New Algorithm of Support Vector Machine by the Bezier Curve

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Abstract— **The report is devoted to improvement of algorithms for separating functions by Bezier curve, which are based on the algorithm design with optimal classifying objects. The developed algorithm performs classification in the systems with complex order.**

Keywords— intellectual analysis of data; computer algebra; pattern recognition; Bezier curve

I. INTRODUCTION

In the course of contemporary technological revolution, studies related to the perspectives of automating of wide range of solutions, so-called intellectual tasks that until now could only be solved by men who were in the center of attention. Therefore a few successful attempts have been done in programming the game of chess, weather prediction, theorem proving, speech recognition, diagnosis of disease, identification of images of human, processing small-formatted documents (bank cheques, postal notices, receipts, etc.), etc. [1-4]. The solution of many these tasks requires the ability of classifying different input data. The proposed parametric method "teaching with a tutor" is based on the method with using Bezier curves.

Purpose of improving the algorithm of separating functions is using methods of computer algebra, which is based on the design of the algorithm, classifies data optimum. Some aspects of this general theory are consequences of the statistics branches that deal with classifying results of measures. New aspects have appeared in connection with researches in the field of intellectual analysis of data and Data Mining.

II. FORMULATION OF THE PROBLEM

We assume that in each data set under the classification there is m sets of real numbers $S_1, S_2, ..., S_j, ..., S_m$, ($S_j \in R$), which we call the objects, and some numbers from these sets we call components of this object $S_j = (x_1, x_2, ..., x_i, ..., x_n)$, $j = \overline{1, m}$ and $i = \overline{1, n}$, $(i, j \in N,\ x_i \in E^n)$. Suppose there are K_ℓ classes $(1, \ell \in N, и\ K_\ell \in E^n)$ that need to divide the objects $K_u \cap K_g = \varnothing$, $u \neq g$, $u, g = \overline{1, \ell}$.

It is required to construct an algorithm $a : S_j \to K_\ell$ which approximates the target dependence in the whole space of objects [1,4,5].

III. METHOD OF THE SOLUTION

One of these numbers, for instance, K_ℓ may correspond to the class of objects related to the not definite decision. It makes "zero" class. In this work E^2 is considered by means of Euclid space. Then set of points are separated from each other by the curves which will be called the dividing curves thereafter. The set of points the dividing curve separates in E^2, and corresponds to one of the classes of K_ℓ will be called solution domains. The proposed algorithm is constructed in order to solve the principles using Bezier curves. To construct the separating curve, firstly, we find middle points M_i ($i = \overline{1, n}$) among the values of the boundary points of the corresponding classes by the known methods. We construct a Bezier curve by the middle points found using the following formula:

$$B(t) = \sum_{i=0}^{n} (C_i^n)(1-t)^{n-1} t^i M_i$$

here C_i^n - binomial coefficient, M_i - mean points among the values of the boundary points of corresponding classes.

IV. RESULTS OF EXPERIMENT

Let's look at the algorithm of separating into classes by the cubic Bezier curves:

At first step, algorithm is supposed to selects S_j objects which located on borders of the classes K_ℓ, ($\ell = 2$).

Second step, algorithm is supposed to determine the average points M_i in the medium classes.

Third step, algorithm is supposed to draw a line of cubic Bezier curve through the midpoints of K_ℓ classes:

$$\mathrm{B}_j(t) = \sum_{i=0}^{n} \left(C_i^n\right)\left(1-t\right)^{n-1} t^i M_i ,$$

$$(t = (0;1),\ n = 3).$$

Fourth step, the cubic Bezier curve is completed: $B^*(t) = \sum_{j=1}^{m} B_j(t)$.

Fifth step, decision rule is composed based on the Bezier curves clasification:

If $B(\vec{S}_i^*) > B^*(t)$, then $\vec{S}_i^* \in K_1$, otherwise $\vec{S}_i^* \in K_2$ class.

Sixth step, if result is satisfactory the algorithm finishes its function, otherwise algorithm backs to the first step.

Below the results of two different algorithms Fig. 1 „Support Vector Machine“ and Fig.2. „The cubic Bezier curves“ are showed:

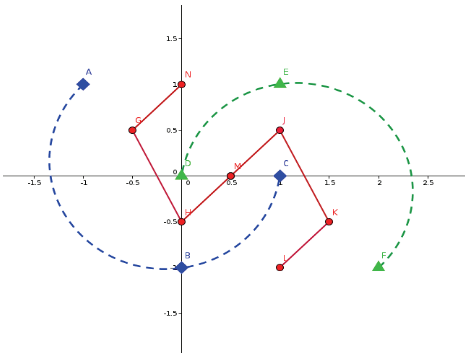

Figure 1. Support Vector Machine (SVM).

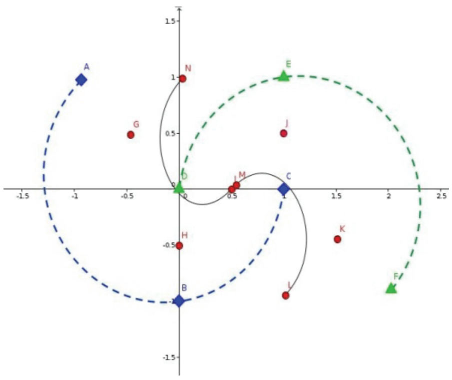

Figure 2. SVM-Bc (Support Vector Machine algorithm is improved using cubic Bezier curves function).

V. CONCLUSIONS

In this work, we proposed one of the possible methods of solving the problem of Pattern Recognition using SVM algorithm principles and composed the decision rule applying Bezier curves classification. After using Bezier curves classification, we achieved: a) efficiency and accuracy of the calculation of the reduction of algorithm SVM; b) high quality of the Pattern Recognition process. We may apply the resulting algorithm of separating objects to complex order occasions. This algorithm will be very useful for Data analyzing systems.

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REFERENCES

[1] L. Rutkowski. "Methods and techniques of artificial intelligence". Moscow. Hot Line - Telecom, 2010 (in Russian).

[2] M. Kh. Hudayberdiev, A. R. Akhatov, A. Sh. Hamroev. "On a model of forming the optimal parameters of the recognition algorithms". International journal of KIMICS, Vol.9, №0.5, October 2011, pp. 95-97

[3] F. Winkler. "Polynomial Algorithm in Computer Algebra", Springer (1996)

[4] Nils J. Nilsson. "Learning machines". McGraw-Hill Book Co., New York, 1965.

[5] V. Vapnik, O. Chapelle. "Bounds on error expectation for support vector machines". Neural Computation._ 2000._ Vol. 12, no. 9._ Pp. 2013–2036 (in Russian).