

**Project Outline**

This project consists of a brief survey and an implementation of a wireless sensor network (WSN) design algorithm for solving a selected problem. Three possible problems are summarized below. You may pick one of the offered problems or define your own network design problem.

- You will start with a brief survey about your problem (~5 papers) which will be included in your progress and final reports with formal references.
- You are required to solve the realistic sizes of your problem with acceptable quality and in reasonable running times.
- You may use any technique other than the manual design. However, you should have a technique for evaluating the quality of your solutions. In order to concentrate your effort on the problem, it is advantageous to choose a technique, which is already familiar to you. If you are not familiar with any of the techniques, search the references and find a technique which has been applied to your problem before or come up with your own heuristic. You may use more than one technique and compare their performances.
- You are encouraged not to work alone, and form groups of two! However, if you wish you may work alone.

**Problem 1: Sink Placement in WSN**

You are given a rectangular area.  $N$  sensors with known battery capacities are already uniformly or nonuniformly random deployed into this region. Place the data sink into a proper location so that the lifetime of the WSN is maximized. Please note that a routing problem is also embedded in this problem, however, you do not have to solve that to optimality.

**Problem 2: Energy Efficient Routing in WSN**

You are given a rectangular area.  $N$  sensors with known battery capacities are already uniformly or nonuniformly random deployed into this region. The data sink is also placed on a given location. Devise a (preferably distributed and dynamic) routing algorithm so that the lifetime of the WSN is maximized.

**Problem 3: Sensor Node Framework in OPNET**

You will design a sensor node framework in OPNET. The design **MUST** be flexible so that a programmer can easily plug-in a new physical, MAC, network, or transport layer. You should design all interfaces clearly to allow for all future needs; a control plane to enable cross-layer designs is also required in this respect. All protocol layers and applications will communicate either through inter-layer interfaces or through the plane. To demonstrate that your framework works properly, you will have to implement simple physical, MAC, network, and transport layers together with battery, sleep scheduler, and management applications.

**Your e-mail containing the selected problem and group members (due 12 March 2007 Monday noon)**

**Your progress report (due 17 April 2007) should contain the following:**

- Definition of the problem in the form of what is given, what is the objective function and what are the constraints
- Results of the brief survey about your problem, and the related references
- Description of the technique intended to be used for solving the problem
- Pseudocode or flowchart of the algorithms used,
- The source code (in preferably C, or any other programming language).

**Your project report (Due 25 May 2007) should contain the following:**

- Contents of the progress report.
- Description of the experiments and test problems planned to be used for evaluating the performance of the network design algorithm.
- Results of the computational experiments
- A CD containing the users manual, the source code, input files for the test problems, an executable program on a PC and the doc file of your project report and presentation.

**Warning:** *The semester is short. There are only 10 weeks left until the deadline not counting the spring break. Start early, plan your time for the literature survey, the implementation, computational experiments approximately three weeks each. Reserve one week for the preparation of the final report. These due dates will roughly guide you for this schedule.*

**You will be required to present your work to your classmates on 22<sup>nd</sup> May 2007 in the form of a 20 minutes long presentation which will include:**

- Definition of the problem,
- Description of the technique used for solving the problem,
- Description of the technique used for evaluating the quality of your solutions,
- Test problems and results. Conclusion.

**Some of the Available Optimal Network Design Techniques are:** Linear Programming and its derivatives, Heuristics, Simulated Annealing, Genetic Algorithms, Reactive Search Algorithms, Memetic Algorithms, Neural Networks, Tabu Search, Ant Colony Optimization.

**Some of the related journals which can be found in B.U. library are:**

- IEEE/ACM Transactions on Networking
- IEEE Journal on Selected Areas on Communications
- IEEE Transactions on Communications
- IEEE Transactions on Information Theory
- IEEE Communications Magazine
- Computer Networks
- European Journal on Wireless Communications and Networking
- Adhoc and Sensor Networks
- Pervasive Computing
- IEEE Network Magazine
- IEEE Computer Magazine
- IEEE Tr. on Wireless Communications
- IEEE Tr. on Mobile Computing

- You may also check the computer networks bibliography at  
<http://www.cs.columbia.edu/~hgs/netbib>

- You may also use the search engines on Internet such as:  
<http://ieeexplore.ieee.org/> or <http://scholar.google.com/>

- You may also want to see the link for technical writing at  
<http://www.cs.columbia.edu/~hgs/etc/writing-style.html>