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A Study of ACO/PSO Approaches in Agriculture and Social Network Fields - A Generic Review

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***Abstract*—In recent years, evolutionary optimization algorithms are used in different domains like medical, business analysis, engineering, agriculture, social network etc. Due to scarcity of resources in agriculture, the farmers need an optimized framework to make proper decisions. Similarly in social networks, there is a need to mine meaningful insight of data among massive dataset and also needs an effective solution for security and privacy of data. In order to provide solutions for the above issues in those fields, many researchers have widely used evolutionary algorithms. This paper provides a generic review of Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO) and its practice in the field of agriculture and social network. For that, this work integrates various author's findings for the benefit of new researchers to get a state-of-the-art in ACO and PSO techniques and their applications.**

Keywords— Ant Colony Optimization, Particle Swarm Optimization, Social Network, Agriculture

I. INTRODUCTION

Optimization is the process of making best or most effective use of situations or resources to acquire an optimized solution for the given problem. The techniques involved will result in productive outcomes with high level of accuracy. Thus, the aim is to provide optimal solution as well as focus is on to give robustness solution which are actually needed in organizations.

The main objective of every optimization algorithms is to yield an optimum solution. So the processes are iteratively continued and compare all the possible solutions until best or satisfactory solution is found. Optimization technique plays a major role in this new digital era. In today's world all engineering design and industry were now adopted to this optimization technique. Another technique namely data mining also widely used to analyze and extract the meaningful information from huge amount of data. Optimization techniques provides well support to implement various data mining algorithms. Most of the techniques like clustering, feature extraction and classification are well hybridized with optimization techniques for an effective implementation. Support Vector Machine and kernel methods supports optimization algorithms to implement data mining process in an effective manner. The very basic algorithms were marking schemes that the ancient folks used to keep track of their grain stock and cattle. As decades passed, many algorithms were evolved from solutions obtained for real time problems. Algorithms like Genetic Algorithm(GA),Ant Colony Optimization(ACO) algorithm, Artificial immune systems (Alaiso et al.),Bees Algorithm, Honey-Bees Mating Optimization (HBMO) Algorithm, Shuffled Frog Leaping Algorithm (SFLA),Cuckoo Search (CS),Firefly Algorithm, Eagle Strategy, Particle swarm optimization (Zecchin et al.) are some of the nature inspired algorithms. Other Nature Inspired algorithms are Artificial Bee Colony (ABC) Algorithm, Firefly Algorithm, Social Spider Algorithm, Bat Algorithm, Strawberry Algorithm, Plant Propagation Algorithm, Seed Based Plant Propagation Algorithm and many others included recently.

PSO,ACO and Cuckoo search algorithms are famous among recent bio inspired algorithms because they are widely used in multidisciplinary domains. Thus, we review the applications of these algorithms in social media and agriculture domain. It will help researchers to know about the implementation process of ACO and PSO algorithms in social and agriculture domain. The aim of this review is to create awareness about the future scope in those two algorithms in the two fields.

Ant colony optimization algorithm serves as a population-based meta heuristic technique for finding the best path through graphs. PSO algorithm works based on population called as swarms and solutions are named as particles. By using fitness function particles are moved in the search space to produce an optimal solution.

Other sections of the paper are formulated as follows: Section 2 describe about the methodology of ACO and PSO algorithms. Section 3 depicts the proven research solutions for various issues in Agriculture and Social Network fields. Section 4 will portray about the research issues in social network field. Section 5 presents concluding remarks and ideas for further research opportunities available in these fields by using bio-inspired approaches

II. OVERVIEW

A. Ant colony optimization

Ants have the capability to smell their food in the best suitable shortest path from their nest. In ants, they have a special type of chemical called pheromone. Initially, the ants move from their colony randomly to find their food from their nest. The shortest path is computed based on the ant which brings more food in less time. When the ants move from their nest in search of food they disperse pheromone from all parts of their body in their path so that it is helpful for other ants to sense and direct them to their food. The pheromone is dispersed when ants reached to their colony. If ants face any hurdles to find their food in the way, they separate into two paths and the shortest path is the path which contains high density of pheromone. The pheromone

with less density in other paths will get evaporated after a period of time.

