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# Artificial Soul Optimization - an Invention

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# Artificial Soul Optimization - An Invention

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**Abstract:** The Soul is eternal and exists even after death of a person or animal. The main idea that is captured in this work is that soul continues to exist and takes a different body after the death. The primary goal of this work is to invent a new field titled "Artificial Soul Optimization (ASO)". The term "Artificial Soul Optimization" is coined in this paper. All the Optimization algorithms which are proposed based on Artificial Souls will come under "Artificial Soul Optimization" Field (ASO Field). In the Particle Swarm Optimization and Artificial Human Optimization, the basic entities in search space are Artificial Birds and Artificial Humans respectively. Similarly, in Artificial Soul Optimization, the basic entities in search space are Artificial Souls. In this work, the ASO Field concepts are added to Particle Swarm Optimization (PSO) algorithm to create a new hybrid algorithm titled "Soul Particle Swarm Optimization (SoPSO). The proposed SoPSO algorithm is applied on various benchmark functions. Results obtained are compared with PSO algorithm. The World's first Hybrid PSO algorithm based on Artificial Souls is created in this work.

## 1 Introduction

The word Soul is present in sacred Hindu religious texts like Srimad Bhagavatham [1] and Bhagavad Gita [2]. "Soul Optimization" is something that deals with Real Souls. It can also be called as "Real Soul Optimization". In this work, the focus is on Artificial Soul Optimization Field (ASO Field) which is defined in the abstract of this paper. Hence it is important to note that "Artificial Soul Optimization" and "Real Soul Optimization" are different.

The corresponding author asked, "Is there something like Soul Computing?" on Researchgate and an expert replied, "Just like I doubt you would find algorithms for 'Unicorn computing', I don't think you will find anything on 'Soul computing'...". Hence there is so much yet to be done in Real Soul Computing and Artificial Soul Computing fields.

Nikola Tesla said, "The day science begins to study non-physical phenomena, it will make more progress in one decade than in all the previous centuries of its existence". Hence authors would like to suggest scientists to study and do projects related to non-physical phenomena like Real Soul Computing and Artificial Soul Computing. The current work studies Artificial Soul Optimization which comes under Artificial Soul Computing.

New ASO Field algorithms are created in this work by modifying Particle Swarm Optimization (PSO) algorithm with ASO Field concepts. Articles [3-9] give details related to PSO algorithms. Hybrid PSO Algorithms that are created by modifying PSO algorithm were shown in [10-14]. Hybrid PSO algorithms that are created by modifying PSO algorithm with Artificial Human Optimization (AHO) Field concepts and details related to AHO Field are given in articles [15-28]. There are no Artificial Soul Optimization Algorithms (ASO Algorithms) proposed in literature till date. Benchmark Functions used in this paper are taken from [29].

The rest of the article is organized as follows:
Section 2 shows Particle Swarm Optimization algorithm. Section 3 shows "Soul Particle Swarm Optimization (SoPSO)". Results are explained in Section 4. Section 5 gives opportunities that are present in ASO Field. Section 6 gives Conclusions.

# 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 Soul Particle Swarm Optimization

The basic entities in Soul Particle Swarm Optimisation (SoPSO) are Artificial Souls. Each Artificial Soul corresponds to a point in search space. For the sake of simplicity, in this work we assume that there are two types of bodies that each Artificial Soul can take. The first body has Body Factor of BF1 and the second body has a Body Factor of BF2. In each generation, Artificial Souls take either first body or second body based on random number generated and BodySelectionProbability. If random number generated is less than BodySelectionProbability then first body is taken else second body is taken. In this study we took BF1 as 0.9 and BF2 as 0.1. Hence if Artificial Soul takes first body then it moves faster in search space because BF1 is 0.9. Whereas if Artificial Soul takes second body it moves slower in the search space because BF2 is 0.1. In each generation, body is dead after velocity and position are updated. Hence Artificial Soul takes new body in next generation. So the Artificial Soul remains eternal in all generations whereas the bodies taken are dead and a new body is taken in every generation by Artificial Souls.

In line number 13, a random number is generated and compared with BodySelectionProbability. If random number is less than BodySelectionProbability then the Soul takes first body else it takes second body. If first body is selected by Soul then lines 14-17 are executed and body factor BF1 is used in the position update equation. If second body is selected then lines 19-22 are executed and body factor BF2 is used in the position update equation. After velocity and position updates, the body taken by Soul is dead. This is the procedure shown for first generation and first Soul. The same procedure is repeated for all the Artificial Souls in first generation. Hence after velocity and position updates, all bodies taken by Souls are dead. Now the second generation is started and Souls take bodies based on random number and BodySelectionProbability as shown in line number 13. The remaining procedure is same as that of first generation. This process continues until termination criteria will be reached.

**Procedure:** Soul Particle Swarm Optimization (SoPSO)

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** ( rand(0,1) <BodySelectionProbability) // Soul takes first body
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)                             $x_{i,d} = x_{i,d} + BF1 * v_{i,d}$
17)                     **end for**
18)             **else** // Soul takes second body
19)                     **for** each dimension d **do**
20)                             $v_{i,d} = w*v_{i,d} +$
                                    $C_1*Random(0,1)*(pbest_{i,d} - x_{i,d})$
                                    $+ C_2*Random(0,1)*(gbest_d - x_{i,d})$
21)                             $x_{i,d} = x_{i,d} + BF2 * v_{i,d}$
22)                     **end for**
23)             **end if**
24)     **end for**
25)     iterations = iterations + 1
26) **while** ( termination condition is false)

