A Critical Comparative Review of Nature-Inspired Optimization Algorithms (NIOAs)

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***Abstract* - Nature is a very rich source of inspiration. Many algorithms have been inspired by nature. The source of inspiration for algorithm development are diverse and, as a result, the algorithms are equally very different. We present in this paper a critical review of current Nature-Inspired Optimization Algorithms (NIOAs) to include: Evolutionary Algorithms (EAs), Swarm Intelligence Algorithms (SIA), Physical and Chemistry Algorithms (PCA), Bio-Inspired Algorithms (BIA) and others. The aim is to explore the performance of the optimization process using a range of different analytical methods and motivate further research.**

Keywords - nature inspired algorithms, swarm intelligence, gravitational search algorithm (gra), chemical reaction optimization (cro), bio-inspired algorithms.

I. INTRODUCTION

Nature is a very rich source of inspiration. New algorithms are nature-inspired, so they have been improved by inspiration from nature [1]. Different levels of classification depending on a number of details and sub sources to be used or implemented. For simplicity, this article will concern or focus on the highest level sources such as biology-inspired which called swarm-intelligence based on swarm intelligence examples of it such as ant colony optimization, particle swarm optimization, cuckoo search, bat algorithm, and firefly algorithm, etc. Many algorithms have been developed by using inspiration from physical and chemical systems such as Central force optimization, Anarchic society optimization, Electro-magnetism optimization. Artificial cooperative search, Social emotional optimization. The source of inspiration for algorithm development are diverse, and as a result the algorithms are equally very different [2].

Algorithms have been summarized in brief in this article. Algorithms may be a comprehensive source of information for further research. It has to be noted that the classifications may not be unique and that some algorithms are more efficient and commonly used than other, further research needs to be carried out. Currently, there may be some un clarity in the article of metaheuristic algorithms. From one side, articles have concentrated on important novel thoughts to solve hard problems. From the other side, some articles artificially create new algorithms for the purpose of being published with little development and no novelty. More research must be encouraged to conduct truly novel and considerable studies that are in fact useful to solve difficult problems. For that reason, the aim of this article is to inspire more research to get better insight into efficient algorithms and solve large-scale real-world problems. This article presents a broad classification of the NIOAs.

II. NATURE-INSPIRED ALGORITHMS (NIOAS)

Nature plays an important role in different human activities as well as being a diverse source of inspiration. Algorithms are developed by drawing inspiration from nature. Therefore, algorithms based on nature are called Nature Inspired Algorithms (NIOAs). The purpose of designing NIOAs is to find out optimal solution of the difficulty. Two key factors define an algorithm:

- Optimal solution
- Time at which a solution is reached.

The achievement of a result (which is fairly good approximate ion of an ideal) in real time is often more desirable than achieving the best result in a long period of time. The nature-inspired metaheuristics meet the goal. In the past two decades, many nature- inspired algorithms have been proposed and applied to solve optimization problems, e.g., Genetic Algorithm (GA), Particle Swarm Optimization (PSO) ant Colony Optimization (ACO), Differential Evolution (DE), etc. Swarm Intelligence is well known algorithm among Nature Inspired Algorithms.

Some of these algorithms use the field of physics, chemistry and biology while some other use music for their functioning. It is observed that, equilibrium is maintained in all the three states i.e. physical, chemical and biological by any method. And we may or may not be familiar with those methods. Further, algorithms are classified in their