FUZZY MODEL OF INTERSECTED IMAGES RECOGNITION BASED ON THE THEORY OF POSSIBILITIES

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Abstract

In practice we frequently have a case, when a recognized image is required to be referred to one of the standard intersected images.

In the paper simulated fuzzy model of intersected object recognition, some singularities of its algorithmic and program implementation and fundamental advantages prior to precise model of this type object recognition are considered.

1. INTRODUCTION

The truth of images recognition is defined in many respects by quality of model of the decisions making about of an entrance image to that or other reference class in conditions intersectance these classes.

As is known, the difference of different images arises on two reasons: natural difference of various images and difference connected with errors of measurement of parameters of images. The latter creates determined difficulties in identifying recognised image with one of the standards. Therefore, minimisation of difference, connected with errors of parameters of images is problematic and its realisation represents large interest for science and practice.

There is set of methods of minimisation of errors of an estimation measure of closeness among objects (MCAO) [2]. However, despite accepted measures on reduction errors a part from them remains and creates a problem at decisions making on recognition of images.

This problem concludes in creation of a zone uncertainty between the next classes, which are usually concludes. It arises around a point of crossing of classes and its width required truth of recognition depends as far as images does not correspond to provided accuracy of measurement values of objects attributes.

Existing techniques of increase of truth of decisions making are not taken into account by individual peculiarities of the theory errors of measurements of sizes and independently try to decide this problem with the help of various mathematical methods [3].

However, as researches have shown, zone un of uncertainty between classes connected with errors of measurement of parameters images is necessary to narrow with use of knowledge from area the theories of measurements, errors and casual sizes for realisation algorithms on authentic recognition of images.

2. SOLUTION

Let two crossed classes set as standard file $\{y_{1,\ i}\}_{i=1,18}$ and $\{y_{2,\ i}\}_{i=1,18}$ and recogni~~sable~~ identifiable file $\{x_i\}_{i=1,18}$. It is required to find to which of two classes $\{y_{1,\ i}\}_{i=1,18}$ and $\{y_{2,\ i}\}_{i=1,18}$ belongs recognisable a file $\{x_i\}_{i=1,18}$.

As recognition of images is definition of similarity between recognised and standard images and as it is known a measure similarities, is based on an opportunity so, for the decision supplied problem the theory of opportunities, is new interpretation of the theory of fuzzy sets, formulated in 1983 L.A. Zadeh [1].

Crux of the theory consists that the sets are considered as "distributions of opportunities ", i.e. as sets more or less possible variable values. Distribution of opportunities is main attribute in representation of the inexact information in to the problem of an approached reasoning [2].

For calculation of a degree of the validity production of rules as far as the conclusion corresponds (meets to the validity) in many intelligent systems operation of fuzzy similarity is applied [2] a_1=a_2, where a_1 and a_2 - accordingly linguistic values, the operation " is close to k.... ". This operation is defined as the measure of an opportunity that value a1 is equal to value a_2 [2].

For the decision of a supplied problem given files, subordinated to the normal law, fuzzy by numbers. Then for each of $\{x_i\}_{i=1, 18}$ functions are calculated fittings $a_1(u)$ and $a_2(u)$, where under $a_1(u)$ and $a_2(u)$ is understood, correspondingly, fitting of an attribute u of an image to standard images y_1 and y_2 [2]:

$$a_1(u)=\begin{cases} 1-\dfrac{ml_1-u}{1} & \text{if } ml_1 - a_1 < u < ml_1 \\ 1 & \text{, if } ml_1 < u < mr_1 \\ 1 \quad \dfrac{u-ml_1}{1} & \text{, if } mr_1 < u < mr_1 + b \\ 0 & \text{, in the other cases} \end{cases} \qquad (1)$$

$$a_2(u)=\begin{cases} 1-\dfrac{ml_2-u}{2} & \text{, if } ml_2 - a_2 < u < ml_2 \\ 1 & \text{, if } ml_2 < u < mr_2 \\ 1 \quad \dfrac{u-mr_2}{2} & \text{, if } mr_2 < u < mr_2 + b \\ 0 & \text{, in the other cases} \end{cases} \qquad (2)$$

The parameters, included in (1) and (2) are estimated following way:

$$ml_1=m_{y1} - \sigma_{y1}, \qquad (3)$$
$$mr_1 = m_{y1}+\sigma_{y1} , \qquad (4)$$
$$ml_2 = m_{y2} - \sigma_{y2}, \qquad (5)$$
$$mr_{2s} = m_{y2} +\sigma_{y2} , \qquad (6)$$

Where m_{y1} and m_{y2} - accordingly, mathematical expectation of first and the second reference objects; σ_{y1} and σ_{y2} - accordingly, average quadratic deviations of the first and second reference objects.

