A Novel Method of Optimizing Lifetime and Reduction in Power Consumption in Wireless Sensor Network

Er. Anju Bala¹, Er. Saurabh Kumar²

¹Student, Ramgarhia Institute of Engineering and Technology, Phagwara, India
²Assistant Professor, Ramgarhia Institute of Engineering and Technology, Phagwara, India

Abstract

Optimal power flow (OPF) problem has already been attempted as a static, optimization problem by adopting gradient based methods and more recently, no conventional ones, such as evolutionary algorithms. However, as the loads, generation capacities and network connections in a power system are always in a changing status, these static methods are of limited use. This paper presents a new algorithm dynamic bacterial forging optimization, for solving the optimal power flow problem in wireless networks in which the systems load changes. The simulation results show that the proposed algorithm can more rapidly adapt to load changes, and more closely adapt to load changes, and more closely trace the global optimum of the system fuel cost.

Keywords: Wireless sensor network, Timing constraints, network lifetime, BFO

I. Introduction

A wireless sensor network has gained worldwide attention in recent years due to advances in wireless communication, information technologies and electronic field. A wireless sensor network consists of sensor nodes deployed over a geographical area for monitoring physical phenomenon like temperature, humidity, vibration, seismic events and so on [1]. It consists of sensor nodes capable of collecting information from the environment and communicating each other with transceivers. WSN term can be broadly sensed as devices range from laptops, PDAs or mobile phones to very tiny and simple sensing devices. At present, most available wireless sensor devices are considerably constrained in terms of computational power, memory, energy and communication capabilities due to economic and technology reasons. That’s why most of the research on WSN has concentrated on the design of energy and computationally efficient algorithms and protocols, and the application domain has been confined to simple data-oriented monitoring and reporting applications. WSNs nodes are battery powered which are deployed to perform a specific task for a long period of time, even years. If WSNs nodes are more powerful or mains-powered devices in the vicinity, it is beneficial to utilize their computation and communication resources for complex algorithms and as gateways to other networks. The collected information will be delivered to one or more sinks, generally via multi-hop communication. The sensor nodes are typically expected to operate with batteries and are often deployed to not-easily accessible or hostile environment, sometimes in large quantities. It can be difficult or impossible to replace the batteries of the sensor nodes. On the other hand, the sink is typically rich in energy. Since the sensor energy is the most precious resource in WSN, efficient utilization of the energy is the most precious resource in WSN. Efficient utilization of the energy to prolong the network lifetime has been focus of most of the research on the WSN. [2] Power consumption evaluation of Wireless sensor network can be evaluated by many methods. One way is to carry out the evaluation directly based on physical hardware, by periodically measuring the remaining battery. This process, however has several problems such as need of high financial investment, reproducibility of the environment, inherent dynamism, complexity and size of WSN’s and potential impact of hardware and human failures. [3] Another way for conducting the power consumption of WSN application through modelling. Although modelling may provide less accurate results than measuring, it provides the designer with the flexibility and agility to evaluate complex scenarios without interfering on the actual environment. [4] A wireless sensor node is made up of four basic components: a sensing unit, a processing unit, a transceiver unit and a power unit. There can be application dependent components such as location finding system or power generator. The architecture of the wireless sensor node can be depicted graphically as
II. Literature Survey

In 2002, Passino [19] proposed Bacterial Foraging Optimization Algorithm (BFOA) for distributed optimization and control. BFA is based on the foraging behavior of Escherichia Coli (E. Coli) bacteria present in the human intestine and already been in use to many engineering problems including multiple robot coordination. According to paper, BFA is better than Particle Swarm Optimization in terms of convergence, robustness and precision.

Bhakwad K.M. et al. (2011) [20] in the paper entitled “Bacterial Foraging Optimization Technique Cascaded with Adaptive Filter to enhance Peak Signal to Noise Ratio from Single Image” proposed a new approach to enhance PSNR of highly corrupted image affected by impulse noise. The adaptive median filter is used to identify pixels affected by noise and replace them with median value to keep the information uncorrupted. The BFO technique minimizes error between adaptive median filter output image and noisy image to maintain an error percentage of 0.0001. The results of proposed method are superior to conventional methods in terms of perpetual quality as well as clarity and smoothness in edge regions of resultant image. This method can also remove salt and pepper noise.

Energy consumption can be lowered by the means of routing algorithm that consumes low energy. In [6], the number of clusters that should be formed for escalating the lifetime of a network with provisions made to include equal number of nodes in each cluster have been minimized. The analysis and simulation results show that with realistic radio model we have achieved better load balance than several existing protocols, like LBEERA, HDS, SHORT, PEGASIS, LEACH and BINARY. A suitable node deployment strategy was adopted for ensuring wireless connectivity between each node.

Factors serve as a guideline to design a protocol or algorithm. Some important factors pertaining to the WSN’s are network topology, operating environment, hardware constraints, transmission media, power management, longevity, scalability, production cost and fault tolerance. Longevity deals with co-ordination of sensor activities and optimization of communication protocols. WSN’s are constrained by limited resources of memory, computation power and energy. Energy can be treated as a cost function or a hard constraint [7].

