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A NEW HEBBIAN-TYPE METHOD FOR SOFT DECISION METHOD

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ABSTRACT:

This article presents an information decision method for information provided by a recognition system composed by two video cameras and two infrared cameras. From each of the video and infrared cameras systems, geometric characteristics are obtained which in are used information fusion. The decision, for determining the label of the object captured in the images is made using a hard type method and a soft type rule by considering an original algorithm based on a modified Hebb-law.

KEY WORDS:

Hebb-law, hard decision method, soft information

INTRODUCTION

The complexity of the captured images, and the numerous parameters that can influence the localization and recognition in images determined the appearance of numerous articles, which propose a vast number of methods [1, 2]. One issue of this subject is to improve the rate of correct recognition using information fusion. It was proposed numerous fusion methods, each having advantages in different situations. But in the end it must be made a decision to relate or not the unknown object with one prototype or cluster. It can be use a hard decision in which every input has a well definite value, or for improving the correct labeling process it can be made a decision, not only on one information fusion results, but based on a set of information fusion, which can be adaptive. This means that the decision can be computed taking in relation different types of fusion, hopefully having different theoretically fundaments and the importance of every fusion method on the result can be based on the past experience. Applying this point of view it can be obtained an adaptive algorithm.

DECISION METHOD

The decision which is determined in this article is used for establishing recognition of an object, using a video and an infrared camera set. From the geometrical characteristics obtained by processing the images, a set of information fusions are determined. The algorithms use for obtaining the results are: heuristic fusion, fuzzy fusion and reinforce fusion [3, 4] denoted respectively with μi $(i \quad \{E, F, C\})$. This fusion results are fuzzy numbers, having more accurate information contains. The reason of using these methods is based on the different theoretical fundaments of these information fusions.

Taking a decision implies a set of inputs, a method and an output which usually is a binary type number, meaning the acceptance or not of the decision. The inputs can be crisp numbers, which determine a specific method, like voting, median result or average determination. The problems with this type of inputs are that is a rigid one, information being lost in the process of inputs determination, (like the fusion results in this experiment). In the case of using soft decision methods, it can be conserved the entire information of the inputs by including both the value and the membership value obtained from the fusion process. In our experiments, for evaluation, we used a hard decision method and a soft adaptive method

2.1. Hard method

This method is based on majority type decision. First, the three information fusion results are convert to crisp numbers D_i by comparing the membership of this values μ_i ($i \quad \{E, F, C\}$) to a threshold θ, (which is usually ½). The final decision is obtained using the relation (1).

$$D_H = \begin{cases} 1 & card\,(D_i = 1) \quad \{2;3\} \\ 0 & card\,(D_i = 1) \quad \{0;1\} \end{cases} \qquad (1)$$

where D_H represents the hard type of decision.

2.2. Soft method

The soft decision is based on a reverse type of approach. First is made the decision, and only in the end is determined the crisp result. That means that is used of the weigh sum of the fusion results memberships, as is presented in relation (2).

$$D_S = \begin{cases} 1 \,|\, (a \cdot \mu_E + b \cdot \mu_F + c \cdot \mu_C \geq \theta \\ 0 \,|\, (a \cdot \mu_E + b \cdot \mu_F + c \cdot \mu_C < \theta \end{cases} \qquad (2)$$

where $a,b,c \quad [0;1]$ are the weigh constants, and the following relation must be satisfied: a+b+c=1

Similar to the method used in hard decision, θ, is a threshold applied for obtaining the crisp number. Usually, is used a value = ½., which corresponds to the maximum uncertainty [6].

The weigh constants are obtained by an iterative method, by tuning these values using a learning process based on comparing the obtain result with the real situation. Soft decision can be obtained using another method for determining the constants, based on Hebb type learning. This procedure applied in artificial neural networks, is based on the reinforcement of the most used constants.

In this case is used the following relation (3) (see [5]):

$$w_{ij} = \alpha \quad y_j \quad x_i - \phi \quad y_j \quad w_{ij} \tag{3}$$

where x_i , y_j is the i input and respectively j output, w_{ij} is the weight of mutual connection, and α , ϕ represents the learning and respectively the forgetting constant used in the learning process The new relation proposed in this article is:

$$\Delta coef_i^t = \alpha \cdot D_i - \phi \cdot \varepsilon_i \tag{4}$$

where i $\{E, F, C\}$,
and

$$coef_i^t = \begin{cases} a^t \mid i = E \\ b^t \mid i = F \\ c^t \mid i = C \end{cases}$$

The constants a, b and c are obtained by updating at t+1 period of time the previous constants used in moment t. Also it must be done a normalization operation in order to maintain the constants sum equal with one.

In order to obtain the constant a, by applying this new method, it will be used the following relation

$$a = \frac{a^{t+1}}{a^{t+1} + b^{t+1} + c^{t+1}} \tag{5}$$

where

$$a^{t+1} = a + \quad a^{t} \tag{6}$$

Constants *b* and *c* are obtained using similar relations.

Similar with the original Hebb artificial neural network method the learning and the forgetting constants will take the following values α = 0,1, respectively ϕ = 0,01,which had be proved to conduct to the best results in the testing process.

It must be observed that even if in this article the two above mention constraints have kept the original names from the Hebb method, in this new relations, it have different meaning, adapted to the decision process. Thus, the α constant is used to weight the right decision, increasing the influence of the specified fusion method. Similar, the ϕ constant is used to decrease the weight of the fusion method, reflecting the influence on the result of the errors.

CONCLUSIONS

For images recognition we have proposed a decision method system composed by two video cameras and two infrared cameras. This system is used for computing three information fusion results, based on: a heuristic method, a fuzzy method and a reinforcement method, which were selected because having different theoretical bases. For each of video and infrared cameras systems, geometric characteristics are obtained which are used in the three types of information fusion.

As a first result of this article, based on the results obtains from these three fusion methods, is proved that the soft decision method is better performing that the hard decision method.

Based on this conclusion it was taken in consideration a new soft decision method, by using a modified Hebb-law. This adaptation of an artificial neural network to a decision method has proved that by using a training based constants it can be improved the decision results. The results are explained because this type of method increase the influence of the better fitting fusion method, for various real conditions

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