The choice a_1, b_1, a_2, b_2 is a little bit problematic. Their values depend on interclassed (m_{y2}-m_{y1}) and intraclassed of distances (σ_{y1}, σ_{y2}). Therefore we choose: $a_1=\sigma_{y1}=b_1$=8,37 and $a_2=\sigma_{y2}=b_2$=8.00 .

As a result of calculation we receive two fuzzy sets, we shall conditionally name them: A= APPROXIMATELY to y_1 and B= APPROXIMATELY to y_2.

The subsequent actions are carried out on following algorithm:

A = APPROXIMATELY to y_1 {0.17/1010; 0/1026; 0/1007; /1013; 0/1021; 0/1015; 0/1008; 0/1012; 0/996; 0.14/1005; 0/1014; 1/999; 0/991; 0/1007; 0/1012; 0.14/1005; 0/1016; 0/1012}.

B = APPROXIMATELY to y_2 {0/0.98; 0/1026; 0.5/1007; 1/1013; 0.3/1021; 1/1015; 0.6/1008; 1/1012; 0/996; 0.2/1005; 1/1014; 0/999; 0/991; 0.5/1007; 1/1012; 0.2/1005; 0.9/1016; 1/1012}.

We break A in level sets, it is meant sets a of a level, defined as:

$$A_a= \{x \mid A (x) > a, x (X\}, \qquad (7)$$

where A - fuzzy subset of final set X = $\{x_1, x_2,..., x_n\}$.

In other words, A - precise subset of set X, which contain those elements, the value of degrees of a fitting is less than a.

In particular, for the decision of a problem, level subset we choose following: $0 < a_1 < 0.25$, $0.25 < a_2 < 0.50$, $0.5 < a_3 < 0.75$, $0.75 < a_4 < 1$. On level a subset $0 < a_1 < 0.25$ are the following elements first level of an fuzzy subset A_{a1} = { 1010; 1005; 1005} .Level subset $0.25 < a_2 < 0.50$ the subset empty, as there elements satisfying to the condition (11). We receive and level $0.5<a_3<0.75$ on subset $0.75 < a_4 < 1$ there is only one element A_{a4} = {999}.

The average value at levels are equal: M_1 = 1006,7; M_2 = 0; M_3 = 0; M_4 = 999.

Value of function of ordering, facilitating comparison fuzzy subsets of an individual interval, represents integral of unification fuzzy level of subsets [3]:

$$F(A) = \int_0^1 M(A_a) = \int_0^{0.25} 1006{,}7\,da + \int_{0.75}^1 999\,da = 2005{,}7$$

We make the same actions and for fuzzy set B:

For an interval $0 < a_1 < 0.25$ B_{a1} = {1005,1005};
For an interval $0.25 < a_2 < 0.50$ B_{a2} = {1007,1021,1007} ;
For an interval $0.5 < a_3 < 0.75$ B_{a3} = {1008} ;
For an interval $0.75 <a_4<1$ B_{a4}={1010;1013; 1015; 1012; 1014; 1012; 1016; 1012;}.

The average values at levels are equal: M_1=1005; M_2=1011,7; M_3 =1008; M_4=1013.

The function of ordering for set B is calculated in accordance with an image and is equal 2021,8.

Comparing values of functions of ordering F (A) and F (B) seeing that the fuzzy subset A is less than fuzzy subset B, therefore the object approximately concerns to a class y_2.

