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A Brief Review on Imperialist Competitive Algorithm Limitations & Future Directions

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Abstract

Imperialist Competitive Algorithm is a heuristic optimization method developed by Atashpaz Gargari and Caro Lucas in 2007. It's a socio- political evolution based algorithm .Various efforts were made to solve constrained problems and discrete optimization. Here we have discussed the various advantage and limitations of ICA.

Keywords: Imperialist Competitive Algorithm; Evolutionary Algorithm

Introduction

All Imperialism is the strategy of extending a nation's authority by territorial gain or by the application of economic and political control over other nations. A country may try to overpower other country by taking control over the supply of necessary goods or any other raw materials.

The ICA is population based process in which each member of the population is called a “country”. Some of the best countries i.e. countries with lesser cost are termed as “imperialist states" and the remaining countries are the “colonies” of those imperialists. The colonies are divided among the imperialist states based on the power.

ICA involves three main operators namely Assimilation, Revolution, Imperialist competition in assimilation process the colonies are moved towards the nearest imperialist states. The total power of an empire depends mainly on the power of the imperialist country. The power of colonies has lesser role in deciding the power of the empire. Revolution occurs if the colony has lesser cost than the imperialist then the position of the colony and imperialist will be interchanged. Imperialistic competition begins among all the empires. If the empire is failed to increase its power then the empire will be eliminated from the competition and the colonies of the empire will be taken by other empires based on its possession. The imperialistic competition will gradually result in elimination of weaker empire. This movement of colonies,

imperialistic nature of empires and the collapse mechanism direct the optimization process.

Initialization of Population

Algorithm starts with initial population **Ncountry**, each individual of the population is known as countries. Countries with lesser cost are imperialist denoted as **Nimp** and others are colony of the imperialist **Ncol**

Countries = {P1, P2, P3.....Pn}

Distribution of Colonies

Normalized cost of the imperialist are calculated using the formula

Cm = cm - max (Ci) Where Cm is normalized cost of the imperialist, cm is cost of the mth imperialist

Power of the imperialist can be calculated using Pm = Cm/Σ Ci

Based on the power of imperialist the colonies will be distributed as

No of colonies for imperialist = Pm x initial no of colonies

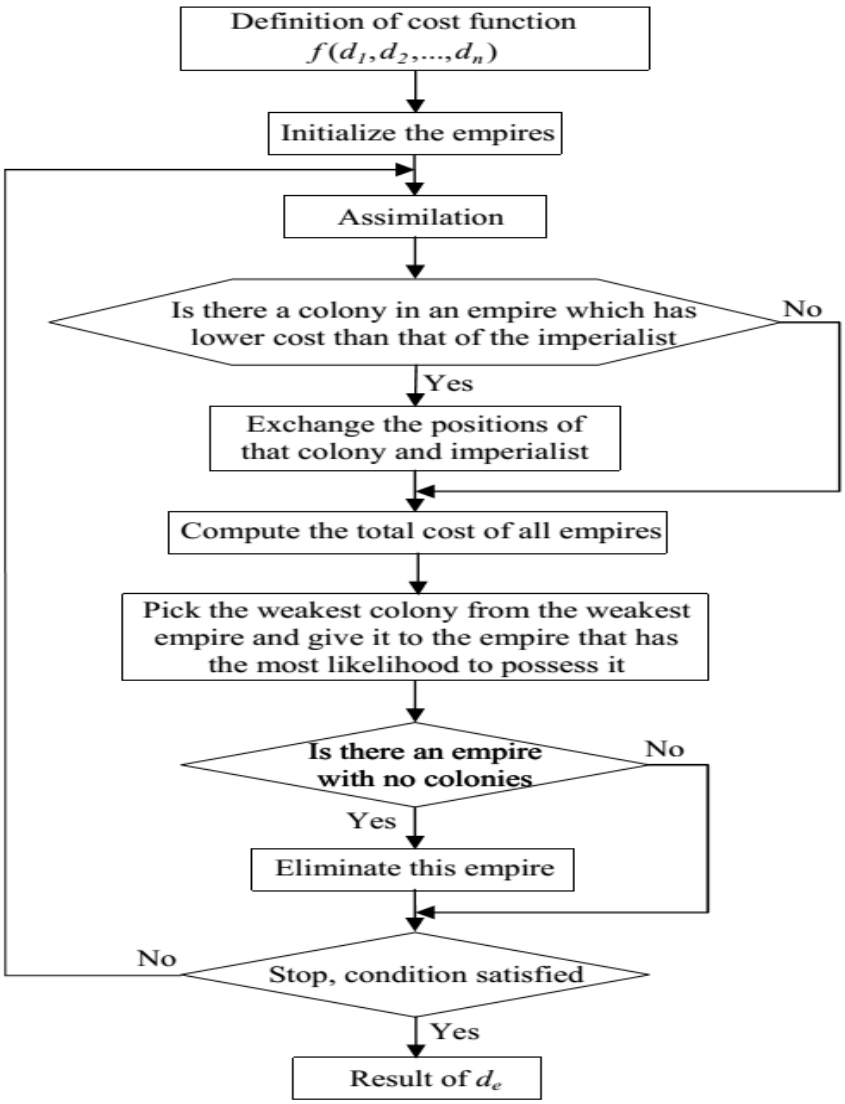
Assimilation

The colonies move towards to the imperialist using some random path which can be

X2 =X1 + β γ d Where X2= new position of the colony, β is the coefficient β>1, γ is the random number U (0, 1) and d is the distance between the starting position of the colony and imperialist.

After Assimilation revolution and imperialist competition takes place finally the algorithm would end up with single empire Power can be calculated as P = power of imperialist + □ (power of colonies of the imperialist) where □ is a constant whose value is 0.1

Algorithm



Review of Literature

In this section the status of various researches in Imperialist Competitive Algorithm are explained in detail.

