Computer and Information Science; Vol. 13, No. 1; 2020
ISSN 1913-8989 E-ISSN 1913-8997
Published by Canadian Center of Science and Education

Artificial God Optimization - A Creation

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Received: December 18, 2019 Accepted: January 6, 2020 Online Published: January 10, 2020

doi:10.5539/cis.v13n1p41 URL: https://doi.org/10.5539/cis.v13n1p41

Abstract

Nature Inspired Optimization Algorithms have become popular for solving complex Optimization problems. Two most popular Global Optimization Algorithms are Genetic Algorithms (GA) and Particle Swarm Optimization (PSO). Of the two, PSO is very simple and many Research Scientists have used PSO to solve complex Optimization Problems. Hence PSO is chosen in this work. The primary focus of this paper is on imitating God who created the nature. Hence, the term "Artificial God Optimization (AGO)" is coined in this paper. AGO is a new field, which is invented in this work. A new Algorithm titled "God Particle Swarm Optimization (GoPSO)" is created and applied on various benchmark functions. The World's first Hybrid PSO Algorithm based on Artificial Gods is created in this work. GoPSO is a hybrid Algorithm, which comes under AGO Field as well as PSO Field. Results obtained by PSO are compared with created GoPSO algorithm. A list of opportunities that are available in AGO field for Artificial Intelligence field experts are shown in this work.

Keywords: artificial gods, artificial god optimization, artificial god computing, computational intelligence, evolutionary computing, particle swarm optimization, genetic algorithms, artificial human optimization, bio-inspired computing, nature inspired computing, machine learning, artificial intelligence

1. Introduction

John Henry Holland proposed Genetic Algorithms in 1970’s (Holland, J. H., 1975). From 1970’s to till date, there are hundreds of Nature Inspired Optimization Algorithms proposed in literature. A Research scientist asked on Researchgate the following question in March 2015 (Sandeep Kumar, 2015):

“Question: What are the various Nature Inspired Optimization Algorithms?”

Another Research Scientist replied the following algorithms as answer to the above question (Sandeep Kumar, 2015):

“Answer: The following is the list of various Nature Inspired Optimization Algorithms:

1. Genetic Algorithms (GA)
2. Simulated annealing (SA)
3. Artificial immune systems (AIS)
4. Boids
5. Tabu Search
6. Memetic Algorithm (MA)
7. Ant Colony Optimization Algorithm (ACO)
8. Cultural Algorithms (CA)
9. Particle Swarm Optimization (PSO)
10. Self-propelled Particles

11. Differential Evolution (DE)
12. Bacterial Foraging Optimization
13. Harmony Search (HS)
14. MBO: Marriage in Honey Bees Optimization
15. Artificial Fish School Algorithm
16. Bacteria Chemotaxis (BC) Algorithm
17. Social Cognitive Optimization (SCO)
18. Artificial Bee Colony Algorithm
19. Bees Algorithm
20. Glowworm Swarm Optimization (GSO)
21. Honey-Bees Mating Optimization (HBMO) Algorithm
22. Invasive Weed Optimization (IWO)
23. Shuffled Frog Leaping Algorithm (SFLA)
24. Central Force Optimization
25. Intelligent Water Drops algorithm, or the IWD algorithm
26. River Formation Dynamics
27. Biogeography-based Optimization (BBO)
28. Roach Infestation Optimization (RIO)
29. Bacterial Evolutionary Algorithm (BEA)
30. Cuckoo Search (CS)
31. Firefly Algorithm (FA)
32. Gravitational Search Algorithm (GSA)
33. Group Search Optimizer
34. League Championship Algorithm (LCA)
35. Bat Algorithm
36. Bumble Bees Mating Optimization (BBMO) Algorithm
37. Eagle Strategy
38. Fireworks algorithm for optimization
39. Hunting Search
40. Altruism Algorithm
41. Spiral Dynamic Algorithm (SDA)
42. Strawberry Algorithm
43. Artificial Algae Algorithm (AAA)
44. Bacterial Colony Optimization
45. Differential Search Algorithm (DS
46. Flower pollination algorithm (FPA)
47. Krill Herd
48. Water Cycle Algorithm
49. Black Holes Algorithm
50. Cuttlefish Algorithm
51. Gases Brownian Motion Optimization
52. Mine blast algorithm

