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TUNED BACTERIAL FORAGING ALGORITHM FOR FACE RECOGNITION TECHNIQUE

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ABSTRACT

This article presents an efficient face recognition technique with the optimal selection of components through Bacterial Foraging Algorithm (BFA) based on Support Vector Machines (SVM). The shortcomings in the field of recognition are non-linear and accuracy which has been considered to resolve by an effective classifier. SVMs are kernel machines which uses minimal optimization algorithm for solving non-linear problems and it has a good perspective in face recognition application. This paper also analyzes how the functionality can be improved by choosing optimum parameters. Experimental results reveal that tuned BFA based SVM trained by RBF neural network lends itself to higher face recognition accuracy than normal SVM, BFA and RBF. Therefore the proposed method trained by RBF is of surpassing that of the existing techniques in face recognition. This Chemical journal is preferred because of Bacterial Foraging process of algorithm, viz chemical correlation and bacterium in Image processing.

Indexing terms/Keywords

Bacterial Foraging, Face Recognition, Support Vector Machines, Radial Basis Functions, Principal Component Analysis.

Academic Discipline And Sub-Disciplines

Department of Information Technology – Faculty of Information and Communication Engineering

SUBJECT CLASSIFICATION

Digital Image Processing - Optimization

TYPE (METHOD/APPROACH)

Experimental Analysis through Optimization Technique involving chemical changes. Example: Bacterial Foraging Optimization

1. INTRODUCTION

Face recognition is the fastest biometric technology which maintains a significant one in research area of pattern recognition. Since it is difficult to intrude, face recognition can be used in security systems, identifying criminals and image processing and image authentication applications. It works with the most obvious individual identifier, the human face in which identification or verification of one or more persons from images are stored in a database of faces. Feature extraction is performed to provide effective information that is useful for distinguishing between faces of different persons. Several researches have been done using neural networks which focused on 2D and 3D face feature extraction [1] to enhance the performance or efficiency of a recognition system.

Support Vector Machines, a well developed classifier used to solve nonlinearity and binary classification problems [2]. Based on the number of support vectors the computational complexity and execution time for SVM classifier is varied. Bacterial Foraging is a recent method which envisioned social behavior of foraging in Escherichia Coli, used for solving multidimensional global optimization problems [3] in an efficient manner.

RBF network receives input patterns directly and does the function approximation and the performance of the network is improved by increasing the number of hidden layers.

The structure of this paper is organized as follows: Section 2 presents components of BFO and SVM followed by proposed method description in Section 3.Empirical analysis are presented in detail in section 4. Finally, conclusions are drawn in Section 5.

2. BFO – SVM COMPONENTS

2.1 Bacterial foraging optimization

One of the recent advancement in optimization algorithms is bacterial foraging which solves global optimization problems in a stochastic approach. Foraging is the process of selecting a path in search of nourishment so that maximization function was observed. The three different stages in life of a bacterium are chemo taxis, reproduction and elimination and dispersal event [4].

Chemo taxes are the motion patterns that a bacteria generates in the presence of chemical attractants and repellants and it can be achieved through swimming and tumbling via flagella. To represent a tumble, a unit length random direction $\lambda(j)$, is generated; this will be used to define the direction of movement after a tumble.

In particular $\varphi_i(j+1,k,l) = \varphi_i(j,k,l) + C(i)\lambda(j)$ (2.1)

where $\varphi_i(j,k,l)$ represent the i^{th} bacterium j^{th} chemo tactic k^{th} reproductive and l^{th} elimination and dispersal step, $C(i)$ is the simple chemo tactic step size taken in the random direction specified by the tumble.

With a single nutrient, a group of E.coli cells move out from the center in a ring manner by moving up the nutrient gradient created by utilization of the nutrient. If high levels of sensor are used as the nutrient, then it results in the release of attractant, and they are grouped. The less healthy bacteria S^r die and the remaining bacteria split into two and are placed in the same location to make bacterial population a constant.

$$S^r = 0.5s \quad (2.2)$$

Elimination and dispersal is an event in which each bacterium is monitored and tracked whether they are in correct places. If not, then place the bacteria in correct space so that they have the footprint in chemo taxis process and continue the search from the beginning.

