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Neuro-Fuzzy Based Approach on Object Tracking

Marvi Abrol[1]

[1]Department of CSE, SMVDU, Katra, Jammu & Kashmir, India
16mms012@smvdu.ac.in

ABSTRACT

Now a days, real-time object tracking is very important for examining video and processing. There are many approaches like statistical methods and filtering techniques that can be used to track the motion of an object. In this paper, we have proposed Neuro-Fuzzy model which takes location, velocity, color, shape for tracking moving objects from video. Also, neural network is trained for extracting such features of object (location, velocity etc). Furthermore model has the ability to learn more quickly and to produce more accurate results. Fuzzy logic is also used as it provides large range of values rather than crisp data.

Keywords : Target Tracking, Neural Network, Fuzzy Logic, Filtering Technique

I. INTRODUCTION

Object tracking in video scenes has become very popular due to its wider role in human-computer interaction, security and surveillance, traffic control, brain scanning, face detection, people counting, manufacturing industry etc. Tracking is basically a technique that locates multiple moving objects over time with the help of camera. It has become an intensive research in the area of video analysis and processing. Figure 1, shows the key steps of tracking, in which the very first step is to detect the object in a given scenario. Once the object is detected, then detected objects can be classified as humans, vehicles, birds, floating clouds and other moving objects.

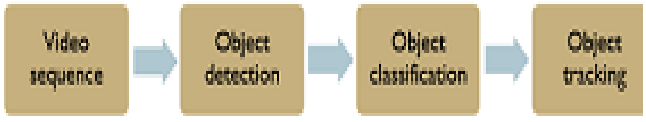

Figure 1

Tracking is basically combination of two problems, one is to identify the presence of object in a video and then to analyze their movement with respect to other objects. The main objective of this paper is to track the target object by extracting its features like position, velocity, color, shape in the pixel domain with the help of neuro-fuzzy model, which is working in a hybrid mode.

II. PROPOSED METHODOLOGY

In this paper, we propose a neuro-fuzzy model for tracking multiple objects. The basic steps in object tracking can be listed as:-

- Identify the objects present in a video.
- Taking frames of the target.
- Foreground / background subtraction.
- Features like location, velocity, color, shape are extracted
- Training and testing of data using neural network based on feature extracted.
- Apply fuzzy logic.

Figure 2, shows the model for tracking object, includes the following components, it takes the input, a video with the help of camera, as the data set for video is available in vision.stanford.edu. The very first step is video processing in which objects present in a scene are identified and are analyzed how these detected objects proceed with respect to each other.

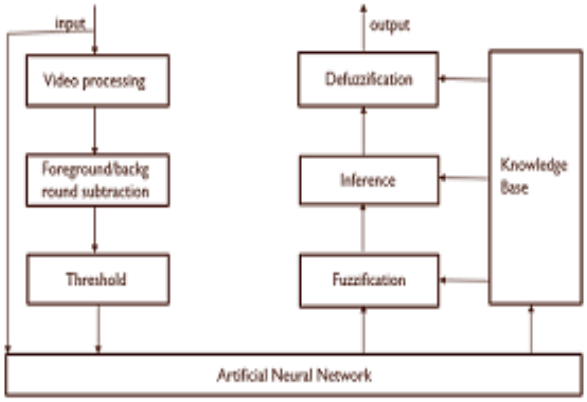

Figure 2

Once the object detected, then separate the foreground from background. This can be done with the help of image thresholding, in which standard threshold value is set. While foreground subtraction we are using kalman filter method. The advantage of using this filtering method is it reduces the effect of noise. Once foreground subtracted, then features like position and velocity are extracted by training neural network. Training reduces errors. 70% of information we use for training purpose and 30% of it for testing purpose. Neural network consists of millions of neurons called units arranged in series of layers. It consists of input units, one or more hidden layers and output layers. Input units receive information from the outside world, here input units are features (position, velocity, color, shape) extracted, which communicates to one or more hidden layers where the actual processing is done through system of weighted connections. The hidden layer then link to an output unit and produces the output. Layers are made up of number of interconnected nodes, which contain activation function, which is used for limiting the amplitude of output of neuron. Also called squashing function commonly used activation functions are given below table:-

Activation function	Equation	Example	1D Graph
Unit step (Heaviside)	$\phi(z) = \begin{cases} 0, & z < 0, \\ 0.5, & z = 0, \\ 1, & z > 0, \end{cases}$	Perceptron variant	
Sign (Signum)	$\phi(z) = \begin{cases} -1, & z < 0, \\ 0, & z = 0, \\ 1, & z > 0, \end{cases}$	Perceptron variant	
Linear	$\phi(z) = z$	Adaline, linear regression	
Piece-wise linear	$\phi(z) = \begin{cases} 1, & z \geq \frac{1}{2}, \\ z + \frac{1}{2}, & -\frac{1}{2} < z < \frac{1}{2}, \\ 0, & z \leq -\frac{1}{2}, \end{cases}$	Support vector machine	
Logistic (sigmoid)	$\phi(z) = \frac{1}{1 + e^{-z}}$	Logistic regression, Multi-layer NN	
Hyperbolic tangent	$\phi(z) = \frac{e^{z} - e^{-z}}{e^{z} + e^{-z}}$	Multi-layer NN	

Once training is done next is to obtain large range of values with the help of fuzzy logic. For such problem fuzzy logic is considered because it calculates the results very successfully within range of solutions, solve easily and compute results by omitting errors. It is a technique that gives range of outputs instead of crisp values. It is based on linguistic model, by linguistic we mean it takes input as well as output linguistic variables rather than numeric values. Fuzzy logic is considered by applying system called "Fuzzy Inference System".