53. Plant Propagation Algorithm
54. Social Spider Optimization (SSO)
55. Spider Monkey Optimization (SMO) algorithm
56. Animal Migration Optimization (AMO) Algorithm
57. Artificial Ecosystem Algorithm (AEA)
58. Bird Mating Optimizer
59. Forest Optimization Algorithm
60. Golden Ball
61. Grey Wolf Optimizer
62. Seed Based Plant Propagation Algorithm
63. Lion Optimization Algorithm (LOA): A Nature-Inspired Meta heuristic Algorithm
64. Optics Inspired Optimization (OIO)
65. The Raven Roosting Optimization Algorithm
66. Vortex Search Algorithm
67. Water Wave Optimization
68. Collective Animal Behavior CAB algorithm
69. Bumble Bees Mating optimization BBM
70. Flower Pollinated Algorithm
71. Chaos Optimization
72. Wind Driven Algorithm
73. Parliamentary optimization algorithm POA
74. Aritificial Chemical Process Algorithm
75. Aritificial Chemical Reaction Optimization Algorithm
76. Chemical Reaction Algorithm
77. Bull optimization algorithm
78. Elephent herding optimization (EHO)
79. Rain Optimization Algorithm".

From the above answer, we can find that many Nature Inspired Optimization algorithms are proposed in literature till date. However, there is not even a single algorithm that takes God (who created the nature) as Inspiration for creating innovative optimization algorithms. Hence, a new field titled "Artificial God Optimization (AGO)" is invented in this work. AGO field is defined as follows:

Artificial Birds are the basic entities in Particle Swarm Optimization algorithm. Similarly, Artificial Gods are the basic entities in Artificial God Optimization (AGO). All the optimization algorithms, which are proposed based on Artificial Gods, will come under AGO Field. Each Artificial God corresponds to a point in search space. In addition to Artificial Gods, there can be Artificial non-Gods in the population. Each Artificial non-God corresponds to a point in the search space. Artificial non-Gods are less powerful than Artificial Gods.

Details related to God can be found in Ancient Hindu Religious Texts (Veda Vyasa, 3100 BCE) – (Veda Vyasa, 400 BCE – 200 CE). AGO Field concepts are applied to Particle Swarm Optimization (PSO) algorithm to create New AGO Field algorithms. PSO field details are given in articles (Saptarshi Sengupta, Sanchita Basak, & Richard Alan Peters II, 2018) - (Riccardo Poli, James Kennedy, & Tim Blackwell, 2007). Articles (Liu H, Xu G, Ding GY, & Sun YB, 2014) - (Satish Gajawada, & Hassan M. H. Mustafa, 2019b) show details related to Hybrid PSO Algorithms that are created by modifying PSO algorithm. Till date, there are no Artificial God Optimization Algorithms (AGO Algorithms) proposed in literature. This work makes use of this research gap and invents AGO field.

The rest of the article is organized as follows:

Particle Swarm Optimization algorithm is developed in Section 2. Section 3 presents "God Particle Swarm

Optimization (GoPSO)". Results are explained in Section 4. Opportunities that are present in AGO Field are detailed in Section 5. Conclusions are given in Section 6.

2. Particle Swarm Optimization

Particle Swarm Optimization (PSO) was proposed by Kennedy and Eberhart in 1995 (Kennedy, J., & Eberhart, R. C., 1995). PSO is based on Artificial Birds. It has been applied to solve complex optimization problems.

In PSO, first we initialize all particles as shown below. Two variables $pbest_i$ and gbest are maintained. $pbest_i$ is the best fitness value achieved by i^{th} particle so far and gbest is the best fitness value achieved by all particles so far. Lines 4 to 11 in the below Figure 1 helps in maintaining particle best and global best. Then, the velocity is updated by rule shown in line 14. Line 15 updates position of i^{th} particle. Line 19 increments the number of iterations and then the control goes back to line 4. This process of a particle moving towards its local best and also moving towards global best of particles is continued until termination criteria will be reached.

1) Initialize all particles

2) iterations = 0

3) do

4) for each particle i do

5) If (f(x_i) < f($pbest_i$)) then

6) $pbest_i = x_i$

7) end if

8) if (f($pbest_i$) < f(gbest)) then

9) gbest = $pbest_i$

10) end if

11) end for

12) for each particle i do

13) for each dimension d do

14) $v_{i,d} = w*v_{i,d} +$
C_1*Random(0,1)*($pbest_{i,d} - x_{i,d}$)
+ C_2*Random(0,1)*($gbest_d - x_{i,d}$)

15) $x_{i,d} = x_{i,d} + v_{i,d}$

16) end for

17) end for

18) iterations = iterations + 1

19) while (termination condition is false)

