ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 1, January 2015

A Survey on Applications of IWD Algorithm

S.Pothumani[1], J.Sridhar[2]

Assistant Professor, Dept. of CSE, Bharath University, Chennai, Tamil Nadu, India[1,2]

ABSTRACT: Intelligent water drops algorithm (IWD) inspired by natural rivers and how they find almost optimal paths to their destination. These near optimal or optimal paths follow from actions and reactions occurring among the water drops and the water drops with their riverbeds. In the IWD algorithm, several artificial water drops cooperate to change their environment in such a way that the optimal path is revealed as the one with the lowest soil on its links. The IWD algorithm is generally a constructive population-based optimization algorithm.This paper discuss about the no of papers which are used iwd algorithm and its application.

I. INTRODUCTION

Swarm intelligence is a study area that deals with natural and artificial systems composed of many individuals that coordinate using decentralized control and self-organization. In particular, the discipline focuses on the collective behaviors that result from the local interactions of the individuals with each other and with their environment. Examples of systems studied by swarm intelligence are colonies of ants and termites, schools of fish, intelligent water drops etc . In this paper a survey on the areas of applicability of intelligent water drops system have been presented. In this survey work nearly 10 papers on the ground of intelligent water drop algorithm used.Scientists are beginning to realize more and more that nature is a great source for inspiration in order to develop intelligent systems and algorithms. In the field of Computational Intelligence, especially Evolutionary Computation and Swarm-based systems, the degree of Imitation from nature is surprisingly high and we are at the edge of developing and proposing new algorithms and/or systems, which partially or fully follow nature and the actions and reactions that happen in a specific natural system or species. Among the most recent nature-inspired swarm-based optimization algorithms is the Intelligent Water Drops (IWD) algorithm. IWD algorithms imitate some of the processes that happen in nature between the water drops of a river and the soil of the river bed.

Natural water drops

In nature, flowing water drops are observed mostly in rivers, which form huge moving swarms. The paths that a natural river follows have been created by a swarm of water drops. For a swarm of water drops, the river in which they flow is the part of the environment that has been dramatically changed by the swarm and will also be changed in the future. Moreover, the environment itself has substantial effects on the paths that the water drops follow. For example, against a swarm of water drops, those parts of the environment having hard soils resist more than the parts with soft soils. In fact, a natural river is the result of a competition between water drops in a swarm and the environment that resists the movement of water drops. Based on our observation in nature, most rivers have paths full of twists and turns. Up until now, it is believed that water drops in a river have no eyes so that by using those eyes, they can find their destination, which is often a lake or sea. If we put ourselves in place of a water drop flowing in a river, we would feel that some force pulls us toward itself, which is the earth's gravity. This gravitational force pulls everything toward the center of the earth in a straight line. Therefore with no obstacles and barriers, the water drops should follow a straight path toward the destination, which is the shortest path from the source of water drops to the destination, which is ideally the earth's center. This gravitational force creates acceleration such that water drops gain speed as they come near to the earth's center. Ideal path, the real path is so different from the ideal path such that lots of twists and turns in a river path are seen, and the destination is not the earth's center but a lake, sea, or even a bigger river. It is often observed that the constructed path seems to be an optimal one in terms of the distance from the destination and the constraints of the environment. One feature of a water drop flowing in a river is its velocity. It is assumed that each water drop of a river can also carry an amount of soil. Therefore, the water drop is able to transfer an amount of soil from one place to another place in the front. This soil is usually transferred from fast parts of the path to the slow parts. As the fast parts get deeper by being removed from soil, they can hold more volume of water and thus may attract more water. The removed soils, which are carried in the water drops, are unloaded in slower beds of the river. Assume an imaginary natural water drop is going to flow from one point of a river to the next point in the front. Three obvious changes happen during this transition:

• Velocity of the water drop is increased.
• Soil of the water drop is increased.
• Between these two points, soil of the river's bed is decreased.

