Секция 1. ИЗМЕРИТЕЛЬНЫЕ СИСТЕМЫ И ПРИБОРЫ, ТЕХНИЧЕСКИЕ СРЕДСТВА БЕЗОПАСНОСТИ

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PARALLEL IPRIALIST COMPETITIVE ALGORITHM: A METHOD FOR GLOBAL OPTIMIZATION

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Abstract. *A novel parallel imperialist competitive algorithm (PICA) is presented for global optimization. The ICA is a new meta-heuristic optimization developed based on a socio-politically motivated strategy and contains two main steps: the movement of the colonies and the imperialistic competition. Here different parallel approach is utilized to improve the movement step of the algorithm. Comparing the new algorithm with the other ICA-based methods demonstrates the superiority of the PICA for the benchmark functions.*

Introduction — The imperialist competitive algorithm (ICA) is one of the recent meta-heuristic optimization techniques. This novel optimization method developed based on a socio-politically motivated strategy. The ICA is a multi-agent algorithm in which each agent is a country and can be either a colony or an imperialist. These countries form some empires in the search space. Movement of the colonies toward their related imperialist and imperialistic competition among the empires forms the basis of the ICA. During these movements, the powerful imperialists are reinforced and the weak ones are weakened and gradually collapsed, directing the algorithm towards optimum points [1]. Figur.1 illustrate the basic movement in ICA algorithm.

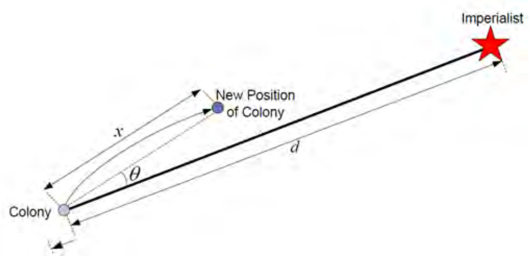

Figure1 – Movement of a colony to imprialist

Imperialistic competition is the main part of the ICA and hopefully causes the colonies to converge to the global minimum of the cost function. This algorithm is proposed by Atashpaz-Gargari and co-workers [2,3]. Kaveh and Talatahari improved the ICA by defining two new movement steps and investigated the performance of this algorithm to optimize the design of skeletal structures and engineering optimization problems [1].

Due to the several weaknesses of all evolutionary algorithm such as converge speed and reliability [4] which are very important factors in industrial applications, we try to propose and experimental model based on the idea of breaking a task to the several smaller tasks in order to solve it faster. Also, in order to increase reliability we use the idea of division the search space into several sub spaces and starting each algorithm with different start point in such environment. This paper adds such positive benefits of parallel structure to the ICA algorithm. In this way, generating different systems substitute random numbers for different start points of the ICA.

In order to evaluate these algorithms, some mathematical benchmark examples are utilized. The results reveal the improvement of the new algorithm.

The rest of the paper is designed as follow: in section two we proposed our new method, in section three we discuss over simulation's results and finally in section four we conclude our work and suggest future works.

II. Parallel Imperialist Competitive Algorithm

Imperialist competitive algorithm based on Atashpaz-Gargari algorithm [1] is used as our main optimization algorithm. Considering what we said before, one of the major problems of all evolutionary algorithms is the computation time. ICA is also suffer from this problem. In this paper we are going to introduce new architecture for to handle this situation.

The new architecture is a mixture of four ICA algorithms that are works parallel together each ICA has same optimization parameter to the other algorithms but the only difference is the starting points.

The idea behind this method is to divide the search space of a big complex ICA to four little ICAs in order to increase variety and decrease converge speed. The psudo code of the method can be seen in Table (1).

The number of countries and imperialist is set, using try and error. After the first phase of new algorithm (three parallel ICAs) we capture first two best results (countries) of each ICA and use it as starting point of 4th ICA. Note that, the 4th ICA also has 80 countries and 8 imperialists but 6 countries from these 80 countries are best outputs of first 3 ICAs. The other parameters of basic ICA are set as bellow:

- β parameter set as 0.7

- θ is not constant and change in [0.1 1.2]
- Maximum iteration is set on 300

Table(1) : Pesudo code of proposed method

Step 1: set the maximum iteration of each ICA to 300 Step 2: set the number of countries to 80 Step 3: set the number of imperialists to 8 Step 4: start three ICAs simultaneously Step 5: capture the first two best results of ICAs and set it as starting point of 4th ICA Step 6: Start 4th ICA Step 7: return final results

III. Simulation and results

In order to test our work, we use two different benchmark functions (Griewank and Rastring both with 10 parameter to be optimized) [5]. Also we use ICA with 1500 iterations, GA with 1500 iterations and SA with starting temperature of 2000 as other optimization techniques. We run algorithms for each function for 100 times. The results are illustrated in Table (2) and Table (3).

Table(2) : Grienwank function results

	Min answer (mean)	SD	Time (seconds)	Global min
ICA	0.0288	0.0329	234.98	0
GA	2.751	2.541	564	0
SA	4.293	3.783	634	0
PICA	0.0021	0.0435	77.16	0

Table(3) : Grienwank function results

	Min answer (mean)	SD	Time	Global min
ICA	2.21	3.26	316	0
GA	9.37	5.4	652	0
SA	12.67	4.7	721	0
PICA	0.029	0.159	72.4	0

The results shows that our proposed method beside the fastest converge to the global minimum, has great performance in subject of the min answer and standard division (SD) of answers which is make the method a precise, fast and reliable method for global optimization tasks. In this context, the reliable method is defined as method which can search the whole search space and find the best local optimum with low range of differentiation. Hence, we can see, our proposed method show noticeable results in compression with basic optimization methods.

IV conclusion

In this work we demonstrate an architecture for optimization based on imperialist competitive algorithm. We show that our proposed method can work on complex problems properly. PICA also shows that it is better than most of the individual evolutionary methods in subject of converge speed, accuracy and reliability. In future, this family of methods can easily combine with other evolutionary algorithms in order to cover their weaknesses. Also, the introduced method can be applied in real word applications to measure its real performance.

Furthermore, we suggest to researchers to improve the basic methods using new random paradigms in order to add more diversity then using evolutionary methods in new architectures such as the architecture we propose.

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STABILITY CONDITIONS IN THE QUASI-STATIC MODE OF A DIFFERENTIAL-CAPACITIVE INSTRUMENT

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Capacitive sensing has advantages compared to other types of sensors. Its attractive properties are: little power consumption, very low sensitivity to temperature, and less complex shielding stray electric fields than shielding inductive sensors from magnetic disturbances [1]. The capacitive sensors have low noise floor, low fabrication cost, low cross-coupling sensitivity. It has also compatibility with Very Large-Scale Integration (VLSI) technology scaling, all of which make it commercially im-