Course Syllabus
EE 652/CSCI 652 Wireless Sensor Networks, Fall 2007

Website accessible through http://blackboard.usc.edu

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 anticipated steady-state size of the class is about 20 students. The prerequisite for this course is EE/CS 450 (Intro to Networks). Students are expected to have strong programming skills (C/C++/Java) and analytical ability. It is recommended that they have taken EE 465 and CS 402. The course is meant primarily for Ph.D. students in EE and CS as well as second year M.S. students with a high-level of ability, self-motivation and an interest in research.

Diagnostic Exam

On the first day of class, students will be assigned a take-home diagnostic exam that is intended to gauge their preparation for this class. Students may consult any passive references (books/articles), but must do this exam alone without communicating with or seeking assistance from others.

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 aims to provide students with a comprehensive introduction to this area, a training in programming protocols for such networks, as well as an in-depth understanding of data-centric networking mechanisms. 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 spatio-temporal configuration of networked sensors, energy-efficient data gathering, handling challenging wireless link conditions, data-centric querying and routing, etc. Through this course students will learn how to design and analyze such mechanisms for different application-specific contexts.

This semester, a substantial emphasis will be placed on software implementation. All students are expected to learn (largely on their own, with some assistance from the TA) how to program wireless motes using NesC/TinyOS and run simulations using TOSSIM. Regularly assigned programming projects will walk students through increasingly difficult concepts in TinyOS. The final project for this course will require a substantial amount of programming.

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 regular written critiques of papers.

The final project (see below for details) will be closely monitored through out-of-class meetings and emails, and will span the full research cycle – from problem formulation to obtaining & analyzing results to paper writing.

Course Outline

The following is an outline for the course, describing the topics we will be covering through the lectures in this course:

1. Sensor network vision and applications (Chapter 1)
2. Time Synchronization (Chapter 4)
3. Localization (Chapter 3)
4. Wireless link quality (Chapter 5)
5. Medium Access (Chapter 6)
6. Routing (Chapter 8)
7. Data-centric Networking (Chapter 9)
8. Transport and Congestion Control (Chapter 10)

Course Readings

The required book for the course is *Networking Wireless Sensors*, Bhaskar Krishnamachari, Cambridge University Press, 2005.

An important supplementary resource is the ANRG sensor networks bibliography, available online at http://ceng.usc.edu/~anrg/SensorNetBib.html

This site contains links to a large number of conference and journal papers that students will find useful in finding papers to read and critique, as well as for final projects.

Research Project

Besides the weekly lectures, critiques, and discussion, a large component of the course will be a semester-long research project on sensor networks. The following are some basic guidelines concerning the project, detailed instructions will be provided during the semester:

- The research projects are meant to be conducted in groups of 2 students.
- During the course of the research project, the students will pick an open problem with the guidance of the instructor, do a substantial software implementation, and analyze the results obtained.
- The project will start at the end of September when the topics will be determined.
- Students will be required to maintain an online log providing regular updates once every couple of days on their progress on the project.
- Students will be required to submit a short 4-page mid-term project report around early November, 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 that will be peer-reviewed, and make a final presentation to the class.
- The projects will be graded on the basis of team success as well as individual effort, the regular progress updates, the mid-term and final project reports, and the final project presentations.

Grading Policy

In this advanced Ph.D.-level course, it is expected that all students will be motivated, responsible for their own learning, and participate actively. Each student must present and participate actively in the discussions each week in class, complete all assignments in a timely manner (reading assignments may be tested using quizzes), and contribute significantly to the group research project. The course grading policy is accordingly as follows:

- Take Home Diagnostic Exam 5%
- Weekly assignment/Quizzes/Discussion: 45%
- Research project: 50%