The circuit of algorithm is submitted on fig. 1. Through the block 2 data of classes $\{y_{1,\ i}\}_{i = 1,\ 18}$ and $\{y_{2,\ i}\}_{i = 1,\ 18}$ and are entered recognising of a file $\{x_i\}_{i = 1,\ 18}$. In the block 3 addresses in the subroutine in which are calculated mathematical expectation and average quadratic deviations of given files. Blocks 4-7 organises cycles, in which occurs ranging of elements file by way of increase. In blocks 8- 11 occurs definition of dependencies between mathematical expectations with average quadratic deviations of classes $\{y_{1,\ i}\}_{i = 1,\ 18}$ and $\{y_{2,\ i}\}_{i = 1,\ 18}$ with intraclass distances, at approximation given files subordinated to the normal law fuzzy numbers.

In blocks 12- 19 and 20- 27 cycles will be organised, accordingly, functions of a fitting are calculated of a file of the rather first and second classes.

In the block 28 the manipulation to the second subroutine comes true,
in which subsets of levels and calculation of average values are defined at each level. As entrance data in the subroutine are set a file $?_{?1}$, values of functions of a fitting rather standard file $\{y_{1,\ i}\}_{i = 1,\ 18}$, left and right borders first fuzzy sublevels and standard file $\{x_i\}_{i = 1,\ 18}$. The block 29 checks a condition of presence of elements and at each level. If at a given level there are no elements of satisfying to condition, the appropriate message (block 30), in is given out opposite case a file of elements first sublevel is printed and average value at this level (block 31).

The same actions are made for second (blocks 32- 35), third (blocks 36- 39) and fourth fuzzy sublevels (blocks 40- 43). The block 44 calculates function of ordering.

The similar actions are made for a file MA_2, values of function of a fitting concerning a class $\{y_{2,\ i}\}_{1=1,\ 18}$ (blocks 45- 61). In the block 62 value of functions of ordering is compared. In case of satisfaction of a condition the message is given out about recognised of a file to a class $\{y_{1,\ i}\}_{i=1,\ 18}$ (block 63), message on a fitting to is otherwise given out to class $\{y_{2,\ i}\}_{i= 1,\ 18}$.

The second variant of algorithm of fuzzy making is also developed the decisions at recognition of crossed images. Function evaluation of a fitting the rather first and second classes, and also previous to this action are similar to the previous variant (blocks 1- 27). In the block 28 a cycle in which will be organised there are the minima from files of values of functions of a fitting of rather first and the second classes, which are written down in a file MA. In the block 32-35 there is the maximum element of this file. In the block 36 number will be a organised counter S1 and S2 for calculation, accordingly, to the first and second classes.

In the block 37 a cycle for acceptance of the decisions, where will be organised

The maximum value of a file MA (MA_MAX) is compared with by values of a file MA (i.e. with values of function of a fitting the rather second class (block 38). In case of satisfaction conditions the value of the appropriate counter is increased on unit (the block 39) and is given out the message about of an object to class y1 the converse condition (block is otherwise checked 41) and in case of satisfaction, the meaning value of the counter is increased on unit (the block 42) and is given out the message about an object to a class y_2.

The block 44 finishes a stage of fuzzy of the decisions making, where value of counters is checked. In case of satisfaction of a condition the message on a fitting to a class y_1 (block 45), otherwise the converse condition (block 46) is checked, case of satisfaction of a condition the message on a fitting is given out to a class y_2 and fulfilment of the program (block 47) is finished.

3. CONCLUSION

Results of machine modelling show, that using theory possibilities for intersected patterns recognition increase truth and speed solution given problem.

