Chapter 6
Genetic-Algorithm-Based Optimization of Clustering in Mobile Ad Hoc Network

Koushik Majumder
West Bengal University of Technology, India

Debashis De
West Bengal University of Technology, India

Senjuti Kar
West Bengal University of Technology, India

Rani Singh
West Bengal University of Technology, India

ABSTRACT

Mobile Ad hoc Networks (MANET) are wireless infrastructure less networks that are formed spontaneously and are highly dynamic in nature. Clustering is done in MANETs to address issues related to scalability, heterogeneity and to reduce network overhead. In clustering the entire network is divided into clusters or groups with one Cluster Head (CH) per cluster. The process of CH selection and route optimization is extremely crucial in clustering. Genetic Algorithm (GA) can be implemented to optimize the process of clustering in MANETs. GA is the most recently used advanced bio-inspired optimization technique which implements techniques of genetics like selection, crossover, mutation etc. to find out an improved solution to a problem similar to the next generation that inherits the positive traits and features of the previous one. In this chapter several genetic algorithm based optimization techniques for clustering has been discussed. A comparative analysis of the different approaches has also been presented. This chapter concludes with future research directions in this domain.

INTRODUCTION

Natural computing encompasses those procedures that are inspired from nature for the optimization of various problem solving mechanisms. Natural computing includes fields like evolutionary algorithms, swarm intelligence, artificial neural network, quantum computing etc. Perceiving natural occurrences as computational processes provide a clear understanding of the natural phenomena and the core principles of computation. Fig. 1 shows the different computation models inspired from nature. Genetic algorithms belong to the category of evolutionary algorithms. Genetic algorithms are employed for the optimization of certain problems using techniques of natural evolution like selection, crossover, mutation and inheritance. It is an advanced bio-inspired optimization technique which has the capability to enhance the performance of a MANET.

Mobile Ad hoc Network or MANETs are wireless network which is organized without any infrastructure. In a MANET the devices move about independently of one another and thus its links with other devices also change (Goyal, Pamar & Rishi, 2011; Kumar & Mishra, 2012). All the devices in a MANET forward packets and hence act as routers (Di Caro, Ducatelle & Gambardella, 2005). Due to lack of infrastructure, MANETs are very useful at times of disasters like floods, earthquakes etc., which leads to destruction of infrastructures. MANETs are also very useful for battlefield communication (Wallner, Harder & Agee, 1999; Attia, Rizk & Mariee, 2009).

In a MANET the routing protocol must be efficient enough to search a path from one node to another, to facilitate communication. The network topology in a MANET changes continuously and so the routing scheme has to keep up with the mobility of the nodes to effectively route packets (Papandriopoulos, Dey& Evans, 2006; Chatterjee, Das & Turgut, 2000). However, a flat routing structure generate huge network overhead which can result in poor functioning of the network in terms of performance. Additionally a MANET comprises of heterogeneous nodes (Chatterjee, Das &Turgut, 2002; Ramanathan & Redi, 2002), i.e. the nodes vary with respect to their resources. For example some nodes might have better computation power, longer battery life etc (Ramanathan, Redi, Santivanez, Wiggins &Polit, 2005; Gibson, 2012; Haas, Deng, Liang, Papadimitratos & Sajama, 2002). These nodes can perform better in an ad hoc network scenario. Clustering in MANETs introduces hierarchy and hence effectively addresses the heterogeneity of nodes and significantly limits the propagation of routing related information throughout the network (Yu & Chong, 2005; Agarwal & Motwani, 2009). In clustering the entire network is partitioned into overlapping clusters or groups. In this approach routes between clusters are kept track of instead of routes between individual nodes. This effectively lowers the overhead due to control messages. In cluster-based routing the nodes may be assigned as a clusterhead (CH), cluster gateway or a cluster member. The CH acts like an organizer for a given cluster. A cluster gateway is not a CH and it connects

Figure 1. Different models of computation inspired by nature
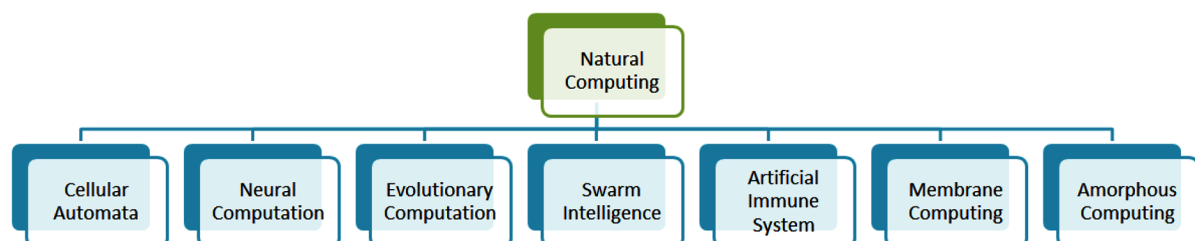
29 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/genetic-algorithm-based-optimization-of-clustering-in-mobile-ad-hoc-network/153811

Related Content

Super-Efficiency DEA Approach for Optimizing Multiple Quality Characteristics in Parameter Design
Abbas Al-Refaie (2010). *International Journal of Artificial Life Research (pp. 58-71).*
www.irma-international.org/article/super-efficiency-dea-approach-optimizing/44671

Machine Learning Approaches Towards Medical Images
Gayathri S. P., Siva Shankar Ramasamyand Vijayalakshmi S. (2023). *Structural and Functional Aspects of Biocomputing Systems for Data Processing (pp. 124-145).*
www.irma-international.org/chapter/machine-learning-approaches-towards-medical-images/318554

Classification of Diabetic Retinopathy Using Regularized Pre-Trained Models
Kalpana Devi (2025). *Exploring the Micro World of Robotics Through Insect Robots (pp. 139-164).*
www.irma-international.org/chapter/classification-of-diabetic-retinopathy-using-regularized-pre-trained-models/359275

Introducing Link Based Weightage for Web Page Ranking
Sutirtha Kumar Guha, Anirban Kunduand Rana Duttagupta (2015). *International Journal of Artificial Life Research (pp. 41-55).*
www.irma-international.org/article/introducing-link-based-weightage-for-web-page-ranking/172139

Generating Fully Bounded Chaotic Attractors
Zeraoulia Elhadj (2011). *International Journal of Artificial Life Research (pp. 36-42).*
www.irma-international.org/article/generating-fully-bounded-chaotic-attractors/56320