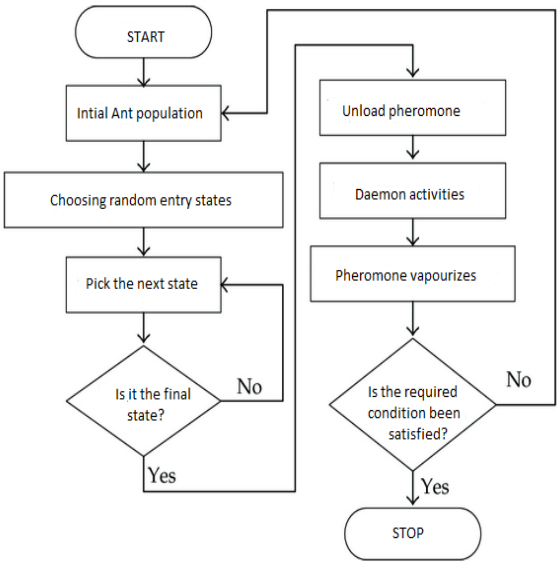

Fig.1. Flow Chart for Ant Colony Optimization

Begin
Initialize the pheromone trails and parameters
Generate initial population (ants)
For each individual calculate fitness
For each ant find the best way
Determine the global best ant
Update the pheromone trail
Check if termination=True
End

Pseudocode for Ant Colony Optimization

B. Particle swarm optimization

PSO imitates the behavior of group of birds. PSO is nothing but it will adopt the process of birds habitat. In general birds are searching food randomly in an area and food is found by following the bird which is nearest to food. This is the optimal solution. The same procedure is followed in PSO algorithm to produce an optimal solution for any kind of problems.

In this algorithm every bird is called as a swarm and all possible solutions are called as particles. Each particle has a fitness value and evaluated based on objective function. The first step in PSO algorithm is to initialize with a group of random particles (solutions). Then each particle is updated to search for the optima. The particles are updated based on the best values generated in every iteration. The first solution is named as pbest and it is the best solution obtained so far. In next iteration pbest value is updated until find the global best solution and nmabed as gbest. Another best value is called as lbest –local best which takes the optimal solution from its nearest neigbours.

Initialize the population
Do {
For i=0 to PopulationSize{
Compute the fitness value
If the fitness value is better than pbest
Then set the current value to pbest
}
Among the pbest choose the optimum solution as gbest
For i=0 to PopulationSize{
Update the particle velocity
Update the particle position }
}**Until** termination criterion is met

Pseudocode for particle swarm optimization

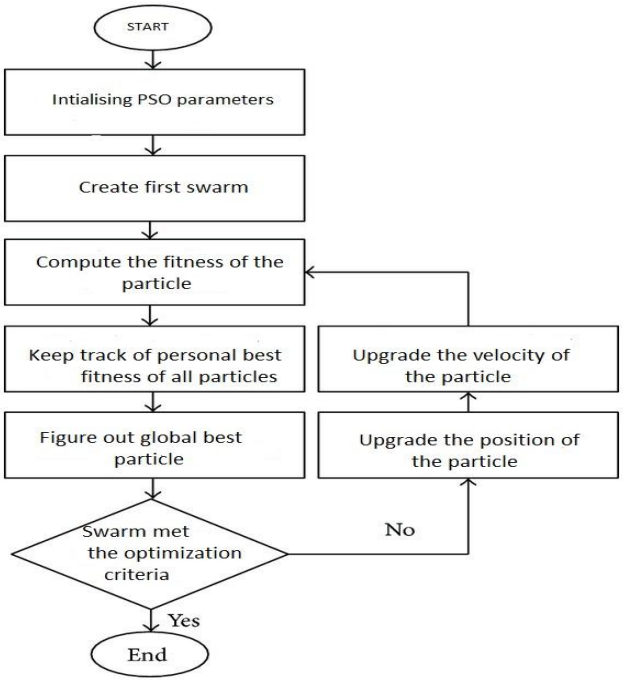

Fig. 2. Flow Chart for Particle Swarm Optimization

C. Depiction of ACO and PSO in agriculture and social network field

Following tabular form paves the way to know how ACO and PSO algorithms helps to resolve the various research problems in Agriculture and Social Network fields as well as it also depicts about the proven solutions by researchers for the research problems and future scope in those fields.

