Imperialist Competitive Algorithm for Improving Edge Detection

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Abstract— The main goal of an image processing system is image understanding and recognition of complex objects in a scene or an image. Basically, one of the first steps in these systems is to detect edges in images. Extreme edge detection algorithms usually detect the intensity or colour in an image. So far, many methods have been proposed for the edge detection, each with its own advantages and limitations. Imperialist competitive algorithm can be used for edge detection. Experimental results show that the proposed solution in compare with other methods can detect edges with good accuracy.

Keywords— image processing, edge detection, Imperialist competitive algorithm

I. INTRODUCTION

In today's world of image processing applications is growing every day. In the fields of medicine, robotics and meteorology research projects in this field and has many applications in this field. Edge detection algorithms are intended to detect edges in an image that refers to the opposite field and choose the feature extraction. Edge detection accepts digital files as input and returns edge mapping as output .Edge mapping usually includes information about the position, orientation and thickness of them. From a technical standpoint, edge detection method consists of two groups: search-based edges and based on the zero crossing. Search-based methods, such as edges by first calculating the size of an edge gradient illumination begun the search in a certain direction and are locally run. The first derivative is used to express the gradient. But in the method based on zero-crossing point, the search point on the second order derivative is applying on the image [1].

Edge detection is generally done by using mathematical functions. Robert operator in 1963 by Robert Lawrence was proposed based on the gradient to drive [2]. Another kind of mathematical operator is Laplacian operator based on assumptions [3]. Prewitt in 1970, according to a discrete gradient operator edge detection proposed. In 1977, Professor Navata present first article of edge detection in colour images and developed Hueckel operator [4]. Then various types of works were done in this field. Canny edge detection algorithm was developed in 1986 by John canny [5]. Known early works done in this category include algorithms are developed by Krisch 1971, Robinson and Frei-Chen 1977. They estimate the gradient with calculating the pixels of local maximum points and examining the localization of edges. Mainly by calculations, they are simple and can be recognized by its edges and orientation [1].

Imperialist competitive algorithm is proposed in this paper for edge detection. Imperialist algorithms are in the field of evolutionary computation approach to find the optimal solution of problems concerned with the optimization. This algorithm with mathematical modelling process of social development - political, optimization algorithms for solving mathematical problems offers. The application of this algorithm to handle evolutionary optimization algorithms such as Genetic Algorithms, Particle Swarm Optimization, Ant Colony Optimization, Simulated Annealing and so on. Like all algorithms under this category, Imperialist competitive algorithm for the initial set of possible answers would form. The initial solutions in genetic algorithms are known as a chromosome, the particle swarm algorithm for a particle, and Imperialist competitive algorithm, also known as country are known. Imperialist competitive algorithm with a pattern that follows the initial solutions (states) can gradually improve the appropriate response for optimization problem.

Rest of the paper is organized as follows. In the second section, some relevant papers are reviewed. Overview of ICA is presented in section III. The proposed approach is presented in Section IV and in section V, experimental results are discussed. Section VI contains the conclusions of the paper.

II. RELATED WORK

Ranjbaran et al. [6] using the edge map of an image present an image denoising method. The denoised image was considering as a linear combination of the observed image and its average value, where the coefficients were controlled by a local edge detector. Implementation the proposed scheme can be done in a single iteration and the speed of the process is reasonably high. Noise reduction quality of the proposed method in compared with Wiener and Total Variation based filters for some images appears to be easy, fast and useful for very noisy images. In another work, Xu et al. [7]

proposed an impulse noise removal method. The proposed method is based on noise detection and image edge detection to improve the performance of vector median filter. First, the corrupted pixels are discriminated from the noise-free pixels by comparing the current pixel with the corresponding pixel in a reference image. Then using a filter, corrupted pixels are filtered by the proposed weighted vector median filter. The novelty of this filter lies in its weighting technique that is based on image edge detection. The weight of each pixel is determined by its group which is related to the image edge. This method can smooth the noise and reduce edge blurring effectively. Experimental results show that the proposed method outperforms other algorithms in terms of MAE, MSE and PSNR values.