The fuzzy system is partitioned into three steps:-

1. Fuzzification.
2. Fuzzy rules.
3. Defuzzification.

The first step is fuzzification, which converts input data having crisp values into range of fuzzy values by attaching membership function to each element. The output of membership function is a value between 0 and 1. The different membership functions are-

1. Triangular Membership Function

This function creates relationship between real-time problem and the examined fuzzy rule set. Here

real-time examined (say A) calculated against 3 fuzzy set parameters(x, y, z).

$$triangle(A;x,y,z) = \begin{cases} 0, & A \le x. \\ \dfrac{A-x}{y-x}, & y \le A \le x. \\ \dfrac{z-A}{z-y}, & y \le A \le z. \\ 0, & z \le A. \end{cases}$$

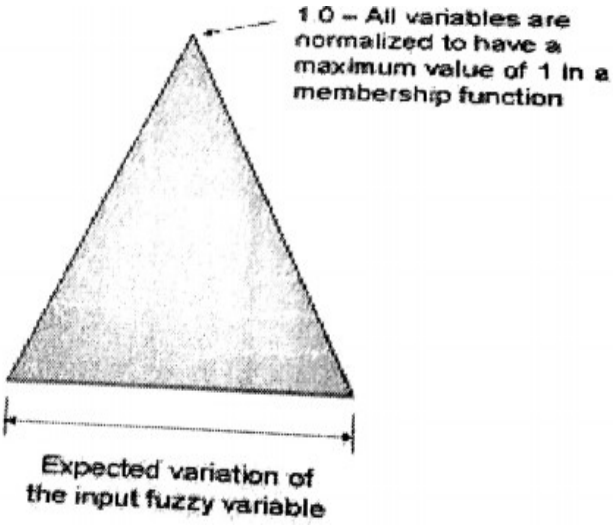

Figure 3. Triangular MFs

2. Trapezoidal Membership Function

This function is used to create a relationship between real-time problem and the observed fuzzy rule set. Here we have real-time considered (say A) calculated against 4 fuzzy set parameters (w, x, y, z)

$$trapezoidal(A;w,x,y,z) = \begin{cases} 0, & A \le w. \\ \dfrac{A-w}{x-w}, & w \le A \le x. \\ 1, & x \le A \le y. \\ \dfrac{z-A}{z-y}, & y \le A \le z. \\ 0, & z \le x. \end{cases}$$

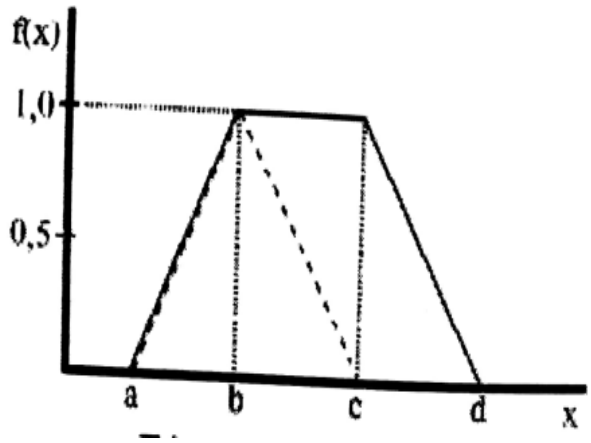

Figure 4. Trapezoidal MFs

3. Gaussian Membership Function

It is defined by considering the relationship between real-time problems (say A) and fuzzy set (z) and σ.

$$gaussian(A;z,\sigma) = e^{-\frac{1}{2}\left(\frac{A-z}{\sigma}\right)^2}.$$

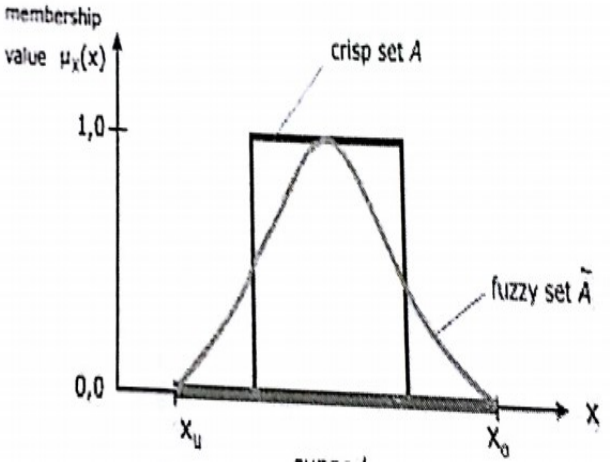

Figure 5. Gaussian MFs

Fuzzy rules is a simple IF-THEN rule with a condition and conclusion, which is created to control the output. The last step is defuzzification in which final result which is a fuzzy outputs are converted into crisp value i.e. single valued output.

III. LITERATURE SURVEY

Tracking is a stepwise approach. Firstly, considering the video with the help of camera and then taking frames of the object of interest from it. While tracking an object, whether it is living or non-living, the basic three steps include such as 1. Object detection, in which object is detected with the help of the following techniques: frame differencing, optical flow and background subtraction. 2. Object classification, in which object is classified on the basis of following features such as shape based, motion based, color based, texture based. Finally, 3. Object tracking using point-based, kernel-based, silhoutte-based tracking technique.

IV.CONCLUSION

In this paper, neural-fuzzy model is proposed for tracking object by extracting different features of target object. Features will be extracted by training neural network so that it can easily track any object to provide better results and deal with, irrespective size, shape. fuzzy rules are constructed which helps in adjusting ranges of input/output membership function depends on the training data and also help in representing the knowledge of motion, able to learn and adapt its behaviour dynamically as it operates. From the discussions, it is cleared that object tracking is widely used in many fields of computer vision, security and surveillance etc.. For tracking, many researchers have traversed and implemented various approaches. Problem domain is the key towards success of a particular approach.

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