In fact, an amount of soil of the river's bed is removed by the water drop and this removed

soil is added to the soil of the water drop. Moreover, the speed of the water drop is increased during the transition.It was mentioned above that a water drop has also a velocity. This velocity plays an important role in removing soil from the beds of rivers. The following property is assumed for a flowing water drop: • A high speed water drop gathers more soil than a slower water drop. Therefore, the water drop with bigger speed removes more soil from the river's bed than another water drop with smaller speed. The soil removal is thus related to the velocities ofwater drops. It has been said earlier that when a water drop flows on a part of a river's bed, it gains speed. But this increase in velocity depends on the amount of soil of that part. This proper of a water drop is expressed below:

The velocity of the water drop is changed such that on a path with little amount of soil, the velocity of the water drop is increased more than a path with a considerable amount of soil. Therefore, a path with little soil lets the flowing water drop gather more soil and gain more speed whereas the path with large soil resists more against the flowing water drop such that it lets the flowing water drop gather less soil and gain less speed. Another property of a natural water drop is that when it faces several paths in the front, it often chooses the easier path. Therefore, the following statement may be expressed: • A water drop prefers a path with less soil than a path with more soil The water drop prefers an easier path to a harder path when it has to choose between several branches that exist in the path from the source to destination. The easiness or hardness of a path is denoted by the amount of soil on that path. A path with more soil is considered a hard path whereas a path with less soil is considered an easy path.

II. INTELLIGENT WATER DROPING ALGORITHM

Intelligent water drops algorithm (IWD) inspired by natural rivers and how they find almost optimal paths to their destination. These near optimal or optimal paths follow from actions and reactions occurring among the water drops and the water drops with their riverbeds. In the IWD algorithm, several artificial water drops cooperate to change their environment in such a way that the optimal path is revealed as the one with the lowest soil on its links. The solutions are incrementally constructed by the IWD algorithm. Consequently, the IWD algorithm is generally a constructive population-based optimization algorithm.The IWD algorithm employs a number of IWDs to find the optimal solutions to a given problem. The problem is represented by a graph (N, E) with the node set N and edge set E. This graph is the environment for the IWDs and the IWDs flow on the edges of the graph. Each IWD begins constructing its solution gradually by traveling between the nodes of the graph along the edges until the IWD finally completes its solution denoted by $IWD\ T$. Each solution $IWD\ T$ is represented by the edges that the IWD has visited. One iteration of the IWD algorithm is finished when all IWDs complete their solutions. After each iteration, the iteration-best solution $IB\ T$ is found. The iteration-based solution $IB\ T$ is the best solution based on a quality function among all solutions obtained by the IWDs in the current iteration. $IB\ T$ is used to update the total-best solution $TB\ T$. The total-best solution $TB\ T$ is the best solution since the beginning of the IWD algorithm, which has been found in all iterations.

III. LITERATURE REVIEW

Application areas:

1.Simulation of intelligent water drop for optimization problem solving TSP is one of the famous NP- hard problems.[1] In this paper, the intelligent water drop algorithm is used to solve this problem. Generally, this problem is used to test the optimization algorithms. So, The accuracy and efficiency of this iwd algorithm is tested in this paper. Depending upon the local heuristic function, the iwd moves from one location to another location. Iwd is implemented

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 1, January 2015

using object oriented approach. The devised algorithm is coded by C++ and tested by Intel Core i3 -350M processor speed 2.26 GHz and RAM of 4 GB. The algorithm is tested by large TSP bench mark graph. From this paper, it is known that the algorithm is faster to find the optimum solutions. Thus there is a lot of scope of problem solving with the IWD algorithm.[2]

2. Optimization with the Nature-Inspired Intelligent Water Drops Algorithm

This paper tests the four different NP- hard problems that are Travelling Salesman Problem, n-queen puzzle, Multidimensional Knapsack Problem and the Automatic Multilevel Thresholding. Finally, the iwd algorithm gives the better results. The paper deals with the comparison of iwd and other algorithms to solve the same problems with the help of graph also. So, it is proved that the iwd algorithm provides the optimum results for these problems.[3]

3.Intelligent water drops algorithm: A new optimization method for solving the multiple knapsack problem