Figure 1. Particle Swarm Optimization (PSO)

3. God Particle Swarm Optimization

The basic entities in the God Particle Swarm Optimization (GoPSO) are Artificial Gods and Artificial non-Gods. Gods can always move in the search space. Whereas non-Gods can move in the search space only if non-God receives blessings of Gods. Based on random number generated and GodProbability, the particle is classified into either Artificial non-God or Artificial God. If a particle is classified as Artificial God then it will update position and velocity irrespective of anything. If particle is classified as Artificial non-God then there are two cases. Based on random number generated and BlessingsOfGodProbability the particle is classified into Blessed non-God or not blessed non-God. Blessed non-God can move in search space and hence updates velocity and position. Not Blessed non-God cannot move in search space and hence does not update velocity and position.

If the random number generated in line 13 is less than GodProbability, then particle is classified as Artificial God else it is classified as Artificial non-God. Lines 14-17 are executed by God. Lines 19-26 are executed by non-God. If the random number generated is less than BlessingsOfGodProbability, then the non-God is blessed else it is not blessed non-God. Blessed non-God executes lines 20-23. Hence, velocity and position are updated for Blessed non-God. Line 25 is blank. Therefore, Not Blessed non-God is blocked and does nothing. The same procedure is repeated for all particles in first generation.

In second generation, line 13 is again executed. Particle classified as God in first generation can be classified as non-God in second generation. Particle classified as non-God in first generation can be classified as God in second generation. Similarly, in second generation, line 19 is again executed. Therefore, whether non-God receives blessings of God or not is dependent on the random number generated and BlessingsOfGodProbability. The remaining procedure is same as that of first generation.

1) Initialize all particles

2) iterations = 0

3) do

4) for each particle i do

5) If (f(x_i) < f($pbest_i$)) then

6) $pbest_i = x_i$

7) end if

8) if (f($pbest_i$) < f(gbest)) then

9) gbest = $pbest_i$

10) end if

11) end for

12) for each particle i do

13) if (random(0,1) <GodProbability) then //God

14) for each dimension d do

15) $v_{i,d} = w*v_{i,d} +$
C_1*Random(0,1)*($pbest_{i,d} - x_{i,d}$)
+ C_2*Random(0,1)*($gbest_d - x_{i,d}$)

16 $x_{i,d} = x_{i,d} + v_{i,d}$

17) end for

18) else //non-God

19) if (random(0,1) <BlessingsOfGodProbability) then // Blessed non-God

20) for each dimension d do

21) $v_{i,d} = w*v_{i,d} +$
C_1*Random(0,1)*($pbest_{i,d} - x_{i,d}$)
+ C_2*Random(0,1)*($gbest_d - x_{i,d}$)

22) $x_{i,d} = x_{i,d} + v_{i,d}$

23) end for

24) else // non-God without blessings does nothing

25) end if

26) end if

27) end for

28) iterations = iterations + 1

29) while (termination condition is false)

Figure 2. God Particle Swarm Optimization (GoPSO)

4. Results

Benchmark Functions used in this paper are taken from (Optimization Test Functions and Datasets, 2017). The proposed God Particle Swarm Optimization (GoPSO) is applied on Ackley, Beale, Bohachevsky, Booth and Three-Hump Camel functions. Results obtained are compared with PSO.