In [8] LEACH Algorithm is presented, which randomly and periodically rotates the role of the cluster head over all existing nodes and ensures that all the nodes run out of their battery almost simultaneously. In this case very low remained energy is wasted at the expiration time of the system[9]. However, the disadvantage of applying cluster head role rotation is that all the nodes in the network must be able to act as cluster heads, and therefore should possess necessary hardware capabilities [10]. This method has some advantage as follows: a cluster head can reduce the number of redundant packets by aggregating data in the cluster [11]. By limiting the domain of the inter – cluster interactions to cluster heads, it maintains communication bandwidth[12]. Also this method can minimize the rate of energy consumption in nodes.

In [13] Bacterial Foraging Optimization [BFO] algorithm for cluster head selection is discussed. BFO is a population based numerical optimization algorithm. In recent years, bacterial foraging behaviour has provided rich source of solution in many engineering applications and computational model. It has been applied for solving practical engineering problems like optimal control [14]. It was shown BFO provides better performance than other popular techniques. However, the computational complexity of BFO for applicability to WSN’s still remains a challenge. In [15] a new approach to enhance PSNR of highly corrupted image affected by impulse noise was designed. The adaptive median filter is used to identify the pixels affected by noise and replace with median value to keep the information uncorrupted. The BFO technique minimizes error between adaptive median filter and output image and noisy image to maintain an error percentage of 0.0001. The results of proposed method are superior to conventional methods in terms of perpetual quality as well as clarity and smoothness in edge regions of resultant image. This method can also remove salt and pepper noise.

Cellular wireless communication is facilitated by Base Transceivers Stations (BTSs) which have appropriate spatial distribution. Cell planning is a fundamental and challenging part of network design process. The automatic techniques that lend a helping hand to locate the optimal number of cell sites in a specified area are
indispensable due to non-uniform user locations and cell fluctuations.[16]

III. Proposed Steps To Achieve The Objective

- With minimum number of sensor nodes having maximum coverage in the network and the nodes are within the communication range.
- By making optimized wireless clusters using the Euclidean distance from all the location nodes to the Sensor Nodes.
- By making the Clusters of the sensor nodes with a corresponding central transceiver point which will be further chosen from a group of sensors.
- By Optimizing the Sensors position within each individual cluster, using BFO.

3.1 BACTERIAL FORGING OPTIMIZATION

The process of natural selection tends to eliminate animals with poor foraging strategies and favour the propagation of genes of those animals that have successful foraging strategies, since they are more likely to enjoy reproductive success. After many generations, poor foraging strategies are either eliminated or shaped into good ones. This activity of foraging led the researchers to use it as optimization process. The Escherichia Coli or E. coli bacteria that are present in our intestines also undergo a foraging strategy. The control system of these bacteria that dictates how foraging should proceed can be subdivided into four sections, namely, chemotaxis, swarming, reproduction, and elimination and dispersal.

3.2 BACTERIAL FORGING OPTIMIZATION ALGORITHM

The algorithm that models bacterial population chemotaxis, swarming, reproduction, elimination, and dispersal is given here (initially j=k=l=0). For the algorithm, updates to the $\theta_i$ automatically result in updates to P number of sensor nodes. The flowchart of the BFO is shown in Figure 4.2. The procedure of BFO is as follows.

1) First of all, get sample no of sensor nodes to be optimized
2) Initialize, the value of $p, S,Nc,N,s,Nre, Ned, Ped$ and the c(i), i=1,2… S . The initial values for the $\theta_i$, i = 1,2,… Smust be chosen.
3) Elimination-dispersal loop: l = l +1
4) Reproduction loop: k=k+1
5) Chemotaxis loop: j=j+1
   a) For i =1, 2,…S, take a chemotactic step for bacterium i as follows.
   b) Compute cost function $J(I,j,k,l)$. The cost function of the BFO is calculated in the following way: First sum the distance squares from each node to the CH for an one cluster. Then this value for all the clusters should be summed over.
   c) Let $J_{last})=J(I,j,k,l)$ to save this value since we may find a better value via a run.

3.3 BACTERIAL FORGING OPTIMIZATION SIMULATION RESULTS

FIG. 3.1 INITIAL LOCATION OF NODES IN NETWORK

FIG.3.2 ATTENUATION FOR SENSOR 1
Initially the location of three different sensor nodes is given. Then the attenuation graph, of each of the sensor node is plotted. Then the graph for the path loss corresponding to each of the sensor node is given. Then the graph for the comparison of the power used by each of the sensor node is plotted. Finally using the various graphs plotted for attenuation, power loss and power comparison, the optimized result i.e. the optimal location where the different sensor nodes should be placed where the power consumption is low and attenuation is less is found.

V. References

[10] N. Jafari et. al “Reduce Energy Consumption and Increase the Lifetime of Heterogeneous...