In this paper, the most popular Multiple Knapsack problem is discussed and solved by using knapsack algorithm. This is the first paper which deals MKP with iwd algorithm. The results of iwd algorithm are optimum. It is proved that the IWD algorithm has the property of the convergence in value. The authors include some changes in iwd algorithm and they proposed the new IWDMKP algorithm which is special for MKP problem. This new optimization algorithm opens a new space for modifying existing algorithms and applies it for new problems.[4]

4. An Intelligent Water Drop Algorithm for Solving Economic Load Dispatch Problem

ELD is one of the interesting real life problems. The main objective of ELD is to distribute the load efficiently with low cost. In this paper the iwd algorithm is used to solve this ELD problem to minimizing the total cost of generation. This algorithm is easy to implement. To test the effectiveness of iwd, 6 unit and 20 unit test systems with incremental fuel cost functions which accounts the value of point to point loading effects.[5] The Numerical results shows that the proposed method has good convergence property and better in quality of solution. And also, this results are compares with GA,PSO,BBO and Hopfield approaches.

5.Intelligent water drops a new optimization algorithm for solving the Vehicle Routing Problem

VRP is one of the most important NP hard problems. [6] The problem is used to serve the number of customers with a fleet of available vehicles. VRP is an important optimization problem in the field of transportation, distribution and logistics. In this paper iwd algorithm is used to solve this VRP. The results for fourteen benchmark problems are discussed and compared with other Meta heuristic approaches.[7]

6. An Intelligent Water Drop Algorithm for Solving Optimal Reactive Power Dispatch Problem

This paper presents an algorithm for solving the multi-objective reactive power dispatch problem in a power system. Modal analysis of the system is used for static voltage stability assessment. Loss minimization and maximization of voltage stability margin are taken as the objectives.[8] Generator terminal voltages, reactive power generation of the capacitor banks and tap changing transformer setting are taken as the optimization variables. In this paper an intelligent water drop (IWD) algorithm has been proposed to solve this combinatorial optimization problem. Intelligent water drop algorithm is a swarm-based nature inspired optimization algorithm, which has been inspired from natural rivers.[9] A natural river often finds good paths among lots of possible paths in its ways from source to destination and finally find almost optimal path to their destination. These ideas are embedded into proposed algorithm for solving

reactive dispatch problem.In this paper, a new approach intelligent water drop (IWD) algorithm [10], is used to solve the voltage contsraint reactive power despatch problem , the proposed algorithm identify the optimal values of generation bus voltage magnitudes, transformer tap setting and the output of the reactive power sources as to minimize the transmission loss to improve the voltage stability.[10] The proposed method formulates reactive power dispatch problem as a mixed integer nonlinear optimization problem and determines control strategy with continuous and discrete control variables such as generator bus voltage, reactive power generation of capacitor banks and on load tap changing transformer tap position.[11] To handle the mixed variables a flexible representation scheme was proposed. The performance of the proposed algorithm demonstrated through its voltage stability assessment by modal analysis is effective at various instants following system contingencies. Also this method has a good performance for voltage

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 1, January 2015

stability Enhancement of large, complex power system networks. The effectiveness of the proposed method is demonstrated on IEEE 30-bus system

7. Improved intelligent water drops algorithm using adaptive schema

Intelligent water drops (IWD) algorithm is a new meta-heuristic approach belonging to a class of swarm intelligence-based algorithms. It is inspired from observing processes of natural water swarm that happen in the natural river systems[12]. This paper presents an improved IWD algorithm based on developing an adaptive schema to prevent the IWD algorithm from premature convergence. The performance of the adaptive IWD is compared with original IWD and other meta-heuristic algorithms in solving travelling salesman problem (TSP). The results clearly show that the proposed algorithm has better performance than those of original IWD, and MIWD-TSP algorithm and very competitive results to others meta-heuristics.[13]

8. The intelligent water drops algorithm: a nature-inspired swarm-based optimization algorithm

A natural river often finds good paths among lots of possible paths in its ways from the source to destination.[14] These near optimal or optimal paths are obtained by the actions and reactions that occur among the water drops and the water drops with the riverbeds. The intelligent water drops (IWD) algorithm is a new swarm-based optimisation algorithm inspired from observing natural water drops that flow in rivers. In this paper, the IWD algorithm is tested to find solutions of the n-queen puzzle with a simple local heuristic[15]. The travelling salesman problem (TSP) is also solved with a modified IWD algorithm. Moreover, the IWD algorithm is tested with some more multiple knapsack problems (MKP) in which nearoptimal or optimal solutions are obtained

