

[8803] Syllabus

Advanced Wireless Networks, 3-0-3

[T,Th], 2-3:15pm, Van Leer

Instructor Information

Instructor
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Office Hours & Location
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General Information

Description

This course aims to educate and inform students on the various advanced topics in wireless networking research. It will build upon the fundamental concepts learnt in ECE 6610 (Wireless Networks) or ECE 4607 (Mobile and Wireless Networks) or any equivalent/introductory wireless course and will take a more research-oriented flavor. We will start by understanding the basics of wireless networks, but quickly start focusing on the challenges in designing and deploying wireless networks on a large scale that can keep up with the exponentially growing demands from application traffic. We will discuss several of the advanced wireless technologies that are a part of the 5G (and beyond) wireless technology evolution, and what it takes to intelligently deploy them in large networks. We will also study, how our wireless networks can double up as a pervasive “sensor” and contribute to several innovative sensing applications in the society. The course will largely be delivered in a lecture-format, but will also borrow heavily from research literature to introduce students to cutting-edge research in wireless networking and sensing, along with a substantial hands-on project. The intent of the course is to expose students to the rich potential for impactful research that lies at the intersection of FutureG wireless networks and multiple other domains like robotics, low-power circuits, immersive media, etc.

Pre- &/or Co-Requisites

Recommended ECE 4607 or ECE 6610 or ECE 6607 or any equivalent course in computer or wireless communication/networks

Basic knowledge of communication and wireless networks, along with an introductory background in wireless communications, will make the course material more accessible and enjoyable for students as it prepares them for advanced topics in wireless networking research.

Course Goals and Learning Outcomes

Upon successful completion of this course, the student should be able to

1. Describe the main classes of wireless networks and the characteristics that differentiate them
2. Analyze the fundamental bottlenecks in scaling advanced physical layer wireless techniques to large networks
3. Analyze the tradeoffs between synchronous and asynchronous access schemes for different types of spectrum access
4. Design a wireless solution capable of leveraging existing and advanced wireless technologies for mobile sensing

5. Write a technical report that articulate a wireless research problem, its challenges and formulation, along with a potential solution

Course Requirements & Grading

Assignment	Date	Weight (Percentage, points, etc)
Programming assignments (2)		20
Mid-term		25
Research paper presentations (2)		15
Final project		30
Peer evaluation & class participation		10

Course Materials

Course Text

None

Additional Materials/Resources

Research papers will be made available on canvas. Experimental devices as relevant for final projects will be provided.

Course Website and Other Classroom Management Tools

On canvas

Course Topics

Introduction

- Asynchronous access networks (WiFi and its progressions)
- Synchronous access networks (cellular and its progressions)
- OFDMA, MIMO, MU-MIMO

Smart Antenna Networking

- Distributed and network MIMO
- Massive MIMO
- Full duplex

- mmWave

Dynamic Spectrum Access

- LTE/5G in unlicensed/CBRS spectrum
- Coexistence between heterogeneous wireless technologies
- LTE direct (peer-peer), Cellular-V2X

SDN in Wireless

- Advanced wireless network architectures
- Adaptive Transmission Techniques
- Network Function Virtualization (NFV) and Mobile Edge Computing (MEC)

Wireless and Mobile Sensing

- Localization and tracking: infra-based and infra-free, absolute and relative (peer-peer)
- Health Monitoring
- Radar sensing

Low-power Wireless Networking

- Wide area IoT networking: LoRA, NB-IoT
- Wireless backscatter: RFID, commodity backscatter

Wireless and Autonomous Platforms

- Reconfigurable mobile networks in the sky
- Autonomous mobile networks as sensing platforms

Course Expectations & Guidelines

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit <http://www.catalog.gatech.edu/policies/honor-code/> or <http://www.catalog.gatech.edu/rules/18/>.

Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will earn a failing grade for the activity in question on the first offense, and will fail the entire course on the second offense. Further, the student will be reported to the Office of Student Integrity, who will investigate the incident and identify its own appropriate penalty for violations as well.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or <http://disabilityservices.gatech.edu/>, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Attendance and/or Participation

Class attendance is highly recommended as the course content will help the students successfully navigate the graded components of the course, including but not limited to the programming assignments, research paper presentations and the final project. There is also a grading component that relates to student participation in the class lectures as well as the group activities they are assigned.

Collaboration & Group Work

Most of the graded components of this course will involve a group/team effort. While the group will be graded jointly, if there are significant differences in the amount of contribution of the team members, appropriate relative grades will be assigned to different members, which is at the discretion of the instructor. While students are allowed to refer to online resources, articles and project codes for assignments and projects, they should not replicate them as is. Further, they should cite references as appropriate.

Extensions, Late Assignments, & Re-Scheduled/Missed Exams

For events that are known ahead of time, for which the student is expected to miss an assignment or exam, it is the responsibility of the student to discuss with the instructor at the semester's start of the course to make alternate arrangements. If circumstances for the lapse are extenuating, alternate arrangements will be considered and decided on a case-by-case basis.

Student-Faculty Expectations Agreement

At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See <http://www.catalog.gatech.edu/rules/22/> for an articulation of some basic expectation that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Student Use of Mobile Devices in the Classroom

As research on learning shows, unexpected noises and movement automatically divert and capture people's attention, which means you are affecting everyone's learning experience if your cell phone, pager, laptop, etc. makes noise or is visually distracting during class. That said, many students find it useful to have a mobile device on hand to access course materials. With this in mind, I allow you to take notes on your laptop, but request that you turn the sound off so that you do not disrupt other students' learning. In addition, if you are doing anything other than taking notes or looking at course materials on your laptop, please sit in the back row so that other students are not distracted by your screen. With respect to cellphones and smartphones, I request that you silence them and leave them in your bag when the class is in session.