Moreover, a new method is presented in [8] to detect salient pieces of boundaries in an image. After detecting perceptually meaningful level lines, periodic binary sequences are built by labeling each point in close curves as salient or non-salient. Tepper et al. propose a general and automatic method to detect meaningful subsequences within these binary sequences. Their experimental results show the good performance, when tested with different saliency criteria, such as contrast, regularity, and the combination of both. In [9] Lopez-Molina et al. introduce a multi-scale method based on increasing Gaussian smoothing, the Sobel operators and coarse-to-fine edge tracking. They include visual examples and quantitative evaluations illustrating the benefits of the proposal.

III. OVERVIEW OF ICA

Considering presented optimization algorithms, what is remarkable is that the most commonly used optimization methods are simulation of natural processes that be computerized. Perhaps one reason for this is tangibility and ease of formulating and understanding the evolution of this process. In contrast, the presented optimization algorithms, even considering the biological evolution of humans and other beings, social evolution and history as he wrapped and most successful development mode, has received little attention. In this scheme, inspired algorithm for optimization of human social evolution is given. Introduced a new algorithm inspired by socio-political process than presented methods with high ability and extent is also fast. Overview of the algorithm is shown in Fig. 1. ICA algorithm called competitive given the development of Imperialist expansion algorithm given, like other evolutionary optimization methods, the number of early starts. In this algorithm, each element of the population is called a country.
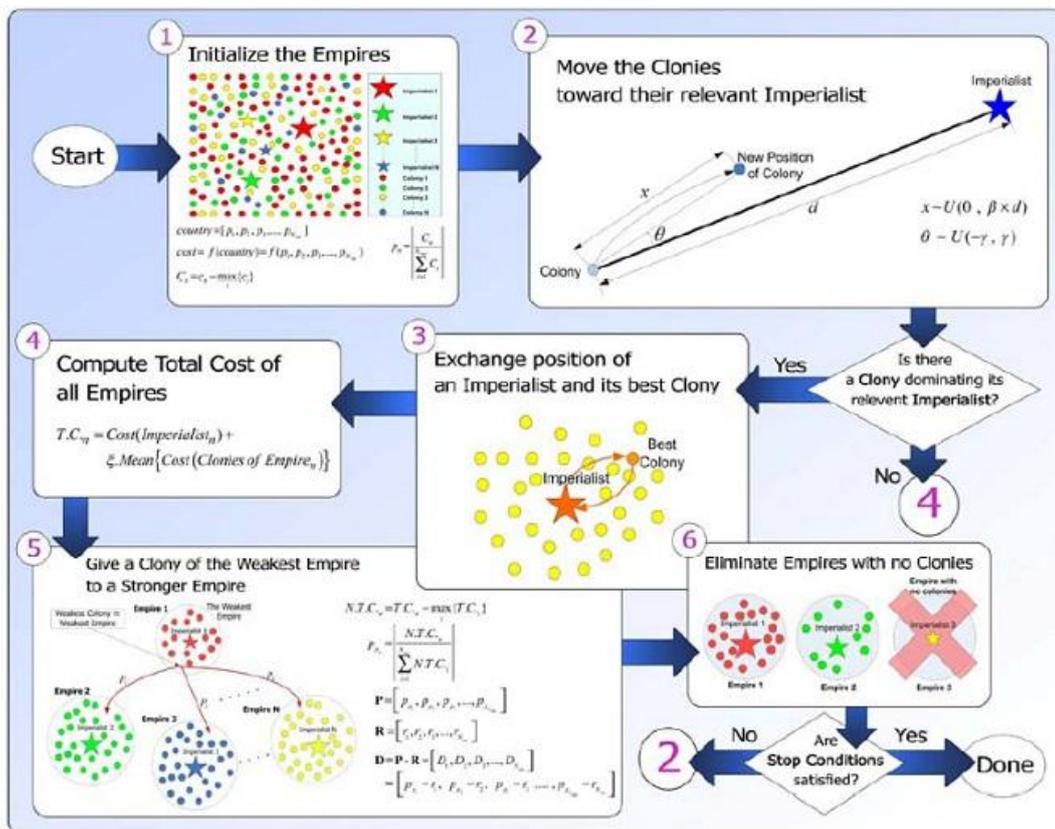

Fig.1. Overview of ICA

Countries are divided into two categories Imperialism and neo-colonialism. Every Imperialist, depending on its power obtains number of colonies. Attracting and competing Imperialist policy, constitute the core of this algorithm. According to the policy, which historically attracted by countries such as France and British Imperialistic was imposed on the colonies, Imperialist countries using methods such as the construction of schools in their own language, try to flip Imperialist country with the language of the colony and culture, and It was the custom.