9. Intelligent water drops algorithm for automatic multilevel thresholding of grey-level images using a modified Otsu's criterion

In this paper, the newly introduced swarm-based optimisation algorithm called intelligent water drops (IWDs) algorithm is adjusted to optimise a modified Otsu's criterion for automatic multilevel thresholding. The proposed algorithm simply called IWD-AMLT is tested with several grey-level images and its performance is assessed by the peak signal to noise ratio (PSNR) measure. The thresholded images obtained by the IWD-AMLT have high qualities according to the subjective judgement and the PSNR values.[16]

10. An improved Intelligent Water Drops algorithm for achieving optimal job-shop scheduling solutions

Job shop scheduling is a typical NP- hard problem has drawn continuous attention from researchers. In this paper IWD algorithm, which is new meta-heuristics, is customized for solving this problems. [17]

Job-shop scheduling is a typical N P-hard problem which has drawn continuous attention from researchers.[18] In this paper, the Intelligent Water Drops (IWD) algorithm, which is a new meta-heuristics, is customized for solving job-shop scheduling problems. Five schemes are proposed to improve the original IWD and the improved algorithm is named the Enhanced IWD algorithm (EIWD). The optimization objective is the make span of the schedule. Experimental results show that the EIWD algorithm is able to find better solutions for the standard bench mark in stances than the existing algorithms. This paper has made a contribution in two aspects.[19] First, to the best of the authors' knowledge, this research is the first to apply the IWD algorithm to the job-shop scheduling problem. This work can inspire further studies of applying g IWD to other scheduling problem s, such as open -shop scheduling and flow shop scheduling. Second, this research further improves the original IWD by employing five schemes to increase the diversity of the solution space as well as the solution quality.[20]

11. Solving Traveling Salesman Problem by Modified Intelligent Water Drop Algorithm

In this paper, a modification to the new problem solving algorithm called "Intelligent Water Drops" or simply IWD algorithm has been proposed. This algorithm is based on the dynamic of river systems and the actions that water drops do in the rivers.[21] Based on the observation on the behavior of natural water drops, artificial water drops are developed which possesses some of the remarkable properties of the natural water drops. These ideas are embedded into the proposed algorithm for solving the Traveling Salesman Problem or the TSP. Here a local Heuristic function has been added to the original IWD algorithm, which measures the undesirability of an IWD to move from one node to another.[22] Also it is suggested that, after a few number of iterations, the soils of all paths of the graph of the given TSP are reinitialized again with the initial soil except the paths of the total-best solution which are given less soil than initial soil. The modified IWD algorithm finds better tours and hopefully escapes local optimums The experiments

indicate that the IWD algorithm is capable to find optimal or near optimal solutions. However, there is an open space for modifications in the standard IWD algorithm, embedding other mechanisms that exist in natural rivers. Also some new better local heuristics can be invented that fit better with the given problem.
The IWD can also be used for solving n-queen problem, multidimensional knapsack problem and even for automatic multilevel thresholding in images[23]. As a consequence, further research can focus on the points for amplification of strengths and eliminating the weaknesses. The IWD algorithm demonstrates that the nature is an excellent guide for designing and inventing new nature-inspired optimization algorithms.[24]

12. An intelligent water drops algorithm based service selection and composition in service oriented architecture
Web services are defined as the pieces of software components, which are distributed over the internet using some standard protocols. With more and more web services become available, QoS is a decisive factor for selecting the most suitable service from a set of candidate services with the identical functionality.[25] Thus the approach about the computation of the QoS is also becoming more important in the service selection. In this paper, we use an algorithm called "Intelligent Water Drops" or IWD algorithm which is inspired from natural science. It is based on the processes that happen in the natural river system. The actions and reactions that take place between the water drops are also considered. The river often chooses an optimal path regarding the conditions of its surroundings to get its ultimate goal, which is often a sea. These ideas are embedded into the web service selection and composition for providing efficient QoS web services. This proposed algorithm provides better computing performance than Particle swarm optimization algorithm (PSO)[26]. consumers, In order to solve services composition, PSO algorithm and Intelligent Water Drops Algorithm are used. To verify the best web service decomposition algorithm, these above two PSO and IWD are compared. The experimental comparison result shows that, the Intelligent Water Drops Algorithm is the best algorithm for web service composition. From that, the IWD algorithm having the higher correctness value, feasibility, and effectiveness than the existing PSO algorithm. Computational overhead for service composition with more than 50 services is left behind for future work[27].

