# MOPLJO-MANET: MULTI-OBJECTIVE PARAMETER LESS JAYA OPTIMIZATION FOR MOBILE AD HOC NETWORKS

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**Abstract**

MANET (Mobile Ad hoc Network) is a self-contained network made up of mobile nodes that communicate without the use of a central controller. These nodes each function as a router, allowing packets to be delivered and received. Routing concerns have been investigated in this paper; routing protocols between any pair of nodes inside an ad hoc network might be challenging to implement since nodes can join or leave the network at any time. This means that an ideal strategy at one point may no longer be viable seconds later. The optimum route between network nodes is found using a multi-objective parameter-less Jaya optimization in this paper. In addition, the proposed technique was compared to current optimization techniques like Genetic Algorithm (GA) and Artificial Bee Colony (ABC), as well as well-known reactive protocols like DSR (Dynamic Source Routing) and AODV (Ad hoc On-Demand Distance Vector). The suggested solution surpasses others in terms of performance characteristics such as Packet Delivery Ratio (PDR) (92.72 %), Delay (0.01042 sec), and Throughput (89.74 %).

**Keywords:** optimization, Jaya Algorithm, Routing, Genetic, ABC, network

## 2. REVIEW OF WORKS

In recent years, several MANET routing protocols have been created [10]. Proactive, reactive, and hybrid protocols are the most common types of such protocols. GSR (Global State Routing) [10], CGSR (Cluster-Head Gateway Switch Routing) [10], FSR (Fisheye State Routing) [10], OLSR (Optimized Link State Routing) [10], WRP (Wireless Routing Protocol) [10], and

DSDV (Destination Sequenced Distance Vector) [10] are examples of proactive routing. If the topology of the network changes in a dynamic environment like MANET, these routing tables are always required to be adjusted by periodically sending routing information (such as connection status and distance vector) between the nodes. Those designs do not include a routing table. A node must first discover the path before sending a data packet. As a result, while overhead routing is reduced, end-to-end data packet delivery improves. In this part, several authors provide a brief evaluation of similar works published in recent years. In this section, Evolutionary algorithms are used to solve network challenges such as routing, mobility, and mobility prediction, among others.

An adaptive Genetic Fuzzy routing technique for multi-path routing in wireless ad hoc networks was presented by Liu et al. (2005). The majority of extant multi-path routing protocols ignore the MANET ambiguity. They choose an "optimal" multi-path set while just considering one single route selection criterion, such as the least number of intermediate hops or the most remaining battery power. As a result, they miss the relationships between several route selection criteria. Existing routing protocols such as DSR, Split Multi-path Routing Protocol (SMR), and Stability-based Multi-path Routing Protocol (SMBR) are compared to the performance of the proposed approach [16].

Mustafa Al-Ghazal et al. (2007) investigated route optimization using genetic algorithms. The suggested approach improves routing using the Cluster Gateway Switching Protocol (CGSP) and the Genetic Algorithm mechanism (GA). In mobile ad hoc networks, GA is utilised as a route optimization approach. To encourage optimal activity of the Medium Access Control (MAC) protocol, each cluster head manages the complete number of mobile nodes in its cluster, reducing the number of groups and cluster heads by a factor of 10 [17]. It also more uniformly divides the loads between clusters by a factor of ten.

Ammar W. Mohemmed et al. (2008) have investigated the shortest path (SP) problem using Particle Swarm Optimization. The main problem of a network is finding the shortest path between the source and the set of receivers. PSO based approach finds the optimal route with high success rates and also finds closer sub-optimal ways. The proposed approach is opposed to the GA, and the proposed strategy gives a better result than others. An author addressing the SP problem uses a simple network topology size [10].

Jyoti Jain et al. (2011) have reviewed the Ant Colony algorithms for further modification. In this proposed work, ACO (Ant Colony Optimization) has been used in case of link failure situation. The path would be discovered by reactive routing, and sustained by the periodic generation of hello messages by all of the connection nodes. Additionally, all nodes in the chain must proactively consider an alternate route for next to the next node. By utilizing this approach, the parameters of the throughput and low delay will possibly boost the overhead. The Overhead should raise the number of path errors in constructive path searching at the same time such that the parts available for alternate route seeking should decrease [11].

In an ad hoc network setting, Gurpreet Singh et al. (2014) designed an innovative ACO-based routing algorithm. The data packets are exchanged between a random set of source and destination nodes in this work. Mobile nodes travel along the path and pheromone tables are formed during mobility. The outcomes are compared to well-known Ant routing protocols such as HOPNET (Hybrid Ant Colony Optimization routing method for mobile ad hoc networks), AODV, and ADSR (Angle-based DSR). The ANTLG protocol resulted in fewer packet losses than the AODV protocol. The results of the simulation reveal that Innovative ACO outperforms typical reactive routing algorithms [5]. There are two types of ants used: forward ants for route discovery and backward ants for route maintenance [20].

