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Evolution of Mimics of Algorithms of Nature (E-man) Part 5[#]: Tutorial on Big_Bang–Big_Crunch algorithm

K RamaKrishna[1], G.Ramkumar[1] and R Sambasiva Rao[2*]

1. Department of Chemistry, Gitam Institute of Science, Gitam University, Visakhapatnam, 530 017, **INDIA**
2. School of Chemistry, Andhra University, Visakhapatnam 530 003, **INDIA**

Email: karipeddirk@gmail.com,rsr.chem@gmail.com

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(Dedicated to Dr P V Subba Rao, former professor of chemistry, Andhra University on his 70th birth anniversary)

ABSTRACT

Big_Bang (BB) is one of successful theoretical models with ample high-tech-precise- experimental evidence explaining the origin and present form of the universe while Big_crunch (BC) appears to be plight of future. The scientific scenario is a conglomeration of Nobel Prize winning results of theoretical physicists, unique concerted experimental efforts in CERN, continual upgradation of 'Standard model' and simulations. BB–BC-algorithm for optimisation is a brain child of Erol and Eksin in 2006. This sparkle is inspiration from a splinter of the Mother Nature. In the Big Bang (BB) phase of the algorithm, uniform random solutions are generated enabling a global search. It is a reflection of dissipation of energy resulting in disorder/high entropy. During Big_Crunch (BC), in the second stage, the wide spread (solution set) points traverse towards a single location called here center of mass (i.e. reciprocal of fitness/object function). In other words the order increases and obviously randomness becomes smaller and smaller around the average point. The algorithm after cycling through a large number of sequences of BB and BC converge towards the true solution. This E-man-tool showed accepted performance in classification of IRIS flowers and discrimination of benign versus cancerous breast. The standard mathematical functions like Rosenberg and complex design tasks are tested with success. In the engineering front, the results of civil constructions of reinforced concrete/domes or ribbed domes design, inverse type-2 fuzzy model based electric-controllers and fuzzy cognitive maps with BB-BC are trustworthy. The incorporation of local search directions, local trap recognition with diversity index, mutation operator enabling escape from local optima, trying with uniform population instead of uniform random numbers in BB operation and chaotic patterns against normal distributions during BC stage etc are recent advances rendering BB-BC still powerful. The clubbing of even incomplete/ vague/apriori task-specific constraints/expert-model-knowledge of basic BB-BC, its binary hybridisation with another nature-mimicking algorithm (Harmony_serch, CSS, PSO, ACO, GA), a quaternary hybrid heuristic-BBBC-PSO-ACO-HarmonySerch enhances applicability into more intricate/exploratory domains of research. The state of art of improvements in BB-BC with advances in mathematical algorithms and intricacies of applications in diverse disciplines is presented. The sequences of events from Planck time till to-date after big_bang, futuristic profile, typical mathematical-models along with experimental evidences and open-ended riddles, a perennial source of inspiration, are briefed in appendices.

Keywords: Big_Bang–Big_Crunch algorithm, Theories of origin of universe, Nature mimicking, E-man, optimization.

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