

ECE 592-076: Cognitive Radio Networks

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Office Hours: by email appointment with “[ECE592-076]” in the subject line

Description: Today's wireless networks are characterized by a fixed spectrum assignment policy. However, a large portion of the assigned spectrum is used sporadically and geographical variations in the utilization of assigned spectrum ranges from 15% to 85% with a high variance in time. The limited available spectrum and the inefficiency in the spectrum usage necessitate a new communication paradigm to exploit the existing wireless spectrum opportunistically. This new networking paradigm is referred to as Cognitive Radio Networks (CRN) and Dynamic Spectrum Access Networks (DySPAN). This course covers the following topics:

- Software Defined Radios (SDR), Cognitive Radios (CR), and CRN Architecture
- Spectrum Sensing
- Dynamic Spectrum Access (DSA)
- Cognitive Communication Protocols and CRN Standards
- Wireless Software Defined Networking (WSDN)

Credit Hours: 3

Course Webpage: <http://www4.ncsu.edu/~slin23/classes/index.html>

Prerequisite: ECE 570 is preferred but not mandatory.

Course Outcomes: After completing this course the students should

1. Apply SDR, CR, and CRN architecture to analyze opportunistic spectrum utilization
2. Derive the spectrum sensing techniques, including transmitter detection, receiver detection, and interference temperature management
3. Derive DSA schemes by considering spectrum decision, spectrum sharing, and spectrum mobility
4. Explain and analyze cognitive communication protocols, such as common control channels and MAC/routing algorithms, as well as CRN standards
5. Derive and analyze several pioneer solutions of WSDN

Grade Distribution:

Midterm exam	30%
Final exam	40%
Homework assignments	30%

Course Materials: Class notes will be available in the course webpage.

Academic Integrity: Students should refer to the University policy on academic integrity found at <https://studentconduct.dasa.ncsu.edu/academic-integrity-overview/>

In an effort to affirm and respect the identities of transgender students in the classroom and beyond, please contact me if you wish to be referred to using a name and/or pronouns other than what is listed in the student directory.

Course Outline

Software Defined Radios, Cognitive Radios, and CRN Architecture (1 Week)

1. Introduction to Cognitive Radio Networks
2. Cognitive Radio Concept
3. CRN Architecture
4. Cognitive Cycle

Spectrum Sensing (4 Weeks)

- 5.1 Spectrum Sensing Techniques
- 5.2 Cooperative Spectrum Sensing
- 5.3 Optimal Sensing
- 5.4 Mobility Aware Sensing

Dynamic Spectrum Access (5 Weeks)

6. Spectrum Decision
- 7.1 Spectrum Sharing: Intranetwork
- 7.2 Spectrum Sharing: Internetwork
- 7.3 Spectrum Sharing: More on Game Theory
8. Spectrum Mobility

Cognitive Communication Protocols and CRN Standards (4 Weeks)

9. Common Control Channels
10. Cognitive Radio MAC Protocols
11. Cognitive Radio Routing Algorithms
12. Cognitive Radio Network Standards

Wireless Software Defined Networking (1 Lecture)

13. WSDN for 5G and Beyond Systems