With the formation of empires, imperial competition between them begins. Every successful Imperialist empire, which misses the competition and increase their power (or at least its influence to prevent the loss) will be deleted from the Imperialist competition. The survival of an empire depends on its ability to attract rival Imperialist empires and the rule

will be bringing them. As a result, the competing imperialist gradually added power of the larger empires and the weaker emperors will be deleted. Empire to increase their power, they will be forced to give up their colonies in progress.

IV. THE PROPOSED SCHEME

ICA is used for edge detection in the proposed scheme, so that the first stage is composed of a number of countries (which are proportional to the number of image pixels). Then some of them as the imperialist (edge) and some of the colonies (non-edge) are considered. Imperialist competitive algorithm iteratively done regularly and each time after absorption policy, revolution, imperialist competition and relocation of the imperialist and colony, the final cost (power) is calculated for each empire. The cost of an empire is the sum of its cost and some factor of its colony. The Empire that has highest power is accepted as final imperialist. Each time the process is repeated until the convergence condition is found, the algorithm repeats until the number reaches 50. Part of the pseudo-code of the proposed scheme is shown in Fig. 2.

%% Problem Definition	CostFunction=@(x) Rastrigin(x); nVar=1; % Number of Unknown Variables VarMin= 1; % Lower Bound of Unknown Variables VarMax= 255; % Upper Bound of Unknown Variables

%% ICA Settings	nPop=100; % Number of Countries
	nImp=10; % Number of Imperials
	nCol=nPop-nImp;
	
	MaxDecades=50;
	
	beta=2;
	
	pRevolution=0.1;
	
	zeta=0.1;

%% Initialization	ShareSettings; imp=InitializeImperials(); BestSol.Position=[]; BestSol.Cost=[] BestCost=zeros(ICASettings.MaxDecades,1); MeanCost=zeros(ICASettings.MaxDecades,1);

```
%% ICA
for Decade=1:MaxDecades

   imp=AssimilateColonies(imp);

   imp=RevolveColonies(imp);

   imp=ExchangeWithBestColony(imp);

   imp=CalculateTotalCosts(imp);

   imp=ImperialisticCompetition(imp);

   ImpCost=[imp.Cost];
   [BestImpCost BestImpIndex]=min(ImpCost);
   BestImp=imp(BestImpIndex);

   BestSol.Position=BestImp.Position;
   BestSol.Cost=BestImp.Cost;

   BestCost(Decade)=BestImpCost;
   MeanCost(Decade)=mean(ImpCost);
```