III. Research Issues In Social Network Field

In Social Network field, the most prominent research issue is privacy and security. Researchers may focus on this issue to provide solution for network attacks and user profile management. They can also extend their focus to provide solution for analyzing the criminal group networks. Till now, there are no good malleable approaches and relevant data set to handle different types of data and also there is an opportunity for researchers to use big data to find useful information in online social networks.

Algorithm: Ant Colony Optimization

TABLE I. IMPLEMENTATION OF ACO IN AGRICULTURE AND SOCIAL NETWORK FIELD

Author(s)	Title	Research Problem	Proven Solution	Drawbacks
Agricultural Field				
(Zhang et al. 2017)	Wheat Hardness Prediction Research Based on NIR Hyperspectral Analysis Combined with Ant Colony Optimization Algorithm	Focuses on Wheat Hardness	Increased prediction ability. Optimized model of the wave band.	This can be applied only to grain kernels
(Nguyen et al. 2016)	Improved Ant Colony Optimization for Optimal Crop and Irrigation Water Allocation by Incorporating Domain Knowledge	Allocation of crops and water to different irrigation areas	Provides detailed irrigation scheduling	Completely relies on visibility factors(VS)
(Alaiso et al. 2013)	Ant Colony Optimization for Scheduling of Agricultural Contracting Work	Scheduling Agricultural Work	Optimal schedule for completion of tasks	Detailed prior study about the location is needed
(Zecchin et al. 2006)	Application of two ant colony optimization algorithms to water distribution system optimization	Minimize the costs associated with Dam infrastructure	Provides lowest cost solution.	Still not proven as the best solution
Social Network Field				
(Sanadhya & Singh 2015)	Trust Calculation with Ant Colony Optimization in Online Social Networks	Finding trust path among N paths	Provides optimal solution for this combinatorial problem	Still need optimal topology to find trust users
(Asghari & Azadi 2017)	A reliable path between target users and clients in social networks using an inverted ant colony optimization algorithm	Identifying reliable path with improved load balancing	Drastically minimized the waiting time of client.	Meta Heuristic algorithms are not used to find reliable path
(Yang & Weng 2012)	Application of the Ant Colony Optimization Algorithm to the Influence-Maximization Problem	Address the influence maximization algorithm	Provides superior performance in solving this influence problem	Selection of influence nodes is a hectic process

Algorithm: Particle Swarm Optimization

TABLE II. IMPLEMENTATION OF PSO IN AGRICULTURE AND SOCIAL NETWORK FIELD

Author(s)	Title	Research Problem	Proven Solution	Drawbacks
Agricultural Field				
(Kumar et al. 2016)	Optimizing Feature Selection using Particle Swarm Optimization and Utilizing Ventral Sides of Leaves for Plant Leaf Classification	Classification of plants	Reduce the overall size of the dataset	Information of the leaf ventral side should be collected
(Fu et al. 2011)	Short-term scheduling of cascade reservoirs using an immune algorithm-based particle swarm optimization	Hydropower scheduling for reservoirs	Optimizing hydropower in cascade reservoirs	Complete details about the reservoir should be collected
(Hasni et al. 2011)	Optimization of Greenhouse Climate Model Parameters Using Particle Swarm Optimization and Genetic Algorithms	Predicting greenhouse climate	Optimized parameter for greenhouse climate	Climatic changes may have a drastic effect
(Fu et al. 2010)	Delineating soil nutrient management zones based on fuzzy clustering optimized by PSO	Classification of soil	Flexible in parameter adjustment and support both local and global search space.	Soil details should be studied.

Social Network Field				
(Wasid & Kant 2015)	A Particle Swarm Approach to Collaborative Filtering based Recommender Systems through Fuzzy Features	Recommendation Systems	Finds Optimal Priority based on efficient user features representations	Not focused on notion of contexts
(Chen & Qiu 2013)	Detecting Community Structures in Social Networks with Particle Swarm Optimization	Community detection in social networks	Effectively extracted the intrinsic community structures	Extend to multi-objective problem
(Zhou & Wang 2016)	A Neighborhood-Impact Based Community Detection Algorithm via Discrete PSO	Community detection in social networks	Exactly detected structure of community	Apply for radar communication networks
(Zhao Xing et al. 2015)	A Novel Social Network Structural Balance Based on the Particle Swarm Optimization Algorithm	Structural balance of social networks	Effective automatic community detection in networks	Implement in large scale networks