2.2 Support vector machine classifier

The root of SVM is the statistical learning theory or VC (Vapnik-Chervonenkis) theory. The basic idea is to determine a hyper plane that can decrease the sum of empirical risk and VC dimensions [5]. The model of SVM classifier is shown in Figure 1.

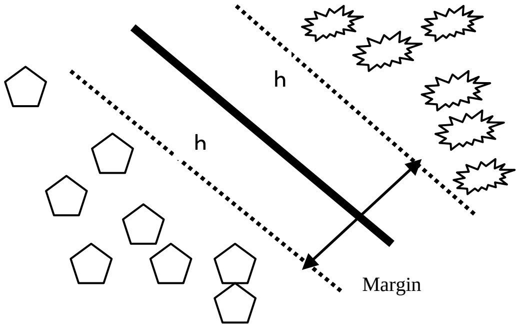

Fig 1: SVM Classifier

The optimization problem is given simply as:

$$min\left[\frac{1}{2}\|w^2\| + R\sum_{i=1}^{n}\xi_i\right] \quad (2.3)$$

where *R* is regularization constant which compromises two criteria margin maximization and error minimization. SVM can handle non-linear kernel functions and is highly effective in selecting features and was used for facial expression recognition in facial image sequences [6].

Radial Basis Function network has only one hidden layer and by made it to function with some number of training sets of a complex or high dimensional problem effectively [7]. The Gaussian transfer function of hidden neurons can be given by,

$$f(r) = exp(-d^2/\sigma^2),\ \sigma > 0 \quad (2.4)$$

Here σ is scaling parameter or width used in categorization of images and *d* is the distance between the input vector and center vector.

3.PROPOSED TECHNIQUE FOR FACE RECOGNITION

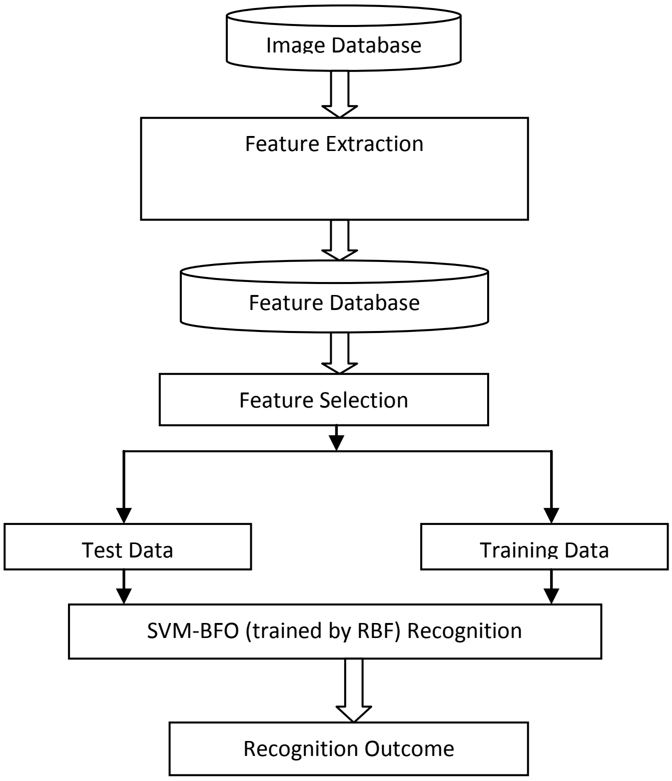

Fig 2: Block diagram of proposed method

The block diagram of the proposed method is shown in Figure 2. The swarming process is tuned and the chemo tactic step can be calculated from the nearest target bacterium and the value can be changed according to the iteration. The bacteria swarm together when cell-to-cell signaling process is carried out in the presence of an attractant. This can be entreated as combined form of cell-to-cell attraction and repulsion effects. This can be given by,

$$J_{cc}(\varphi_t, P(j,k,l)) = \sum_{i=1}^{s} J_{cc}^{i}\left(\varphi_t, \varphi^i(j,k,l)\right) = \sum_{i=1}^{s}\left[-d_{attract}\,exp\left(-w_{attract}\sum_{x=1}^{y}(\varphi_{xt}-\varphi_x^i)^2\right)\right] + \sum_{i=1}^{s}\left[h_{repellent}\,exp\left(-w_{repellent}\sum_{x=1}^{y}(\varphi_{xt}-\varphi_x^i)^2\right)\right] \quad (3.1)$$

where,

φ_t - location of nearest target bacterium till j^{th} chemo taxis, k^{th} reproduction and l^{th} elimination.