Fig. 2. Pseudo-code of the proposed scheme

V. EXPERIMENTAL RESULTS

To perform the experiment, we use MATLAB to implement the proposed design methods to access articles on a common image (image Lena) and compare it with the approaches have been presented as Robert operators [10], Prewitt operators [10], Sobel [10], Canny [10], Marr-Hildreth [11], Boolean edge detector [11]. Comparative results are presented in Fig. 3.
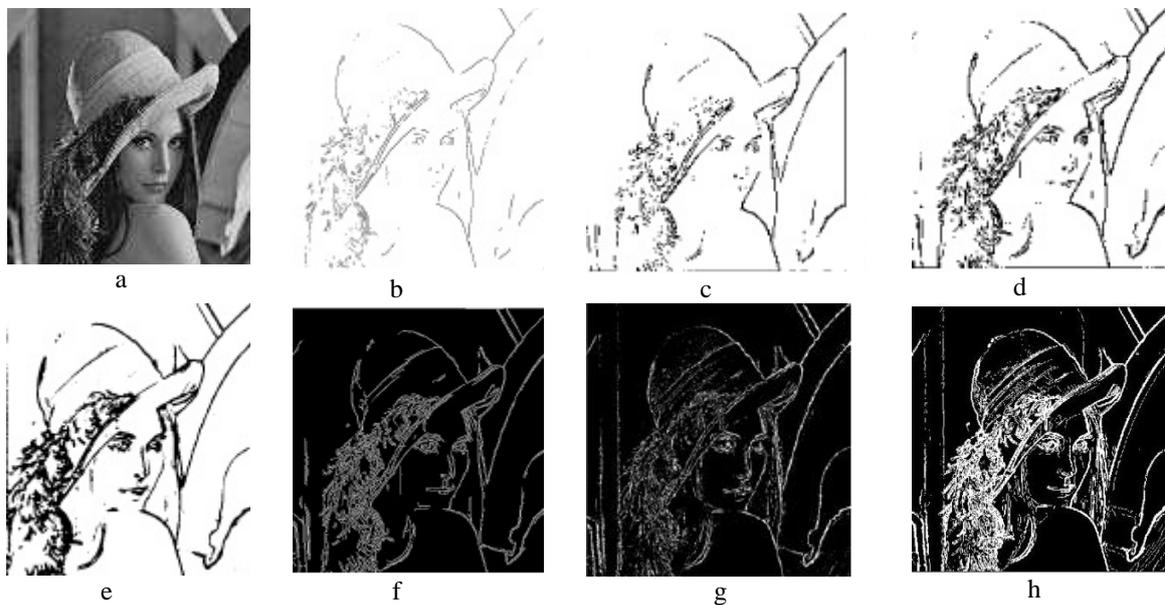

Fig. 3. Comparison of the proposed scheme with the other methods: (a) original image, (b) Robert operators, (c) Prewitt operators, (d) Sobel operators, (e) Statistical approach, (f) Canny edge detector, (g) Boolean edge detector, (h) the proposed method

VI. CONCLUSION

In this paper an imperialist competitive algorithm (ICA) is used to edge detection. This algorithm uses the policy of assimilation, the competition between the Empire and cost calculation of the Empire and can determine the most powerful empire (edge). Using MATLAB implementation of this algorithm on Lena image, the proposed approach showed the power of edge detection. The proposed approach represents an improvement compared with other methods of edge detection.

REFERENCES

[1] M. A. Oskoei and H. Hu, "A Survey on Edge Detection Methods", Technical Report: CES-506, School. ECE, University of Essex, 2010.

[2] L. G. Roberts, "Machine Perception of Three Dimensional Solids", In Optical and Electro-optical Information Processing, pp. 159-1970, 1965.

[3] L. G. Prewitt, B. Lipkin, and A. Rosenfeld, "Object Enhancements and Extraction", In Picture Processing and Psychopictorics, pp. 75-149, 1970.

[4] H. Hueckel, "An Operator Which Locates Edges in Digitized Pictures", Journal of the ACM (JACM), vol. 18, no. 1, pp. 113-125, 1971.

[5] J. Canny, "A Computational Approach to Edge Detection", IEEE Trans. on Pattern Analysis and Machine Intelligence, vol. 8, no. 6, pp. 679-698, 1986.

[6] A. Ranjbaran, A. H. A. Hassan, E. S. Kheng and B. Ranjbaran, "An edge detection based noise removal algorithm", Computer and Electrical Engineering, Article in press, 2013.

[7] J. Xu, L. Wang and Z. Shi, "A switching weighted vector median filter based on edge detection", Signal Processing, vol. 98, pp. 359-269, 2014.

[8] M. Tepper, P. Muse, A. Almansa, and M. Mejail, "Finding contrasted and regular edges by a contrario detection of periodic subsequences", Pattern Recognition, vol. 47, pp. 72-79, 2014.

[9] C. Lopez-Molina,B. D. Baets, J. Sanz, and E. Barrenechea, "Multiscale edge detection based on Guassian smoothing and edge tracking", Knowledge-based Systems, 44, 101-111, 2013.

[10] A. Halder, N. Chatterjee, A. Kar, S. Pal and S. Pramanik, "Edge detection: A statistical approach", 3rd International Conference on Electronics Computer Technology (ICECT 2011), pp. 306-309, 2011.

[11] E. Nadernejad, S. Sharifzadeh, and H. Hassanpour, "Edge detection technique: evaluations and comparisons", Applied mathematical sciences, vol. 2, pp. 1507-1520, 2008.