# 4 Results

The proposed Soul Particle Swarm Optimization (SoPSO) is applied on five benchmark functions. Results obtained are compared with PSO.
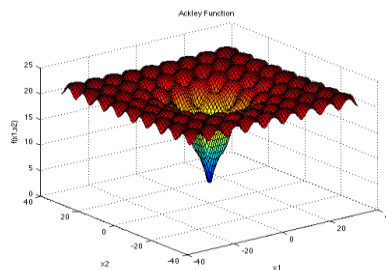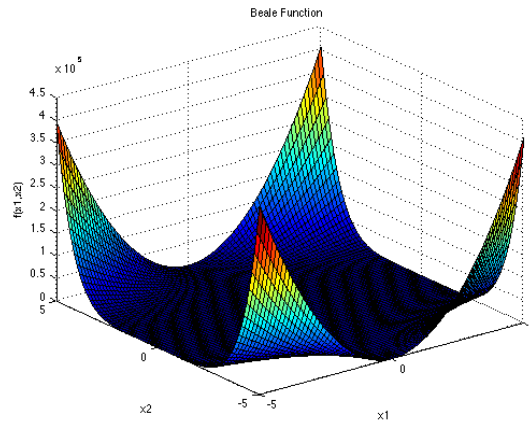


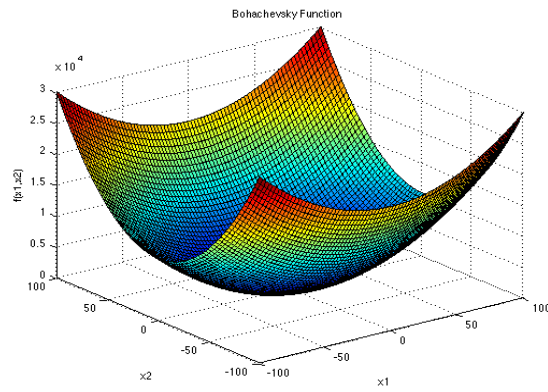**Figure 1. Ackley Function**

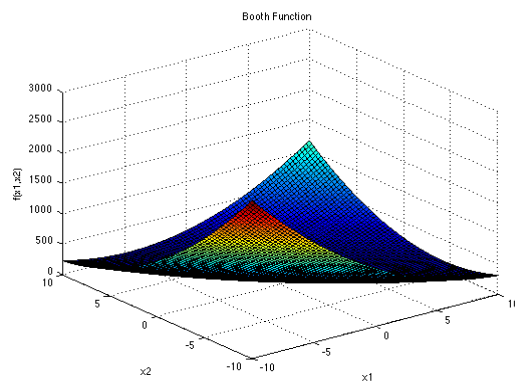**Figure 2. Beale Function**



**Figure 3. Bohachevsky Function**
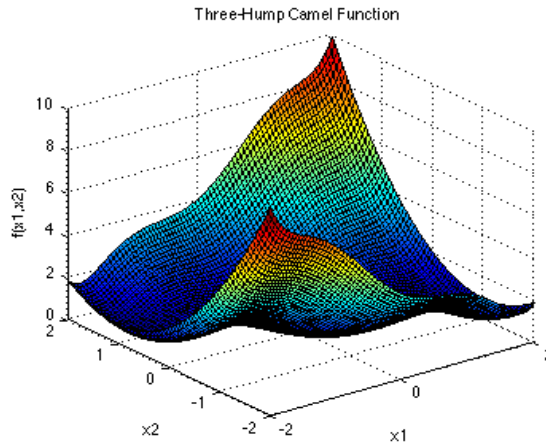


**Figure 4. Booth Function**

**Figure 5. Three-Hump Camel Function**

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

**Table 1. Overall Result**

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 SoPSO and PSO performed well on all benchmark functions.

# 5 Interesting Opportunities in Artificial Soul Optimization Field

The following are opportunities for experts in Computational Intelligence Field:

1) International Institute of Artificial Soul Optimization, Hyderabad, INDIA
2) Indian Institute of Technology Roorkee Artificial Soul Optimization Labs, IIT Roorkee
3) Foundation of Artificial Soul Optimization, New York, USA.
4) IEEE Artificial Soul Optimization Society
5) ELSEVIER journals in Artificial Soul Optimization
6) Applied Artificial Soul Optimization – A New Subject

7) Advanced Artificial Soul Optimization – A New Course
8) Invited Speech on "Artificial Soul Optimization" in world class Artificial Intelligence Conferences
9) A Special issue on "Artificial Soul Optimization" in a Springer published Journal
10) A Seminar on "Recent Advances in Artificial Soul Optimization" at Technical Festivals in colleges
11) International Association of Artificial Soul Optimization (IAASO)
12) Transactions on Artificial Soul Optimization (TASO)
13) International Journal of Artificial Soul Optimization (IJASO)
14) International Conference on Artificial Soul Optimization (ICASO)
15) www.ArtificialSoulOptimization.com
16) B.Tech in Artificial Soul Optimization
17) M.Tech in Artificial Soul Optimization
18) PhD in Artificial Soul Optimization
19) PostDoc in Artificial Soul Optimization
20) Artificial Soul Optimization Labs
21) To become "Father of Artificial Soul Optimization" field

# 6 Conclusions

A new field titled "Artificial Soul Optimization (ASO)" is invented in this work. A new algorithm titled Soul Particle Swarm Optimization (SoPSO) is designed and results show that proposed SoPSO performed well on all benchmark functions like PSO. In this work, a list of opportunities in ASO Field is shown for Computational Intelligence Field Experts. Not much work was done in Soul Computing and Artificial Soul Computing Fields till date. The new ASO field invented in this work comes under Artificial Soul Computing Field. There is scope for other innovative algorithms like Soul Ant Colony Optimization (SoACO) similar to SoPSO.

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