

SOLVING MULTICAST ROUTING PROBLEM USING PARTICLE SWARM OPTIMIZATION

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ABSTRACT

In a given network there exist many paths from source to destination, among all selected paths finding the optimal shortest path is a challenging task. In this research paper, we proposed a new concept of particle swarm optimization technique, called swarm intelligence, to solve the multicast routing problem to find out the optimal route associated with a network, here we also used triangular fuzzy number tools to encode particles in PSO (particle swarm optimization), first it breaks the network into small spaces and from the small space it computes the optimal path.

Keywords: Multicast Routing, Particle Swarm Optimization, and Swarm Intelligence

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1. INTRODUCTION

There exist many routes from a source to a destination in a given graph but finding the optimum route at the lowest cost is extremely difficult. The term “swarm” comes from the field of artificial intelligence. In swarm intelligence, there are a number of shortest path techniques used to overcome this problem. Many research papers are available to tackle routing problems using PSO [Rehab and Abdel-Kader \(2011\)](#), all of which employ the same technique but use various particles encoding in the discrete form [Baburaj and Vasudevan \(2008\)](#). To tackle this problem, we designed a simple encoding approach it breaks the space into

smaller space of reduced size after that combine all the results for evaluating the optimal path, it works on the the greedy approach principle.

2. USE OF PARTICLE SWARM OPTIMIZATION

Swarms are a group of particles in PSO that are used to discover the shortest path from source to destination of a network. Every particle has an initial location (its current position in time), a personal best position (its best position among all particles in search space), and associated velocity of every particle. During this method, every particle tries to move towards the particle closest to the optimal solution, but the best solution is obtained from [Xu et al. \(2007\)](#)

$$v_i = \omega v_i + \varphi_p r_{pbest} (p_{i_best} - x_i) + \omega_g r_{gbest} (g_{ibest} - x_i) \tag{1}$$

$$x_i = x_i + v_i \tag{2}$$

In the swarm, $i=1,2,3,4,\dots,n$ and P_{i_best} is the particle best solution, where $g(i_{best})$ is the global best solution, v is the particles velocity and p, g are control parameters that regulate the particle's efficiency

3. PSEUDO CODE OF MULTICAST PSO

Assume that G is a multicast tree

The initial root of the multicast tree is denoted by symbol "S"

D is the final root multicast tree

Create an initial swarm at random

- Continuing for each particle i until you have reached the maximum number of iterations
Calculate the best fitness value possible.
 - Best position should be updated.
 - 1) Velocity update
 - 2) Refresh the global position
- Until the threshold termination is reached

4. (A) PSO TO SOLVE MULTICASTING NETWORK WITH VERTICES WITH TRIANGULAR FUZZY NUMBER

Figure 1

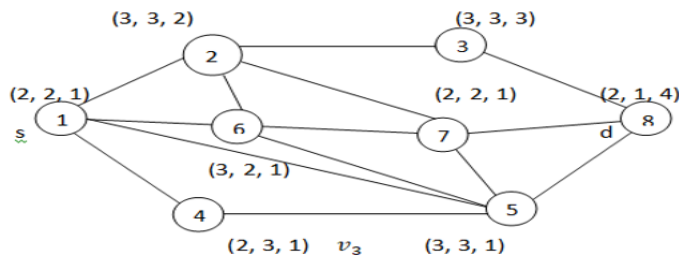


Figure 1 Multicast Network

To solve multicast routing problem by using PSO, in this network vertex $s = (s_1, s_2 \dots s_n)$ is a source vertex and $d = d_1, d_2 \dots d_n$ called destination vertex. In starting iteration of PSO we have initially determined the random route from source to destination because every particle associated in multicast network has capable to give the solution of problem. In initial stage network break the paths sequentially into small space.

Table 1

Table 1	
Route number	Route list
1	1-2-7-8
2	1-6-7-8
3	1-6-5-8

Consider the starting velocity of each particle is zero in equation (2), for which the “P best “defines initial routes as the current best paths of particles as follows

$$P_{best} = \begin{matrix} | 1 - 2 - 7 - 8 | \\ | 1 - 6 - 7 - 8 | \\ | 1 - 6 - 5 - 8 | \end{matrix}$$

From the above three particle we have to find the global best of the particles which have minimum cost among all particles. minimum cost of the particle we can find by using Euclidean distance between two configurations $s = (s_1, s_2 \dots s_n)$ and $t = (t_1, t_2 \dots t_n)$ in euclidean space. i.e., Mathematically define by

$$\sqrt{(t_1 - s_1)^2 + (t_2 - s_2)^2 \dots \dots (t_n - s_n)^2}$$

we get G_{best} is 1-6-7-8, by using Euclidean distance formula

Now velocity of particle (v_{part}) is evaluated by taking the difference between G_{best} & P_{best}

