

**USC Course Syllabus:  
EE 652/CSCI 652 Wireless Sensor Networks  
Fall 2004**

## **Instructor**

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## **Catalogue Description**

Sensor network applications, design, and analysis. Deployment; energy-efficiency; wireless communications; data-centric operation; capacity and lifetime; collaborative signal processing; reliability, fault-tolerance and security.

## **Enrollment & Prerequisites**

The size of the class will be limited to about 25 students, and admission is based on prior instructor approval. The prerequisite for this course is EE/CS 450 (Intro to Networks). It is recommended (but not required) that students have taken EE 465 and that they have good programming skills (C/C++/Java) as well as skills in mathematical analysis. The course is meant primarily for Ph.D. students in EE and CS as well as second year M.S. students with motivation and a particular interest in research.

## **Course Goals**

From this course, students will gain a thorough introduction to the area of wireless sensor networks. Wireless sensor networks are unattended distributed systems consisting of large numbers of inexpensive devices – each capable of a combination of sensing, communication and computation. Such sensor networks are expected to be deployed in high densities in order to obtain detailed information about the operational environment. Applications range from environmental monitoring and seismic studies to mobile target tracking.

Sensor networks provide a fundamentally new set of research challenges – involving design and analysis of self-configuration protocols and distributed algorithms that are energy-efficient, fault-tolerant and scalable. This is a new and rapidly developing research area with many open problems of cross-disciplinary interest. The course will provide students with a comprehensive introduction to this area through readings of a large number of recent papers (more than 70) on different topics spanning the subject and through talks by guest speakers. Students will also have an opportunity to contribute to this area through the publication of results from the required group research project for this class.

Students will critically examine recently proposed mechanisms for the deployment and configuration of sensors, energy-efficient data gathering, handling challenging wireless link conditions, data-centric querying, routing, and storage, maximizing network lifetime and capacity, collaborative signal processing, reliability, fault-tolerance and security. Through this course students will learn how to design and analyze such mechanisms for different application-specific contexts.

This course also aims to train students in the craft of academic research. Substantial emphasis will be placed on reading research papers in a critical and analytical manner. Students will be required to turn in weekly written critiques of the papers that they read. They will be required to make at least one in-class presentation during the semester on papers from the assigned readings as well as a group presentation pertaining to the project. The group projects will be closely guided on a weekly basis through out-of-class meetings and emails, and will span the full research cycle – from problem formulation to obtaining & analyzing results to paper writing. Guest speakers from academia and industry will give talks on different aspects of sensor networks to the class.

## **Course Outline and Readings**

The following is an outline for the course, describing the topics we will be covering through the lectures and readings in this course, about one topic every week or two. In each class, typically, the instructor will provide a lecture, and one or two students will make presentations to the class, together covering the readings for that week. Guest speakers will make presentations as well.

### **Topic 1 The Sensor Network Concept**

- Introduction
- Applications

### **Topic 2 Deployment & Configuration**

- Localization and calibration
- Coverage and connectivity

### **Topic 3 Wireless Communications**

- Link quality, shadowing and fading effects

### **Topic 4 Medium Access**

- Scheduling sleep cycles

### **Topic 5 Data Gathering**

- Tree construction algorithms and analysis
- Asymptotic capacity
- Lifetime optimization formulations

### **Topic 6 Routing and Querying**

- Publish/Subscribe mechanisms
- Geographic routing
- Robustness
- Storage and retrieval

## **Topic 7 Collaborative Signal Processing and Distributed Computation**

- Detection, estimation, classification problems
- Energy-efficient distributed algorithms

## **Topic 8 Security**

- Privacy issues
- Attacks and countermeasures

## **Research Project**

Besides the weekly readings, critiques, presentations and discussion, a large component of the course will be a semester-long research project on sensor networks. The following are some guidelines concerning the project:

- The research projects are to be conducted in groups of 2-3 students, working closely with the instructor.
- It is expected that the project groups will be formed and the projects commenced no later than four weeks after the start of classes.
- During the course of the research project, the students will identify an open problem, formulate a concrete proposal for addressing the problem, research prior and related work, propose a new scheme or develop a novel analysis, and obtain results to evaluate their ideas.
- The projects may vary in approach from analysis, to computer simulations to experimental implementation, or preferably a combination of these. Students will have the freedom to identify the topic and choose an approach based on their own background and interests.
- Students will be required to submit a short 4-page mid-term project report due around week 8, which will describe the research topic, related and prior work relevant to the problem, the methodology to be followed, and preliminary results, if available.
- Students will be required to document the full project in the form of a high-quality final report, about 10-15 pages in length, and make a final presentation to the class. The final presentations from all groups will be made during the final two weeks of class. Other researchers or faculty in the area may be invited to attend these final project presentations.
- The projects will be graded on the basis of both team success and individual effort, the mid-term and final project reports, and the final project presentations.

## **Grading Policy**

Weekly assignment/paper critiques (best 10): 40%

In-class reading-based presentation 10%

Research project: 50%

## **Statement for Students with Disabilities**

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to the instructor (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. – 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.