φ_{xt} - x^{th} parameter of target bacteria

s is total number of bacteria, *y* is the parameter to be optimized, and $d_{attract}$, $w_{attract}$, h_repellent, w_repellent are the coefficients.

The reproduction method is tuned such that the average value of entire chemo tactic cost function can be used for deciding the health of each bacterium. In this paper it is tuned by placing maximum objective value of chemo tactic functions added by a constant (α) is employed for deciding the health of each bacterium.

Health of bacterium *i* is,

$$J^{i}_{health} = max\{J_{sw}(i, j, k. l)\} + \alpha \qquad (3.2)$$

4. EMPIRICAL ANALYSIS FOR FACE RECOGNITION

The sample images of face can be taken from ORL database. Initially the features of face from the face database are selected. It was developed by AT&T Laboratories, Cambridge, U.K [8].There are 400 images of 40 distinct persons. The images were taken at different time instances with high degree variability in lights, face expressions and different postures.

Fig 3: Experimental face images with different posture, expressions and illumination(ORL)

In SVM-BFO model, tuned BFO is accustomed to select the specified parameters of SVM *R* and *σ*. In the analysis, the efficiency and execution rate of SVM-BFO trained by RBF are compared with SVM, BFO and RBF. Here face recognition is deduced with different posture, expressions and illumination as shown in Figure 3. In each testing, few images are noted as training data and the remaining are testing data. The face recognition and execution rate of SVM-BFO trained by RBF compared with SVM, BFO and RBF are as shown in Figure 4 and Figure 5. The results showed that SVM-BFO trained by RBF has greater face recognition and execution rate than usual BFO, SVM and RBF. The recognition rate is given numerically in table 1.

Fig 4: Comparison of recognition rates

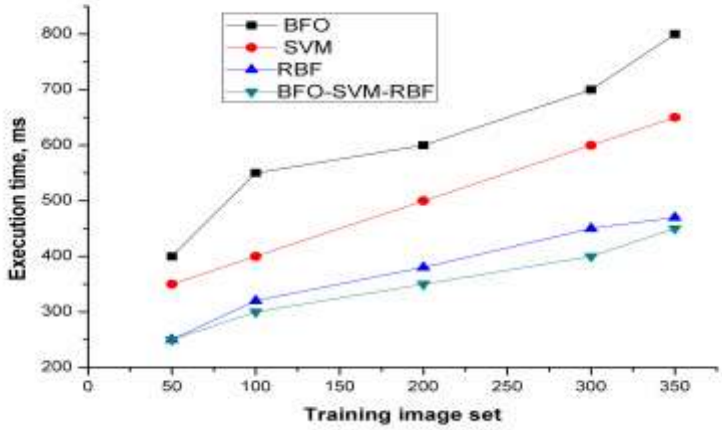

Fig 5: Execution rates with different number of training images

Table 1. Recognition results of SVM-BFO-RBF, RBF, SVM and BFO

	Constraint description Varying levels of expression, posture and intensity	Number of Training images	Algorithm	Face recognition Accuracy (%)
			SVM-BFO-RBF	**98.6**
			RBF	94
Case 1	Very High	175	SVM	82.7
			BFO	79.2
			SVM-BFO-RBF	**98.4**
			RBF	92
Case 2	High	150	SVM	82.4
			BFO	79.5
			SVM-BFO-RBF	**98.2**
			RBF	93
Case 3	Moderate	200	SVM	82
			BFO	79.8
			SVM-BFO-RBF	**98.5**
			RBF	91
Case 4	Low	125	SVM	82.3
			BFO	79.6
			SVM-BFO-RBF	**98.3**
			RBF	90
Case 5	Very Low	300	SVM	82.6
			BFO	79.4

5. Conclusion

This paper has presented an optimal face recognition algorithm based on support vector machine and bacterial foraging optimization. Bacterial foraging optimization is induced from biological behavior of bacteria which can effectively improved by tuning some of its parameters. The proposed method is compared with the classical BFO, SVM and RBF. The performance metrics observed are recognition rate and execution rate and the experimental results are very encouraging. Further research on this area can be concentrated to the combination of adaptive foraging techniques and trained by recent artificial neural network models.

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