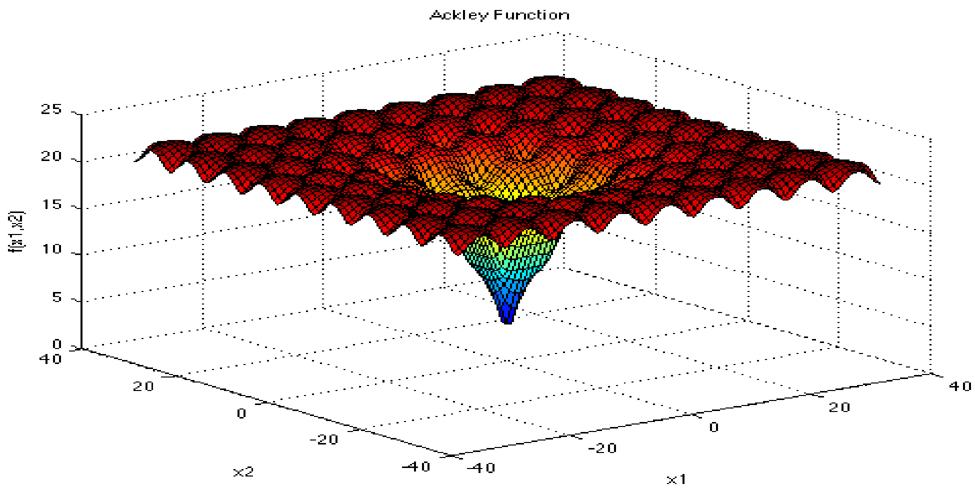

Figure 3. Ackley Function

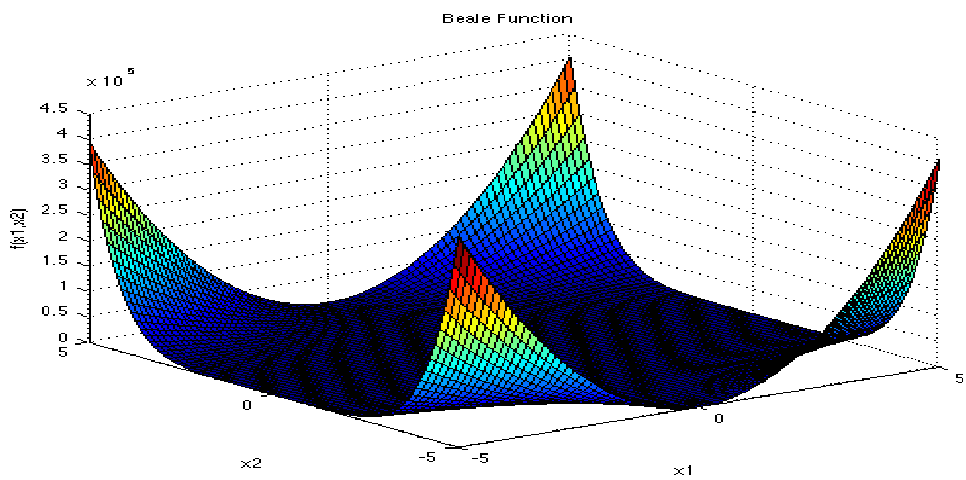

Figure 4. Beale Function

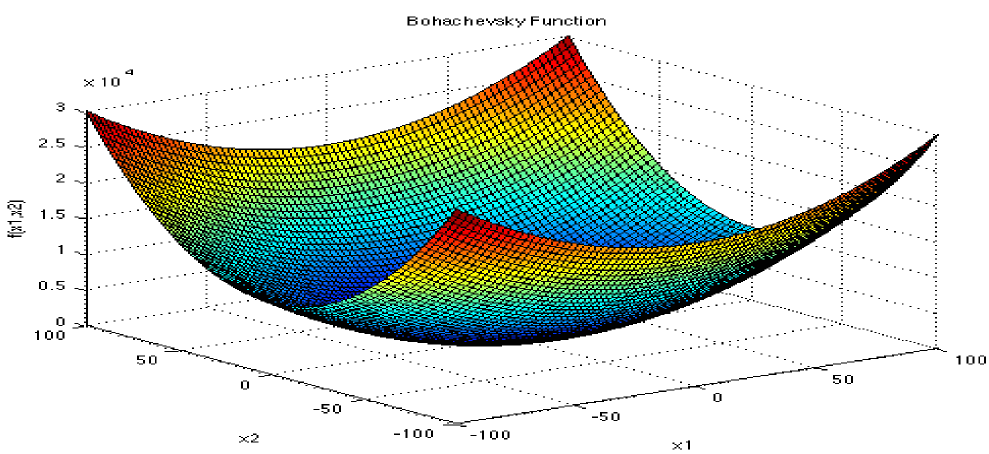

Figure 5. Bohachevsky Function

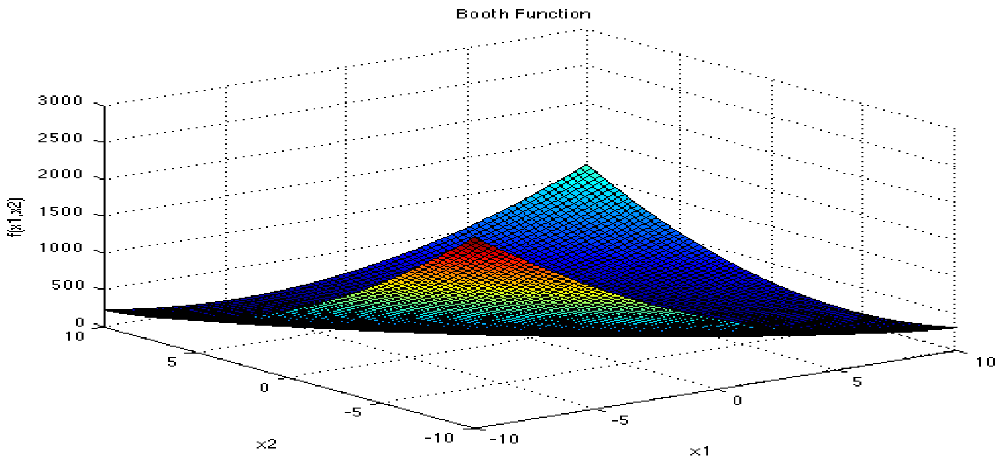

Figure 6. Booth Function

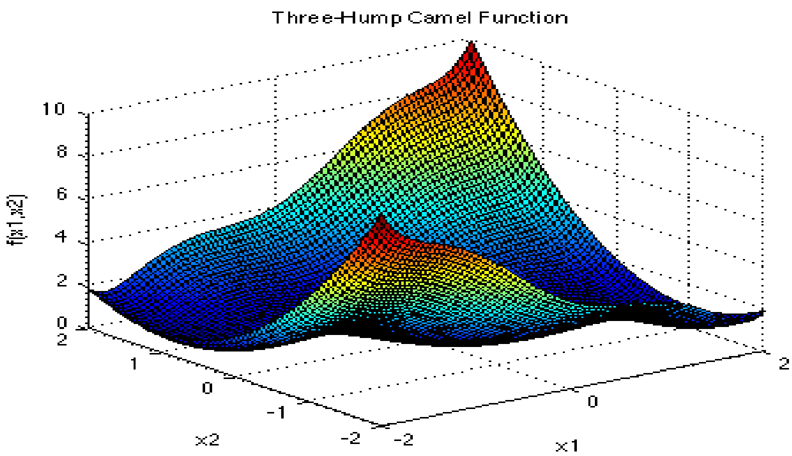

Figure 7. Three-Hump Camel Function

Table 1. Overall Result

Benchmark Function / Algorithm	GoPSO	PSO
Ackley Function		
Beale Function		
Bohachevsky Function		
Booth Function		
Three-Hump Camel Function		

In Table 1 Green represents Performed well. Red represents did not performed well. Blue represents performed between well and not well. From Table 1, we can see that both GoPSO and PSO performed well on all benchmark functions.

5. Interesting Opportunities in Artificial God Optimization Field

The following are the opportunities in Artificial God Optimization field (AGO field) for experts in Artificial Intelligence field:

1) International Institute of Artificial God Optimization, Hyderabad, INDIA

2) Indian Institute of Technology Roorkee Artificial God Optimization Labs, IIT Roorkee

3) Foundation of Artificial God Optimization, New York, USA.

4) IEEE Artificial God Optimization Society

5) ELSEVIER journals in Artificial God Optimization

6) Applied Artificial God Optimization – A New Subject

7) Advanced Artificial God Optimization – A New Course

8) Invited Speech on "Artificial God Optimization" in world class Artificial Intelligence Conferences

9) A Special issue on "Artificial God Optimization" in a Springer published Journal