Now consider particle velocity associated in path 3 in [Table 1](#)

$$V_{part} [3] [] = G_{best} [] - P_{best} []$$

$$V_{part} [3] [] = (1 \ 6 \ 7 \ 8) - (1 \ 6 \ 5 \ 8)$$

$$= 7$$

Similarly, the particle’s velocity can be determined for path -1, path-2 and path-3 in [Table 1](#) obtained as follows

$$V_{part} [i] [j] = \begin{bmatrix} 6 \\ 0 \\ 7 \end{bmatrix}$$

The position of each particle is updated in accordance with the new velocity. Final result, the procedure for modified the position s of all particles associated network in Figure 1 is defined as

$$C_{part} [i] [j] = V_{part} [i] [j] + C_{part} [i] [j]$$

For last (3rd) particle we find the new position

$$C_{part} [i] [j] = (7) + (1\ 6\ 5\ 8)$$

$$C_{part} [i] [j] = (1\ 5\ 6\ 7\ 8)$$

The three p-best represented in Figure 1 by dark line. Using a dark dashed line ,one G is preferable .Following the update of the second particle ,we now have a set of nodes from which we can try to discover a route from source to destination .one advantage of this strategy is that we don't have to search all nodes in the network ;instead, we only have to explore paths between these nodes .As a result ,all networks are divided into little networks, and we search inside this small group of networks ,with the node positions of these small closed networks changing by dynamically .when the associated particle's velocity and position are changes simultaneously ,every particles eventually produce a better solution.

$$C_{part} [3] [j] = 1-5-7-8$$

Figure 2

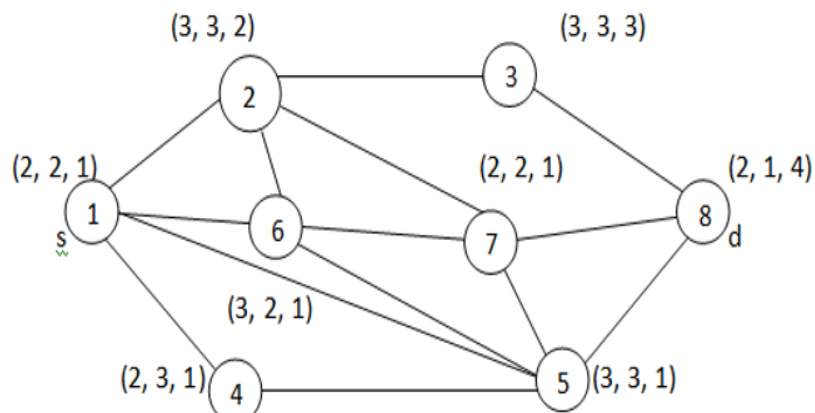


Figure 2

Figure 3

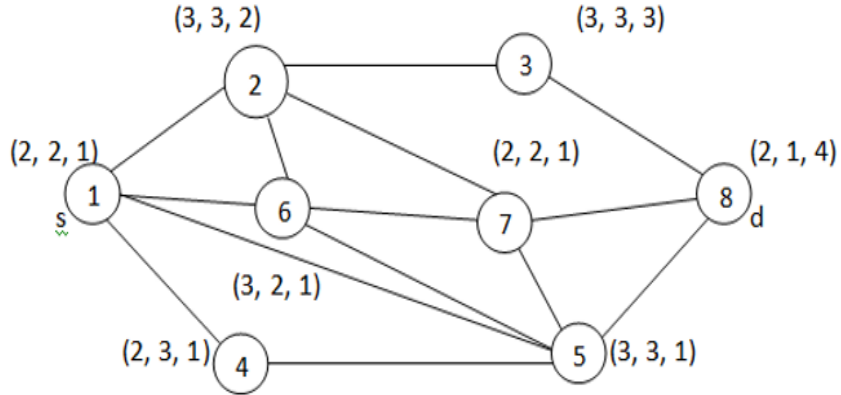


Figure 3 The network cost path is lowered from 6.62 to 5.17 after updating particle 1-2-7-8 to 1-2-3-8