4. REFERENCES

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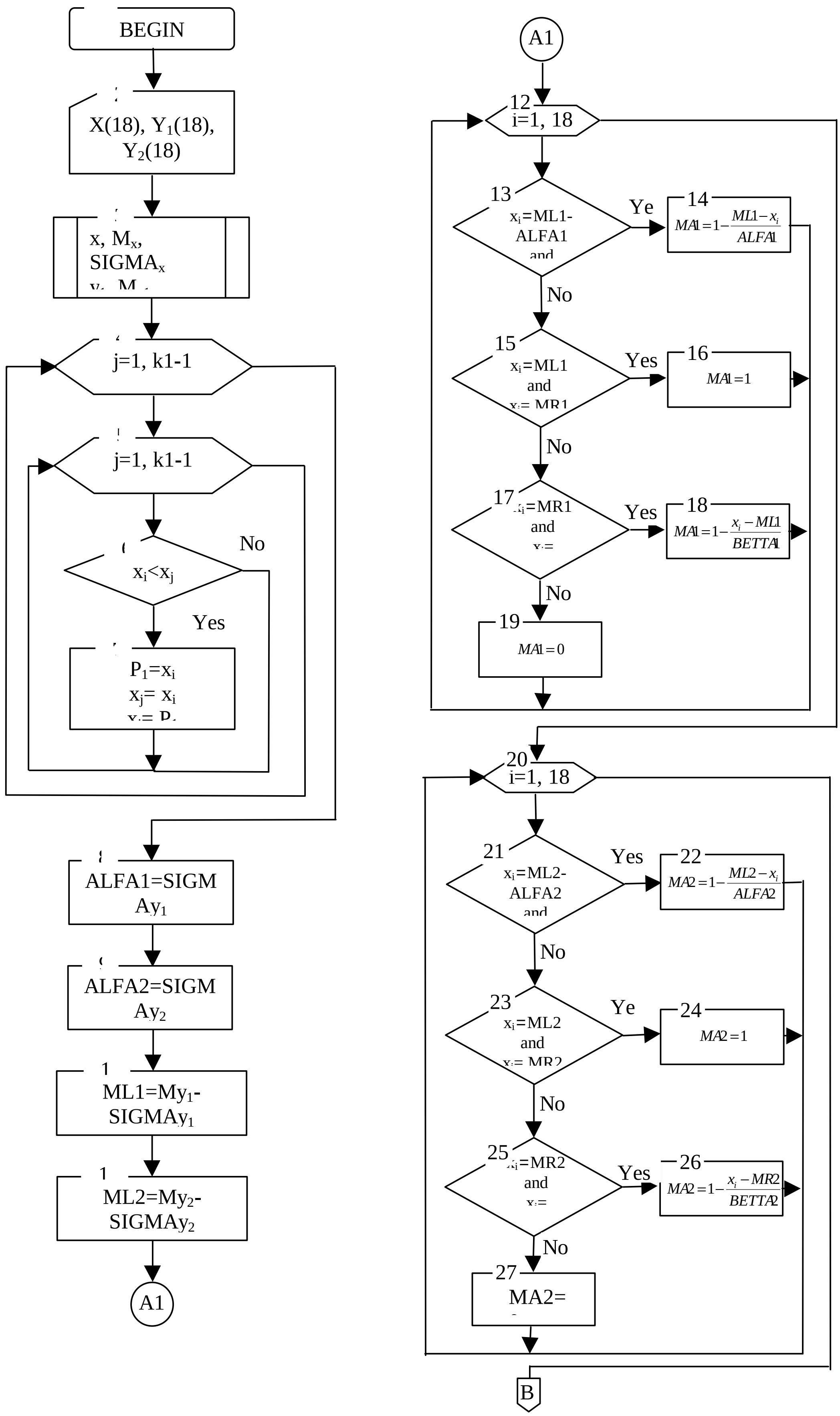
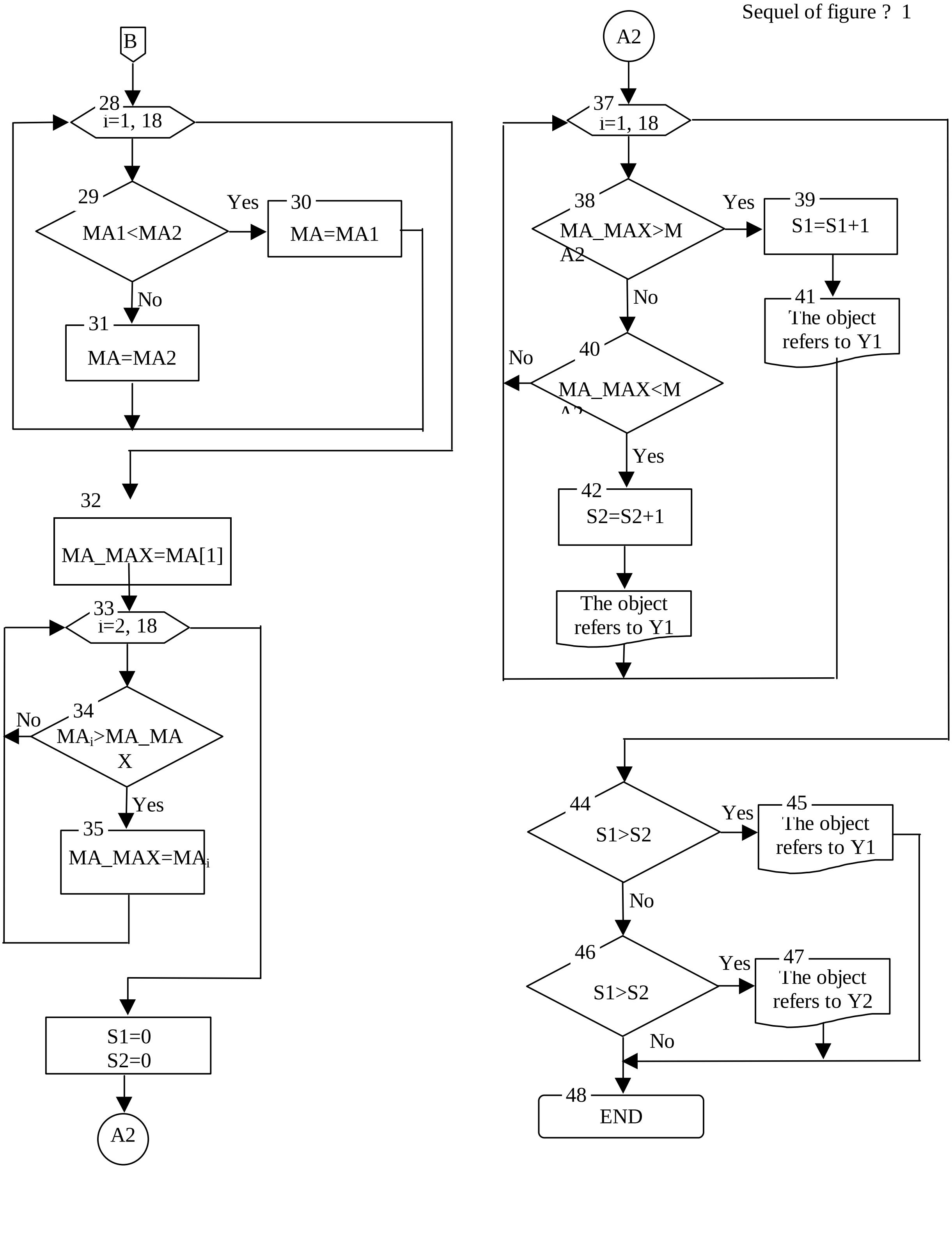

