PhD in Information and Communications Technologies - ICT

PhD Course:

Communications Networking and Traffic Management for Autonomous Mobile Systems

by:

Prof. Izhak Rubin

Course Contents:

Analysis, design and traffic management of autonomous mobile systems. Telecommunication networks, mobile wireless networks, and multiple-access communication systems. Networking architectures, multiple-access communications under adaptive quality-of-service metrics. Autonomous mobile networked systems. Cellular wireless networks, WiFi mesh networks, peer-to-peer mobile ad hoc wireless networks. Autonomous transportation networked systems. Traffic management architectures in support of self-driving cars. Adaptive multimedia streaming over mobile wireless networks. Energy and pollution aware sustainable networking.

Prof. Rubin's Bio-sketch:

Prof. Izhak Rubin is Distinguished Professor at the Electrical Engineering Department, University of California, Los Angeles (UCLA). He is Co-Director of the UCLA Public Safety Network Systems Laboratory, Area Director of the UCLA Master of Science (MS) Engineering Online Program, IEEE Fellow since 1987 for "*contributions to the analysis and design of computer communication systems and networks, and to engineering education*", and he received several awards, including the *UCLA Engineering Excellence in Teaching Award* 2014.

Class Schedule:

Week 1:
Tuesday, October 10, 13:30 - 16:30; Wednesday, October 11, 13:30 - 16:30; Thursday, October 12, 13:30 - 16:30.

Week 2:
Tuesday, October 17, 13:30 - 16:30; Wednesday, October 18, 13:30 - 16:30; Thursday, October 19, 13:30 - 16:30.

Week 3:
Tuesday, October 24, 13:00 - 17:00; 2 hours lectures + 2 hours final examination.

Course Outline:

1. Network Services, End Users and Layouts
2. Switching methods and networking protocols
3. Multiple Access Protocols, Algorithms and Schemes
    A. Fixed assigned multiple access; TDMA, FDMA, CDMA, SDMA, WDM; hybrids
    B. Demand assigned multiple access (DAMA): reservation and polling schemes
    C. Random access mechanisms; ALOHA, CSMA, CSMA/CD, IEEE 802.11 type CSMA/CA; adaptive random access schemes; OFDMA; MIMO; signaling and control for cellular wireless networks and autonomous mobile networked systems
    D. Conservation laws and queueing based stochastic modeling and analysis of multiple access networks. Applications to the calibration, analysis and design of wireless network systems.
4. Cellular Wireless Network Systems
    A. Architecture of cellular wireless network systems
    B. Modeling, analysis, design and optimal resource allocations for cellular wireless networks
    C. Cross-layer modeling, analysis and design of heterogeneous wireless networks that employ a hybrid of micro and macro base station nodes and cells.
    D. Optimal joint rate/power adaptations, cross-cell coordinated scheduling and resource allocations for cellular wireless networks; multicast and unicast message distributions; public safety networks; fractional frequency reuse (FFR) and other scheduling methods; use of directional and omni-directional antenna modules; multi-radio modules.
    E. Optimal cross-layer protocols and resource allocations for the adaptive support of multimedia flows..
5. Mobile Ad Hoc Wireless Networks (MANETs)
    A. Networking mechanisms for mobile ad hoc wireless networks (MANETs) through the use of peer-to-peer networking operations, without the aid of a core network infrastructure.
    B. MANET routing algorithms
    C. Mobile Backbone Networks (MBNs) and such UAV aided networks; optimal adaptive rate/power, scheduling and routing.
6. Communications networking for highway vehicles
    A. Vehicular ad hoc networks (VANETs); safety communications; messaging and streaming applications and services.
    B. Networking protocols and algorithms for VANET systems and their modeling, design and analysis; Distance Based Forwarding (DBF) protocols; Vehicular Backbone Networking (VBN) methods.
    C. Design of multi layer protocol modules for VANET systems.
    D. Associated radio systems and wireless vehicle-to-vehicle (v2v) and vehicle-to-infrastructure (v2i) communications networking protocols.
7. Integrated networking and traffic management for autonomous mobile systems (5 lectures)
    A. Architectures for autonomous mobile platoons / swarms and highway transportation systems
    B. Communications networking and traffic management for autonomous (self driving) vehicular systems
    C. Energy, pollution and sustainability aware configuration and regulation for autonomous mobile systems
    D. Design and management of autonomous mobile systems using a hybrid of ad hoc and infrastructure based networking systems