Sensing, Communications and Networking for Smart Wireless Devices

Course description: The course will cover different types of sensing, communication and networking techniques for current/future smart devices. The focus of this course is to build the foundations for building real-world technologies and solutions. The course will start with some mathematical concepts and then how to apply them in solving real-life problems. Key topics of this course include GPS, indoor localization techniques, motion tracking, applications of different sensing modalities, low power wireless protocols etc.

Grading: Here is the grading schema

Assignments	30
Midterm	30
Final project	20
Paper presentation	20

Tentative topics: A tentative list of topics are as follows.

Introduction: Technology, scope, applications of wireless sensing and sensor networks.
Localization: GPS localization, indoor localization challenges, RSSI based localization, fingerprinting based approaches, Time-of-flight (ToF), Time difference of arrival (TDoA), Clock synchronization.
Signal Processing and applications: Time domain to frequency domain conversion, DFT basics, Beamforming basics and applications, Angle-of-arrival (AoA) based localization
IMU sensor and motion sensing: Understanding inertial measurement unit (accelerometer, gyroscope, magnetometer), sensor fusion, applications of IMUs for motion tracking, gesture detection, activity tracking etc.
MAC in sensor networks: Requirements, synchronous vs asynchronous MAC, low-power MAC, specific examples including IEEE 802.15.4
Routing in sensor networks: Energy aware routing, geographic routing, attribute based routing etc.
Device-free sensing: Wireless signals and communication channels for sensing, applications like human presence detection, digital agriculture etc.
Dynamic time warping and applications: Basics of pattern matching, dynamic time warping, applications like posture detection, hand movement tracking etc.

References: There will not be any dedicated textbook for this course. Students are expected to read research papers and online materials/tutorials, which will be provided with the corresponding lectures.