IV. CONCLUSION

From this review, we conclude that the iwd algorithm is used to solve different types of NP hard problems in a efficient manner compare with other problems. Each paper explains the compared study with other algorithms. In future, this iwd algorithm is applied for new types of problems also.

REFERENCES

[1]. Shah-Hosseini, H. (2007). Problem solving by intelligent water drops. Proceedings of IEEE Congress on Evolutionary Computation, pp. 3226-3231, SwissotelThe Stamford, Singapore, September.
[2]. Shah-Hosseini, H. (2008b). The Intelligent Water Drops algorithm: A nature-inspired swarmbased optimization algorithm. Int. J. Bio-Inspired Computation, Vol. 1, Nos. 1/2, pp. 71–79.
[3]. Shah-Hosseini, H. (2009). Optimization with the Nature-Inspired Intelligent Water Drop Algorithm. Evolutionary Computation, pp. 572, October 2009.
[4] Udayakumar R., Khanaa V., Kaliyamurthie K.P., "High data rate for coherent optical wired communication using DSP", Indian Journal of Science and Technology, ISSN : 0974-6846, 6(S6) (2013) 4772-4776.
[5]. E. Bonabeau, M. Dorigo, and G. Theraultz, Swarm Intelligence: From Natural to Artificial systems, Oxford University Press, 1999.
[6]. Konstantinos E. Parsopoulos and Michael N. Vrahatis, Particle Swarm Optimization and Intelligence: Advances and Applications, Information Science Reference, 2010.
[7]. S. Lin, Computer Solutions of the Travelling Salesman Problem, Bell Syst. Journal, vol. 44, 1965, pp. 2245-2269.
[8] Vijayaprakash S., Langeswaran K., Gowtham Kumar S., Revathy R., Balasubramanian M.P., "Nephro-protective significance of kaempferol on mercuric chloride induced toxicity in Wistar albino rats", Biomedicine and Aging Pathology, ISSN : 2210-5220, 3(3) (2013) pp.119-124.
[9]. TSP Library (TSPLIB95), Available at: http://comopt.ifi.uni-heidelberg.de/software/TSPLIB95/
[10]. A. J. Wood and B. F. Wollenberg, "Power generation operation and control", *John Wiley and Sons, New York*, 1984
[11]. J. B. Park, K. S. Lee, J. R. Shin and K. Y. Lee, "A particle swarm optimization for economic dispatch with non smooth cost functions", *IEEE Trans. on Power Systems*, Vol. 8, No. 3, pp. 1325-1332, Aug. 1993.
[12] H. T. Yang, P. C. Yang and C. L. Huang, "Evolutionary Programming Based Economic Dispatch For Units With Non-smooth Fuel Cost Functions", *IEEE Transactions on Power Systems*, Vol. 11, No. 1, pp. 112-118, 1996.
[13] Udayakumar R., Khanaa V., Kaliyamurthie K.P., "Optical ring architecture performance evaluation using ordinary receiver", Indian Journal of Science and Technology, ISSN : 0974-6846, 6(S6) (2013) pp. 4742-4747.
[14] T. Jayabarathi, G. Sadasivam and V. Ramachandran, "Evolutionary programming based economic dispatch of generators with prohibited operating zones", *Electric Power Systems Research*, Vol. 52, No. 3, pp.

