Course Syllabus
EE 652/CSCI 652 Wireless Sensor Networks, Fall 2011

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

A key prerequisite for this course is EE/CS 450 (Intro to Networks), which will be waived only for Ph.D. students. 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.

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, forming the next-generation ***Internet of Things***. 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.

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. Programming projects will walk students through increasingly difficult concepts in TinyOS.

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 Readings

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

Beyond this, we will also read and discuss more recent papers from the literature.

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 (Chapters 8, 9)
7. Transport and Congestion Control (Chapter 10)

Research Project

- Besides the weekly lectures, critiques, and discussion, a large component of the course will be a substantial research project on sensor networks. Details on this will be provided during the semester. The projects will be graded on the basis of team success as well as individual effort, regular progress updates, the mid-term and final project reports, and 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:

- Assignments, Quizzes: 50%
- Research project: 50%