10) A Seminar on "Recent Advances in Artificial God Optimization" at Technical Festivals in colleges

11) International Association of Artificial God Optimization (IAAGO)

12) Transactions on Artificial God Optimization (TAGO)

13) International Journal of Artificial God Optimization (IJAGO)

14) International Conference on Artificial God Optimization (ICAGO)

15) www.ArtificialGodOptimization.com

16) B.Tech in Artificial God Optimization

17) M.Tech in Artificial God Optimization

18) PhD in Artificial God Optimization

19) PostDoc in Artificial God Optimization

20) Artificial God Optimization Labs

21) To become "Father of Artificial God Optimization" field

6. Conclusions

Artificial God Optimization field (AGO field) is invented in this work. A novel God Particle Swarm Optimization (GoPSO) is created in this work. PSO and GoPSO performed well on all benchmark functions. The invented AGO field comes under Artificial God Computing Field. As mentioned in arXiv pre-print, arXiv: 1903.12011 [cs.NE], there is scope for many PhD's and PostDoc's in Artificial Human Optimization field. In addition it is mentioned that there are millions of articles possible in AHO field. Similarly, we can easily prove that AGO field invented in this work has millions of opportunities, which are yet to be explored by Research Scientists across the globe.

Acknowledgments

Thanks to GOD. Thanks to everyone and everything who directly or indirectly helped us to reach the stage where we are now today.

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