

Artificial God Optimization – A Creation

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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. 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:

"Question: What are the various Nature Inspired Optimization Algorithms?"

Another Research Scientist replied the following algorithms as answer to the above question:

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. Artificial Chemical Process Algorithm
75. Artificial Chemical Reaction Optimization Algorithm
76. Chemical Reaction Algorithm
77. Bull optimization algorithm
78. Elephant 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. But there is not even a single algorithm which 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 [1-2]. AGO Field concepts are applied to Particle Swarm Optimization (PSO) algorithm to create New AGO Field algorithms. PSO field details are given in articles [3-9]. Articles [10-28] 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 shown in Section 2. Section 3 shows “God Particle Swarm Optimization (GoPSO)”. Results are explained in Section 4. Opportunities that are present in AGO Field are shown 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. 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 text helps in maintaining particle best and global best. Then the velocity is updated by rule shown in line no. 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.

Procedure: Particle Swarm Optimization (PSO)

```
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)       $x_{i,d} = x_{i,d} + v_{i,d}$ 
17)    end for
18)  end for
19)  iterations = iterations + 1
20) while ( termination condition is false)
```

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 doesn't update velocity and position.

If the random number generated in line number 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 number 25 is blank. Hence Not Blessed non-God is blocked and does nothing. The same procedure is repeated for all particles in first generation.

In second generation, line number 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 number 19 is again executed. So, 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.

Procedure: God Particle Swarm Optimization (GoPSO)

```

1) Initialize all particles
2) iterations = 0
3) do
4)   for each particle i do
5)     if ( f( xi ) < f( pbesti ) ) then
6)       pbesti = xi
7)     end if
8)     if ( f( pbesti ) < f( gbest ) ) then
9)       gbest = pbesti
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)        vi,d = w*vi,d +
          C1*Random(0,1)*(pbesti,d - xi,d)
          + C2*Random(0,1)*(gbestd - xi,d)
16)        xi,d = xi,d + vi,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)          vi,d = w*vi,d +
            C1*Random(0,1)*(pbesti,d - xi,d)
            + C2*Random(0,1)*(gbestd - xi,d)
22)          xi,d = xi,d + vi,d
23)        end for
24)      else // non-God without blessings does nothing
25)
26)    end if
27)  end if
28) end for
29) iterations = iterations + 1
30) while ( termination condition is false)

```

4 Results

Benchmark Functions used in this paper are taken from [29]. The proposed God Particle Swarm Optimization (GoPSO) is applied on five benchmark functions. Results obtained are compared with PSO.

