Soft computing based energy efficient algorithms for wireless sensor networks

Prasanta K. Jana, *IEEE Senior Member*
Department of Computer Science & Engineering
Indian Institute of Technology (ISM)
Dhanbad-826 004, India

Abstract: Over the past few years, the world has witnessed potential applications of wireless Sensor Networks (WSNs) in environment monitoring, surveillance systems, military, health care, disaster warning systems and home applications. However, conservation of sensors' energy is the central problem in such applications. This is because the sensor nodes have limited power source. Moreover, in many applications such as battlefields, forests, etc., WSNs are deployed in harsh environments with limited access to human beings. Therefore, it is almost impossible to replace the sensor nodes or replenish their battery when their energy gets completely exhausted. Therefore, efficient usage of energy of the sensor nodes has been the prime focus in the applications of WSNs. Various issues have been studied for reducing energy consumption of the sensor nodes to extend lifetime of WSNs. Among them, energy efficient clustering and routing are placed the two most important topics which have been studied extensively.

Clustering and routing in WSNs are two important optimization problems which are known to be NP-hard in nature. Note that given n sensor nodes and m gateways, the number of possible clusters is m^n. It should also be noted that if the relay nodes have an average of d valid one-hop neighbor relay nodes, then the number of valid routes is d^m. Therefore, the computational complexity of finding the optimal route and optimal cluster for a large WSN is very high for a brute force approach. Moreover, an optimization method requires reasonable amount of memory and computational resources and yet finding out good results is desirable. In order to obtain a faster and efficient solution of the clustering and routing problem, soft computing approaches such as Particle Swarm Optimization (PSO) and Genetic Algorithm (GA), Ant Colony Optimization (ACO) etc. are highly appreciated. In fact many clustering and routing algorithms have been developed which are based on soft computing techniques.

In this talk, I will present various algorithms for clustering and routing problems in WSNs which are based on two popular soft computing techniques, namely particle swarm optimization and Genetic Algorithm. All the algorithms will be presented with their novelty in efficient particle and chromosome encoding schemes along with the Linear/Nonlinear Programming formulations of the clustering and routing problems. The simulated results will also be discussed and analysed for the sake of comparison of the state of art algorithms. The presentation will be concluded with the future scope of research towards the applications of soft computing approaches to solve other optimization problems of WSNs.