Gargari and Lucas (2007) proposed imperialist competitive optimization concept precisely explaining the stages of its development from social simulation to optimizer. Like other evolutionary algorithms, the proposed algorithm initiates with a population where the best ones are imperialist others forms the colony. Colony move towards imperialist in a random manner, revolution occurs if the colony defeats the imperialist. Imperialistic competition is an essential operator for the algorithm to converge quickly. Implementation of one prototype is discussed in more detail, and the results obtained from application of algorithm on the prototype have been shown

to perform successfully. It is suggested to alter some of the process in algorithm to improve its working**.** This algorithm is compared with PSO and GA.

Arish et al. (2014) investigated on imperialist competitive algorithm (ICA) in solving optimization problems, it's observed that it frequently falls into the local minimum and has lesser convergence speed. To solve this issue a fuzzy version of this algorithm is introduced. Here the powerful imperials are chosen based on the fuzzy membership function rather than the cost function, other countries becomes their colonies. In absorption policy, the fuzzy function plays the role of cost function in regular ICA. In this algorithm, there is no elimination of empires instead they move toward one point.

Eskandar et al. (2010) They proposed to use two methods to attain the stopping criteria which includes a) imposing constraints mostly addition of the penalty function to the objective function is preferred b)removal of infeasible here they have analysed 52 and 72 bar trusses by imposing addition of penalty function as the termination condition of the algorithm. The calculated value shows that the ICA is as good as other algorithms and also better than other methods regarding the accuracy and convergence rate such as PSO, HPSO.

Razeghi and Amir (2011) investigated on structural damage detection and evaluation on the basis of modal parameters of a damaged structure using imperialist competitive algorithm. it is a most suitable and feasible method for detecting the structural damage in the structures. This was applied to the numerical examples such as multi story plane steel strutures such as frame and truss. 12 DOF shear building model is used in which five damage patterns have been considered which includes All of the braces of the first story are broken, All of the braces of the first and third stories are broken, One brace of the first story is broken, One brace at the first and third stories is broken, 1/3 of area of one brace at the first story is cut. It's concluded that damage identification method is much more receptive to location and value of damage. This is due to the application of imperialist competitive algorithm for optimizing the cost function.

Kaveh and Talatahari (2010) developed a new approach towards better solution. In the New imperialist competitive Optimization Technique proposed here, each colony move towards imperialists using two ways (1) different random values for the solution vector (2) instead of using θ orthogonal colony imperialist contact line is used. Here they have compared ICA and PSO. It's observed that in ICA the global best in the best among the predefined agents whereas in PSO it's the best of all the agents. This helps the ICA to get global best with faster convergence.

Malekian et al. (2012) investigated on volume fraction optimization of functionally graded conical shells to reduce the density intial GDQ method is implemented but the computation time is high ,to improve the speed of the optimization process, ANN and ICA are used.Two system of neural network are trained for frequency and density,training samples are given as input t o ANN and MLP network is used ,ICA algorithm helps to optimize the process.The ICA shows superior results than the genetic algorithm.

Maryam et al. (2011) investigated on adopting ICA to avoid premature convergence problem by optimizing the weights of Multilayer Perceptron (MLP)

Artificial Neural Network. The ICA method is evaluated on four known classification problems and compared against methods like: GA, RPROP, MinFinder. An precise comparison of the four methods which uses 30 fold experiment replication is presented. The experimental results showthat the proposed ICA method is showing superior results than other methods. Evolutionary optimization strategy are more suitable for faster convergence rate and better global optima achievement.

Pourbaba and Talatahari (2013) investigated on a model to obtain the cost efficient design considering different conditions of backfill satisfying the stability, height and properties of ground. The optimum design based on the angle of internal friction while the height of the wall rises. Sensitivity analysis done for Angle of internal friction of the underneath soil , Sliding Safety Factor, Base Friction Conditions, and Impact of used Concrete strength on the optimum Results. This chaos based ICA is exploit to find the efficient results. It blends the imperialistic competition process with chaos theory. Cost efficient cantilever retaining wall design is tested using the new proposed method and comparison is made with other methods.

Sabour et al. (2011) developed a meta-heuristic method called imperialist competitive ant colony algorithm (ICACO).In ICACO additional to the random number, variance is introduced to get a faster convergence and results were compared with other algorithms

Berneti and Shahbazian (2011) investigated on Imperialist Competitive Algorithm (ICA) an evolutionary algorithm is utilized in order to optimize the primary weights of a feed forward neural network. ICA is used as an initialization algorithm in order to produce the weights of neural network and The Mean Square Error (MSE) treated as the cost function. Minimizing cost function is the objective. The predictive performance of the ICA-ANN model is better than that of the traditional Back propagation neural network since it combines local and global searching ability of the BP and ICA.

Talatahari et al. (2012) investigated on uniting the benefits of chaotic maps and the ICA to obtain best possible solution. The colony movement is modified using chaotic maps. The main advantage of the chaotic map is non repetition of chaos The orthogonal colony imperialist competitive line is utilized, An improved ICA with 2 movement steps, and 4 varieties of chaotic maps are utilized. Instead of generating random numbers for the movement of colony we can use chaotic map it will provide the data needed within single iteration.

Dallegrave Afonso(2013) they proposed a new method called AR-ICA ,during the search of global optimum a method called attraction and repulsion is introduced. The results were compared with the other algorithms.

Conclusion

Imperialist Competitive Algorithm is a heuristic global optimization which is used in various real life applications. Here we have presented the concept of ICA and work carried out on ICA by various researchers. An extensive literature review is presented which is used to find out the limitations in various methods and which gives a better direction for future scope.

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