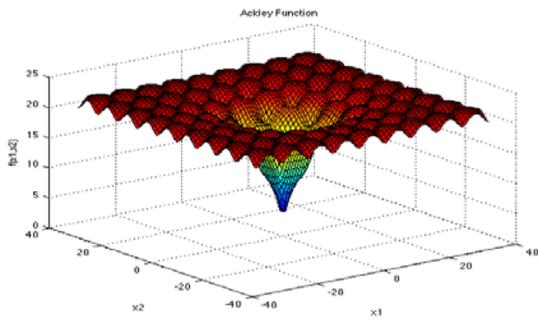


Figure 1. Ackley Function

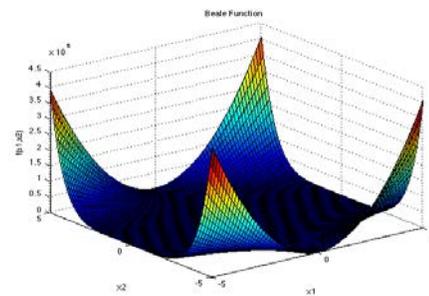


Figure 2. Beale Function

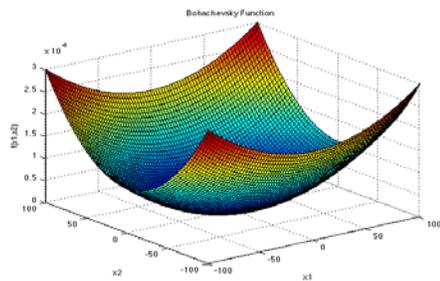


Figure 3. Bohachevsky Function

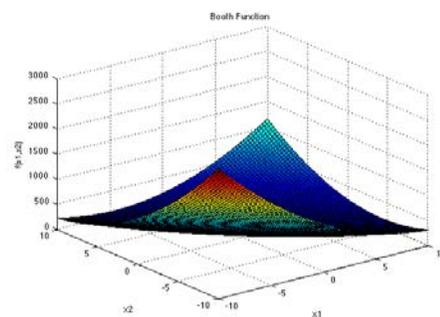


Figure 4. Booth Function

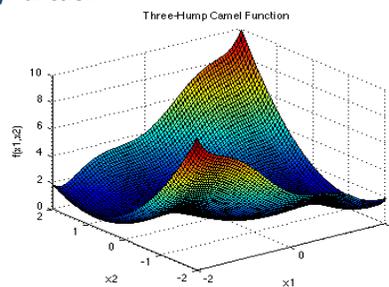


Figure 5. Three-Hump Camel Function

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 didn't 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. It is also 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.

ACKNOWLEDGEMENTS

The authors of this work would like to thank the following Editorial Members of “Transactions on Machine Learning and Artificial Intelligence (TMLAI)” for accepting our innovative invention titled Artificial God Optimization Field (AGO Field):

- o Professor Er Meng Joo, School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore

- Professor Djamel Bouchaffra, Department of Mathematics and Computer Science, Grambling State University, Louisiana., United States
- Prof Bhavani Thuraisingham, Department of Computer Science, Erik Jonsson School of Engineering and Computer Science, The University of Texas at Dallas, United States
- Professor Dong-Hee Shin, Department of Interaction Science, Social Computing Institute, Sungkyunkwan University, Seoul, Korea, Republic of
- Professor Filippo Neri, Professor of Computer Information Systems, Faculty of Information & Communication Technology, Dar Guzeppi Zahra, University of Malta, Malta
- Prof Mohamed A Zohdy, Department of Electrical and Computer Engineering, Oakland University, United States
- Professor Wee SER, Associate Professor Director, VALENS Research Centre, School of Electrical and Electronic Engineering; Program Director (MISA), Nanyang Institute of Technology in Medicine and Health Nanyang Technological University, Singapore
- Professor Liang Yanchun, Deputy Dean of College of Computer Science, Jilin University, China
- Professor Julia Johnson, Dept. of Mathematics & Computer Science Laurentian University, Sudbury, Ontario, Canada
- Professor Farouk Yalaoui, Institut Charles Dalaunay, University of Technology of Troyes, France
- Professor Jai N Singh, Department of Mathematics and Computer Science, Barry University, Miami Shores, Florida, United States
- Dr Kyriakos G Vamvoudakis, Dept of Electrical and Computer Engineering, University of California Santa Barbara, United States
- Dr Zezhi Chen, School of Computing and Information Systems; Faculty of Science, Engineering and Computing; Kingston University London, United Kingdom
- Dr Luis Rodolfo Garcia, College of Science and Engineering, Texas A&M University, Corpus Christi, United States
- Dr Hafiz M. R. Khan, Associate Professor & Graduate Program Director, Department of Biostatistics, Florida International University, United States
- Dr Xiacong Fan, School of Engineering, Behrend College, The Pennsylvania State University, United States
- Dr Chen Yanover, Machine Learning for Healthcare and Life Sciences IBM Haifa Research Lab, United States
- Dr Vandana Janeja, Information Systems Department, University of Maryland, Baltimore, United States
- Dr Nikolaos Georgantas, Senior Research Scientist at INRIA, Paris-Rocquencourt, France
- Dr Zeyad Al-Zhour, College of Engineering, The University of Dammam, Saudi Arabia
- Dr Zdenek Zdrahal, Senior Research Fellow in Artificial Intelligence, Knowledge Media Institute, The Open University, Milton Keynes MK7 6AA, United Kingdom
- Dr Steve S. H. Ling, University of Technology, Sydney, Australia
- Dr Marianne Hoogeveen, Arena Analytics, United States
- Dr Hooshang Hemami, Dept. of Electrical and Computer Engineering The Ohio State University Columbus, Ohio 43210, United States
- Dr Hiroyuki Utsunomiya, University of Tokyo, Japan

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