Impact Analysis of Type-2 Fuzzy Logic for Weighted Multiple Instance Learning Performance on Motion Blur and Low-Resolution Attributes

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***Abstract*—Type-2 fuzzy logic is an extension of type-1 fuzzy logic. Type-2 fuzzy logic can model an uncertainty better than type-1 fuzzy logic. Because it can model uncertainty well, type-2 fuzzy logic is very well used for decision making. In weighted multiple instance learning (WMIL), the tracker has not been able to decide whether the tracker has failed or not. In this paper, we analyze the influence of Type-2 fuzzy logic for WMIL performance on the motion blur and low-resolution attributes. Based on the experimental results, WMIL's performance blur increased by 0.0725 while in the low-resolution attribute, WMIL's performance decreased by -0.0045 when compared to WMIL without fuzzy logic type-2. The parameters used to analyze performance are success plot and precision plot.**

***Index Terms*—Type-2 fuzzy logic, weighted multiple instance learning, motion blur, low-resolution, object tracking.**

I. Introduction

There have been many research on object tracking algorithms that can improve performance from previous methods. One of them is weighted multiple instance learning (WMIL), which it is an algorithm modified from a pre-existing method, namely multiple instances learning (MIL). On [1], Zhang and Song explained that WMIL is more accurate and more efficient than MIL because it can select more effective features. Although WMIL is an update algorithm and has been modified, WMIL cannot determine whether the tracking results are incorrect or correct as explained in [2]. Although the result has drifted, the tracker will keep tracking [3]. In this paper, we use type-2 fuzzy logic to detect failures from WMIL output.

II. System Model

We use type-2 fuzzy logic to detect failures in WMIL output. WMIL's output is the bounding box of the selected object based on the maximum probability of the sample in the strong classifier. Where the strong classifier is defined as:

$$H_K = \sum_{k=1}^{K} h_k(x) \tag{1}$$

where $h_k(x)$ is weak classifier.

From this bounding box, parameters used in type-2 fuzzy logic in TABLE I, the Bhattacharyya coefficient and also the centroid center point can be calculated to detect the failure. In general, type-2 fuzzy logic consists of 4 main processes, those are fuzzification, inference, type reduction, and defuzzification [4].

TABLE I
The Parameter of Fuzzy

No.	Parameter	Membership
1.	Distance	Near
		Far
2.	Bhattacharyya Coefficient	Similar
		Not Similar

In this paper, the distance parameter has range from 0 to 1 as we can see in Fig 6 and Bhattacharyya parameter has range 0 to 500 in Fig 2.

There are 4 rules used in this fuzzy system:

1) if the distance is near and Bhattacharyya coefficient is similar, the output is successful.
2) if the distance is near and Bhattacharyya coefficient is not similar, the output is successful.
3) if the distance is far and Bhattacharyya coefficient is similar, the output is failed.
4) if the distance is far and Bhattacharyya coefficient is not similar, the output is failed.

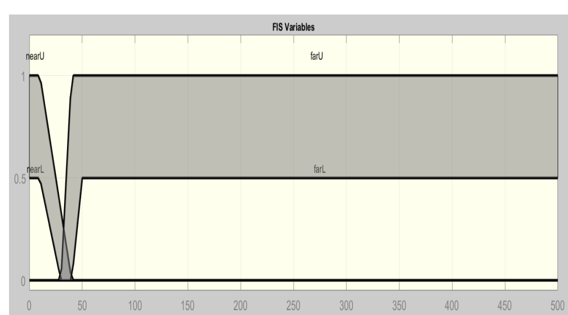

Fig. 1. Membership representation from the distance parameter

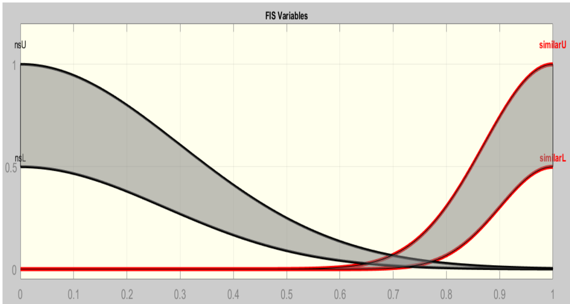

Fig. 2. Membership representation of bhattacharya coefficient parameters

III. EXPERIMENTAL RESULT

We evaluate our system using OTB-50 based on success plot and precision plots parameter. OTB-50 has 50 datasets that we use for evaluating [5]. From the results of experimental result, for the motion blur attribute, the performance results of our system increased by 0.08 based on precision plots in Fig 3 and 0.065 based on success plots in Fig 4. This result shows us that this method is good for motion blur where color histogram-based representation is sensitive to motion blur [6].

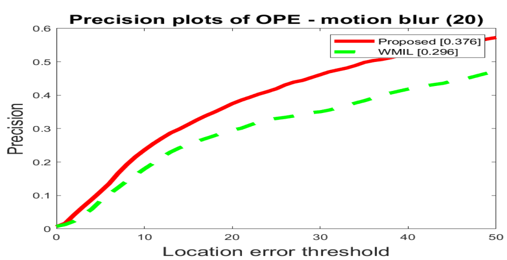

Fig. 3. Precision plot for motion blur attribute

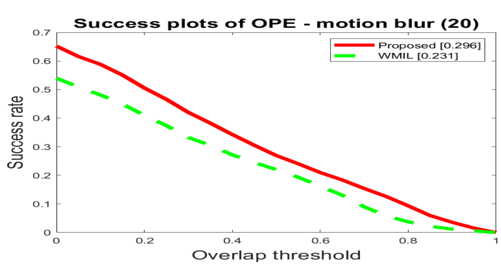

Fig. 4. Success plot for motion blur attribute

As for the low-resolution attribute, the performance of our system has decreased by -0.005 and -0.0004 can be seen from fig.5 and fig.6.

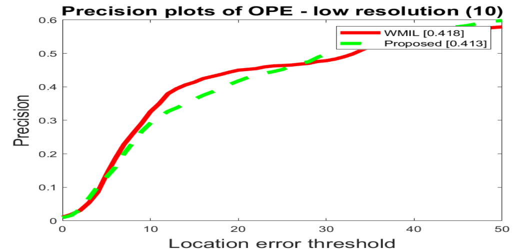

Fig. 5. Precision plot for low resolution attribute

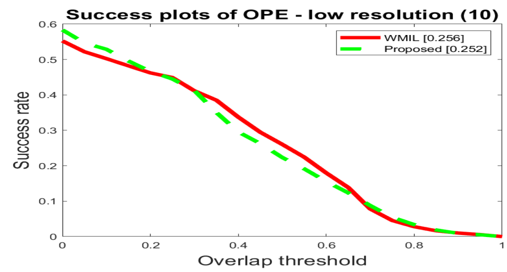

Fig. 6. Success plot for low resolution attribute

IV. CONCLUSION

We have proposed an online weighted multiple instance learning using interval type-2 fuzzy logic which can detect failure while tracking. On the proposed method, we conduct some experiments. From the experimental results, type-2 fuzzy logic can improve the performance of weighted multiple instance learning for the motion blur attribute. However, for the low-resolution attribute there was a decline in performance. This is very influenced by the parameters used in fuzzy systems.

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