BEGIN
X(18), Y1(18), Y2(18)
x, Mx, SIGMAx
j=1, k1-1
j=1, k1-1
xi<xj
No
Yes
P1=xi
xj= xi
ALFA1=SIGMAy1
ALFA2=SIGMAy2
ML1=My1-SIGMAy1
ML2=My2-SIGMAy2
A1
A1
12
i=1, 18
13
xi=ML1-ALFA1
Ye
14
MA1=1-(ML1-xi)/ALFA1
No
15
xi=ML1
and
Yes
16
MA1=1
No
17
xi=MR1
and
Yes
18
MA1=1-(xi-ML1)/BETTA1
No
19
MA1=0
20
i=1, 18
21
xi=ML2-ALFA2
Yes
22
MA2=1-(ML2-xi)/ALFA2
No
23
xi=ML2
and
Ye
24
MA2=1
No
25
xi=MR2
and
Yes
26
MA2=1-(xi-MR2)/BETTA2
No
27
MA2=
B

Figure.1

Sequel of figure ? 1



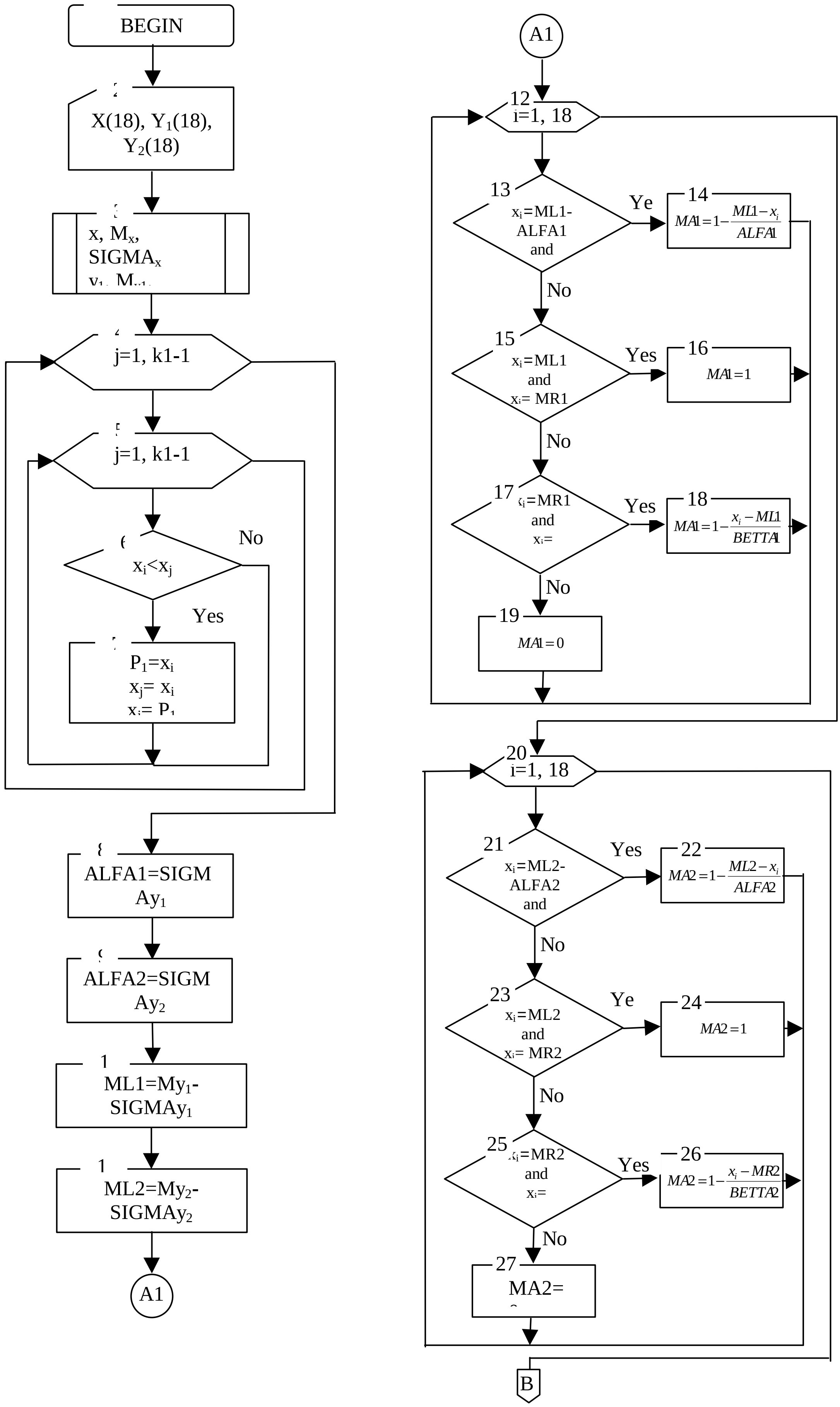

BEGIN
X(18), Y1(18), Y2(18)
x, Mx, SIGMAx
j=1, k1-1
j=1, k1-1
xi<xj
No
Yes
P1=xi
xj= xi
ALFA1=SIGMAy1
ALFA2=SIGMAy2
ML1=My1-SIGMAy1
ML2=My2-SIGMAy2
A1
A1
12
i=1, 18
13
xi=ML1-ALFA1
and
Ye
14
MA1=1-(ML1-xi)/ALFA1
No
15
xi=ML1
and
xi= MR1
Yes
16
MA1=1
No
17
xi=MR1
and
Yes
18
MA1=1-(xi-ML1)/BETTA1
No
19
MA1=0
20
i=1, 18
21
xi=ML2-ALFA2
and
Yes
22
MA2=1-(ML2-xi)/ALFA2
No
23
xi=ML2
and
xi= MR2
Ye
24
MA2=1
No
25
xi=MR2
and
Yes
26
MA2=1-(xi-MR2)/BETTA2
No
27
MA2=
B

Figure.1

Sequel of figure