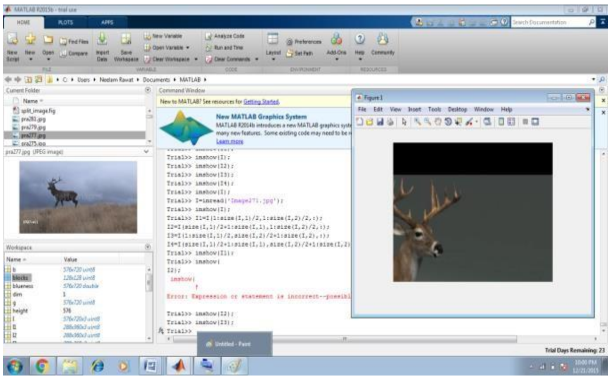


Fig. 8:

8. Conflict of interests

The authors declare that there is no conflict of interest’s regard- ing the publication of this paper.

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