Figure 4

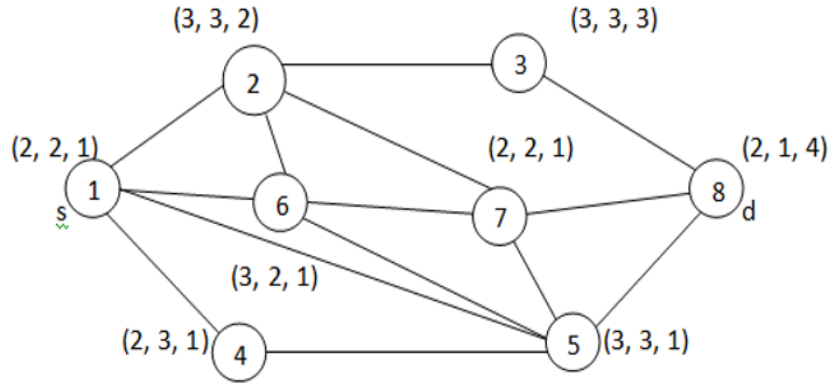


Figure 4 Network after updating

Position of particle is changed from (1,2,3,8) to (1,2,7,8) by doing cost path reduced from 6.62 to 5.17 which is shown in Figure 2. similarly, Figure 3 show path of third particle position is update from (1,6,5,7,8) to (1,5,7,8) and cost of path is modified from 6.16 to 5.15

Simulation Result

There are 35 nodes in this example, and each link connecting the nodes has a cost. To test the influence of particles, two simulation procedures were used. The first simulation uses 10 particles, 30 nodes, and 40 iterations, whereas the second uses 15 particles, 35 nodes, and 40 iterations.

Figure 5 shows that the cost of the path is 45 after 10 iterations, but after 50 iterations, the minimal cost path is 12, which is the network's ideal path. At 10th iteration the cost route in the network is 35, while in 8 in the 50 iterations, as seen in the second Figure 6. As a result of which we obtain a decent path in the second iteration because they have spread so widely in the network

Figure 5

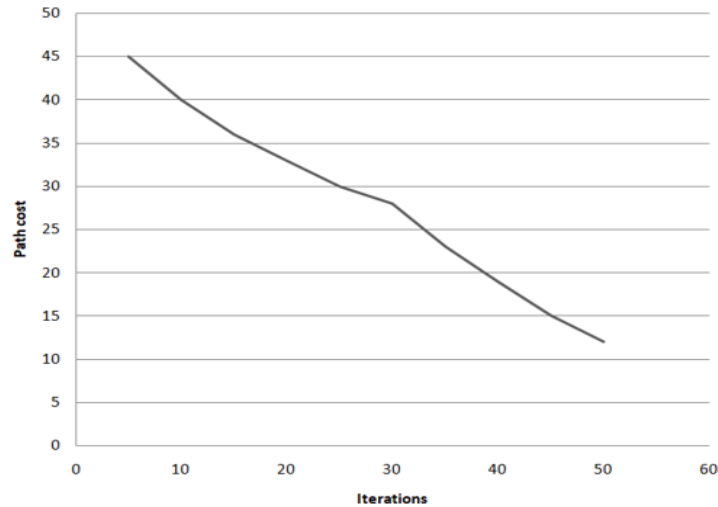


Figure 5 Simulation Result of 10 Particles

Figure 6

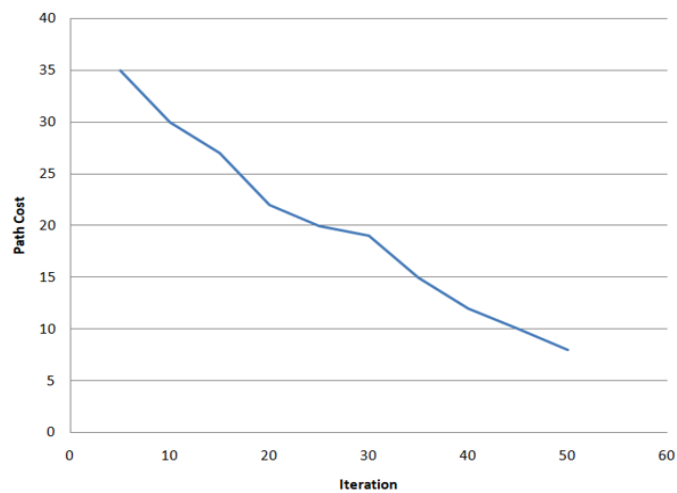


Figure 6 Simulations Result Of 15 Particles

5. CONCLUSION

Many approaches to solve the routing problem using PSO have been described, but this one stands out since it uses simple encoding particles and is straight forward to implement. when by increasing the number of particles or iterations, the result is more accurate. This method can be implemented to tackle not only routing but also discrete problems.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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