261-266, 1999.
[15] Z. X. Liang and J. D. Glover, "A zoom feature for a dynamic programming solution to economic dispatch including transmission losses, *IEEE Trans. on Power Systems*, Vol. 7, No. 2, pp. 544-550, May 1992.
[16] El-Sharkawy, M., and Nieebur, D., "Artificial neural networks with application to power systems", *IEEE Power Engineering Society, ATutorial Course*, 1996.
[17] Sundararajan M., "Optical instrument for correlative analysis of human ECG and breathing signal", International Journal of Biomedical Engineering and Technology, ISSN : 0976 - 2965, 6(4) (2011) pp.350-362.
[18] Youssef, H. K., and El-Naggar, K. M., "Genetic based algorithm for security constrained power system economic dispatch", *Electric Power Systems Research*, Vol. 53, pp. 4751, 2000.
[19] S.O. Orero, M.R. Irving, "Economic dispatch of generators with prohibited operating zones: a genetic algorithm approach", *IEE Proc. Gen. Transm. Distrib.*, Vol. 143, No. 6, pp. 529534, 1996.
[20] D. C. Walters and G. B. Sheble, "Genetic algorithm solution of economic dispatch with the valve-point loading", *IEEE Trans. on Power Systems*, Vol. 8, No. 3, pp. 1325-1332, Aug. 1993.
[21] Udayakumar R., Khanaa V., Kaliyamurthie K.P., "Performance analysis of resilient ftth architecture with protection mechanism", Indian Journal of Science and Technology, ISSN : 0974-6846, 6(S6) (2013) pp. 4737-4741
[22] Nasimul Nomana, Hitoshi Iba, "Differential evolution for economic load dispatch problems", *Electric Power Systems Research*, Vol. 78, pp. 13221331, 2008.
[23] W. M. Lin, F. S. Cheng and M. T. Tsay, "An improved Tabu search for economic dispatch with multiple minima", *IEEE Trans. on Power Systems*, Vol. 17, No. 1, pp.108-112, Feb. 2002.
[24] Aniruddha Bhattacharya, P.K. Chattopadhyay, "Solving complex economic load dispatch problems using biogeography-based optimization", *Expert Systems with Applications*, Vol. 37, pp. 36053615, 2010.
[25] Hamed Shah-Hosseini, "The intelligent water drops algorithm: a natureinspired swarm-based optimization algorithm", *International Journal of Bio-Inspired Computation*, Vol. 1, Nos. 1 and 2, pp. 71-79, 2009.
[26] Shah-Hosseini. H, "Optimization with the Nature- Inspired Intelligent Water Drops Algorithm", *Int. Journal of Intelligent Computing and Cybernetics*, Vol. 1, No. 2, pp. 193-212, 2008.
[27] Z. Michalewicz, M. Schoenauer, "Evolutionary algorithms for constrained parameter optimization problems", Evol. Comput. vol. 4, no. 1, pp. 1-32, 1996.
[28] P.JENNIFER, DR. A. MUTHU KUMARAVEL, Comparative Analysis of advanced Face Recognition Techniques, International Journal of Innovative Research in Computer and Communication Engineering, ISSN(Online): 2320-9801, pp 4917-4923 Vol. 2, Issue 7, July 2014
[29] Dr.R.Udayakumar, Computer Simulation of Polyamidoamine Dendrimers and Their Complexes with Cisplatin Molecules in Water Environment, International Journal of Innovative Research in Computer and Communication, ISSN(Online): 2320-9801,pp 3729,25-30, Vol. 2, Issue 4, April 2014
[30] DR.A.Muthu kumaravel, Mr. Kannan Subramanian, Collaborative Filtering Based On Search Engine Logs, International Journal of Innovative Research in Computerand Communication Engineering, ISSN(Online): 2320-9801,pp 2432-2436, Vol. 2, Issue 1, January 2014
[31] Dr.A.Muthu Kumaravel, Mining User Profile Using Clustering FromSearch Engine Logs, International Journal of Innovative Research in Computerand Communication Engineering, ISSN(Online): 2320-9801,pp 4774-4778, Vol. 2, Issue 6, June 2014
[32] P.Kavitha, Web Data High Quality Search - No User Profiling, International Journal of Innovative Research in Computerand Communication Engineering, ISSN(Online):2320-9801,pp 2025-2030, Volume 1, Issue 9, November 2013