Shubhajeet Chatterjee et al. (2015) suggested a highly efficient and scalable enhanced dynamic source routing with Ant colony-based routing protocol method in MANETs. Ant colony optimization is the basis for this

routing algorithm. The work's ultimate goal is to reduce end-to-end delay, energy usage, and routing overhead. When a node needs to deliver a packet to another node in this work, it checks the route cache first. If no path is known, send a route request to Neighborhood nodes locally. The simulation findings demonstrate that increasing DSR improves results [21].

Gin-Xian Kok et al. (2015) have proposed a novel network coding routing protocol in a wireless ad hoc network which is used to improve the performance of throughput by reducing the workload in the system so that all data packets are transferred. Wireless network suffers from low network due to high data transmission for multi-hop communication. An author faces two challenges while deploying network coding in an ad hoc network. In essence, the first one encodes the identified packets, and the second one incorporates network coding in routing protocols. Simulation studies show that NCR (Network Coding Routing) gives a promising outcome [4].

NaercioMagaia et al. (2015) have proposed a multi-objective routing algorithm in a wireless sensor network. An objective of this routing is to minimize delay and Except Transmission Count (ETX). To solve the routing dilemma, the EA (Evolution Algorithm) has been used, and genetic operators are being used to generate a better answer. Genetic operators are Selection, crossover and mutation [9].

In a multi-hop wireless network, Roberto Magan-Carrion et al. (2016) looked at relay node location in wireless ad hoc networks to maximise network connectivity. Inter-node throughput and node reachability are used to characterise network connectivity in this study. Two processes follow the node procedures: initial selection and solution selection. Optimization algorithms are also employed to improve performance. In stages one and two, the PSO (Particle Swarm Optimization) algorithm is used and assessed. The term "particle" refers to a candidate solution or a swarm of particles. It's a population-based iterative technique that uses the fitness function to solve a routing problem using parameters.

D. MadhuBabu and M. Ussenaiah (2019) have investigated the Cuckoo search (CS), and M-Tree based multi-cast routing for mobile ad hoc networks. In this work, the authors have followed two steps for route selection, which involve M-Tree construction and multi-cast route selection. DIVC (Divisional based Cluster) is a strategy of clustering influenced by Divisive Clustering or a top-down solution. There, all the data are clustered in a cluster by the method and then splits more into groups before all the data independently comprise a bunch. Cluster division includes several parameters or restrictions that a cluster node satisfies. The proposed algorithm for multi-cast routing is built based on the CS algorithm, which relies on the environment of the cuckoo genus. The suggested algorithm embraces the above problems providing sufficient transmission from the source to a range of destinations along the chosen suitable routes. CS routing offers maximum multi-casting with multiple targets, such as energy, lifespan, delay and distance [12].

Table 1 summarizes the various routing approaches proposed for route selection in the past decade.

**Table 1. Summary of routing approaches for MANETs**

| Sno | Year | Authors | Algorithm | Problem | Routing approach | Parameters |
|---|---|---|---|---|---|---|
| 1. | 2005 | Hui Liu et al. | Genetic Algorithm | Select optimal Multipath Routing | Genetic Fuzzy Multi-Path Routing | Link stability, queue occupancy rate, and Energy |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | consumption rate. |
| 2. | 2007 | Mustafa Al-Ghazal et al. | Genetic Algorithm | Route optimization | CGSR (Cluster Gateway Switching Protocol) | Battery power and mobility |
| 3. | 2008 | AmmarW. Mohemmed et al. | PSO algorithm | Shortest path problem | - | |
| 4. | 2011 | Jyoti Jain at al. | ACO | ACO modification | - | Throughput and End to End delay |
| 5. | 2014 | Gurpreet Singh et al. | Innovative Ant colony Algorithm | Rapid Change of Mobile nodes | Reactive Protocols (HOPNET, ANTLG and AODV) | Hop count, delay |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6. | 2015 | Shubhajeet Chatterjee et al. | Enhanced DSR algorithm | Reduce End to End Delay | Reactive Protocol (DSR) | Delay, Energy and Routing Overhead |
| 7. | 2015 | Gin-Xian Kok et al. | Network coding Algorithm | Improve the performance of throughput by reducing the workload | - | Hop count, Routing overhead |
| 8. | 2015 | NaercioMagaia et al. | Multi-objective Routing Algorithm | Minimize Delay and Excepted Transmission Count | Reactive Protocol (DSR) | Delay and ETX and Bandwidth |
| 9. | 2016 | Roberto Magan-Carrion et al. | PSO algorithm | Improve Network Connectivity in Multi-hop Environment | Reactive Protocols | Node Hop count, Ban |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | dwidth |
| 10. | 2019 | D. MadhuBabu and M. Ussenaiah | Cuckoo Search algorithm | Provide optimal multi-cast routing | AODV | Distance, Destination Flag |

The optimization approach plays a vital role in mobile ad hoc networks, as this literature review shows. For route selection, many strategies have been proposed in the literature. However, they all have drawbacks, such as a low maximum packet delivery latency and a flat accuracy rate. As a result, in this research, a combination of diverse algorithms that can improve the system's efficiency is applied.

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