Chapter 44
TAntNet-4: A Threshold-Based AntNet Algorithm with Improved Scout Behavior

Ayman M. Ghazy
Cairo University, Egypt

Hesham A. Hefny
Cairo University, Egypt

ABSTRACT

Traffic Routing System (TRS) is one of the most important intelligent transport systems which is used to direct vehicles to good routes and reduce congestion on the road network. The performance of TRS mainly depends on a dynamic routing algorithm due to the dynamic nature of traffic on road network. AntNet algorithm is a routing algorithm inspired from the foraging behavior of ants. TAntNet is a family of dynamic routing algorithms that uses a threshold travel time to enhance the performance of AntNet algorithm when applied to traffic road networks. TAntNet-1 and TAntNet-2 adopt different techniques for path update to fast direct to the discovered good route and conserve on this good route. TAntNet-3 has been recently proposed by inspiring the scout behavior of bees to avoid the bad effect of forward ants that take bad routes. This chapter presents a new member in TAntNet family of algorithms called TAntNet-4 that uses two scouts instead of one compared with TAntNet-2. The new algorithm also saves the discovered route of each of the two scouts to use the best of them by the corresponding backward ant. The experimental results ensure the high performance of TAntNet-4 compared with AntNet, other members of TAntNet family.

INTRODUCTION

Traffic congestion is a serious problem in most modern cities. Nowadays traffic jams and congestion on roads become one of the most difficult problems that face every one in every day. Traffic congestion wastes fuel and hours of work time. Construction of new roads may be very costly or impossible in many cases. Therefore, the importance of finding methods for efficient utilization of the existing

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infrastructure appears. Researches devote a lot of effort to minimize traffic congestions and to improve road utilization and safety.

Vehicle routing is one of the most important services that provided by a modern Intelligent Transportation Systems. The traffic on road network is dynamic, in other words the traffic flow on roads are changed over time. However there exist many alternative routes to reach destination but most drivers using the route based on their previous experiences. But the route state is changed over time, so the good route may be one bad after some time and vice versa. Hence it is clear that the depending on the derivers experience is not the optimal way. The previous discussion represents the needing to use an intelligent route guiding system, that are take into account the real time road state, i.e. the dynamic data of the network such as congestions. The navigation system, can direct drivers to good route and consequently transfer the overload to other routes. This make road network could operate efficiency at peak volume levels.

Swarm intelligence was widely applied for traffic routing for both computer network and road network. One of the most promising swarm intelligence methodologies that applied for traffic routing is the Ant based routing algorithms.

AntNet algorithm introduced by Di Caro and Dorigo (1998), the algorithm inspired from the behavior of real ant when foraging, for routing through communication network.

This chapter focuses on the TAntNet family which appears in (Ghazy, 2011; Ghazy et al. 2012 and Ghazy & Hefny 2014) as a modification for AntNet for dynamic traffic routing of road network. Also this chapter presents a new member in TAntNet family that is called TAntNet-4.

BACKGROUND AND RELATED WORKS

Ant routing algorithms is one of the most promising swarm intelligence (SI) methodologies that are studied in many researches (Di Caro & Dorigo, 1998; Kassabalidis et al., 2002; Kroon & Rothkrantz, 2003; Suson, 2010; Claes, R., & Holvoet 2012; Jabbarpouret al., 2014a; Yousefi & Zamani, 2013 ; Ghazy & Hefny, 2014, Jabbarpour et al., 2014b and Girme, 2015).

AntNet algorithm appears in 1998 by Di Caro & Dorigo (1998) for routing of data communication network. The algorithm with its distributed multi agent characteristics, attracted many researchers to adopt the algorithm in both data communication network and road traffic network.

It has been shown that under varying traffic loads of data networks, AntNet algorithm represents better performance than that of Dijkstra's shortest path algorithm (DhillonVan & Mieghem, 2007). Also it has been it has been shown in Kiruthika and Kalyanasundaram (2015) that, AntNet algorithm gives better results comparing with Ad hoc on demand Multipath Distance Vector algorithm. Many improvements have been proposed to the AntNet algorithm. Baran and Sosa (2001) presented a modified algorithm that initialize the routing table with data that reflects previous knowledge, about network topology rather than the presumption of uniform probabilities distribution given in original AntNet algorithm. Tekineret al. (2004) proposed a new version of the AntNet algorithm that utilized the ant/packet ratio to limit the number of used ants. Soltani et al. (2006) introduce a new type of ants called helping ants to increase cooperation among neighboring nodes, thereby reducing AntNet algorithm's convergence time. Gupta et al. (2012) presented a study for computation of the pheromone values in AntNet. Radwan et al. (2011) introduced a modified AntNet with blocking–expanding ring search and local retransmission technique for routing of Mobile ad hoc network (MANET). Sharma et al. (2013) showed that load balancing is successfully fulfilled for ant based techniques.