IV. CONCLUSION

This review paper gives an outline perception of ACO/PSO approaches in Social Network and Agriculture fields. The mentioned two fields in this paper are the prominent areas particularly in the developing countries like India. Use of bio-inspired approaches especially ACO and PSO in agriculture filed support the farmers to make better decisions and helps to yield high quality crops. It discusses about the use of optimization algorithms and the findings by several authors in context to social network and agriculture field. This study has also revealed some of the research issues in those fields. The future work may be carried on hybridization model of ACO and PSO approaches with other evolutionary algorithms and also use some of the data analysis techniques to handle mass amount of data in those fields.

REFERENCES

[1] Alaiso, S, Backman, J & Visala, A, 2013, 'Ant Colony Optimization for Scheduling of Agricultural Contracting Work', IFAC Proceedings Volumes, vol. 46, no. 18, pp. 133-137.

[2] Asghari, S & Azadi, K, 2017, 'A reliable path between target users and clients in social networks using an inverted ant colony optimization algorithm', Karbala International Journal of Modern Science, vol. 3, no. 3, pp. 143-152.

[3] Chen, Y & Qiu, X, 2013, 'Detecting Community Structures in Social Networks with Particle Swarm Optimization', Proceedings of the Frontiers in Internet Technologies, pp. 266-275

[4] Fu, Q, Wang, Z & Jiang, Q, 2010, 'Delineating soil nutrient management zones based on fuzzy clustering optimized by PSO', Mathematical and Computer Modelling, vol. 51, no. 11, pp. 1299-1305.

[5] Fu, X, Li, A, Wang, L & Ji, C, 2011, 'Short-term scheduling of cascade reservoirs using an immune algorithm-based particle swarm optimization', Computers & Mathematics with Applications, vol. 62, no. 6, pp. 2463-2471.

[6] Hasni, A, Taibi, R, Draoui, B & Boulard, T, 2011, 'Optimization of Greenhouse Climate Model Parameters Using Particle Swarm Optimization and Genetic Algorithms', Energy Procedia, vol. 6, no., pp. 371-380.

[7] Kumar, A, Patidar, V, Khazanchi, D & Saini, P, 2016, 'Optimizing Feature Selection Using Particle Swarm Optimization and Utilizing Ventral Sides of Leaves for Plant Leaf Classification', Procedia Computer Science, vol. 89, no., pp. 324-332.

[8] Nguyen, DCH, Dandy, G, Maier, H & Ascough, J 2016. 'Improved Ant Colony Optimization for Optimal Crop and Irrigation Water Allocation by Incorporating Domain Knowledge'.

[9] Sanadhya, S & Singh, S, 2015, 'Trust Calculation with Ant Colony Optimization in Online Social Networks', Procedia Computer Science, vol. 54, no., pp. 186-195.

[10] Wasid, M & Kant, V, 2015, 'A Particle Swarm Approach to Collaborative Filtering based Recommender Systems through Fuzzy Features', Procedia Computer Science, vol. 54, no., pp. 440-448.

[11] Yang, W-S & Weng, S-X 2012. 'Application of the Ant Colony Optimization Algorithm to the Influence-Maximization Problem'.

[12] Zecchin, AC, Simpson, AR, Maier, HR, Leonard, M, Roberts, AJ & Berrisford, MJ, 2006, 'Application of two ant colony optimisation algorithms to water distribution system optimisation', Mathematical and Computer Modelling, vol. 44, no. 5, pp. 451-468.

[13] Zhang, H, Gu, B, Mu, J, Ruan, P & Li, D, 2017, 'Wheat Hardness Prediction Research Based on NIR Hyperspectral Analysis Combined with Ant Colony Optimization Algorithm', Procedia Engineering, vol. 174, no., pp. 648-656.

[14] Zhao Xing, L, Li Le, H & Hui, Z 2015. 'A Novel Social Network Structural Balance Based on the Particle Swarm Optimization Algorithm'.

[15] Zhou, D & Wang, X 2016. 'A Neighborhood-Impact Based Community Detection Algorithm via Discrete PSO'.