
EE 359 - Wireless Communications – Winter 2020

Project Information and Suggestions

The term project (for students electing to do a project) is a research project related to any topic in the wireless area. Some suggested topics are listed below, but you are by no means limited to these topics. The project can be a literature survey, analysis, simulation, or experiment. If you want to be ambitious you can propose a project that includes original research. However, re-deriving a known result from scratch, repeating a simulation experiment, or a literature survey of 2-3 papers is also fine. The low-risk approach is a literature survey; if you plan any other type of project be aware that it will require more (and a possibly unpredictable amount of) time. Note that your references must be published and/or you must supply an electronic link to them on your website.

Two people may collaborate on the project if the joint project satisfies the following three criteria:

1. The project is of sufficient scope to merit collaboration by two people. It is expected that the amount of work on the collaborative project be approximately double that of a project undertaken by just one student.
2. The joint project cannot be separated into two effectively separate projects. In other words, there must be some reason why the work is done as a joint project rather than two separate projects.
3. The work can be delineated between the collaborators so that I can grade you separately.

Due to the more complicated nature of collaborative projects and their need to satisfy these three criteria, collaborative projects must be approved by the instructor prior to the proposal deadline. The three criteria required for collaboration must be discussed in the project proposal. Both the project proposal and final report must have separate sections written by each collaborator describing their contribution. In rare cases collaboration by three students may be permitted, this also requires instructor approval prior to the proposal deadline.

Details and Deadlines:

- A 1 page **proposal is due 2/7 at midnight (hard deadline)**. The project proposal should include a fairly detailed description of what you plan to do. If you are doing a literature survey you should cite and briefly describe the papers you are using, what aspects of these papers you plan to focus on, and how you propose to compare the different approaches in each paper. (one should not have to read the papers to understand your project proposal). You should also pick important high-impact papers to survey – citation count in Google scholar is one measure of the impact of a paper but not the only one. In particular, recent papers or very old papers may have a low citation count but be extremely important in terms of having ignited a new field or discovered/proved a new result. If you are doing a simulation you should describe in detail the system that you plan to simulate and how you plan to simulate it. If you are doing an original analysis you must describe the system you are analyzing, the specific aspects of the system you plan to analyze, and how you plan to do the analysis. Your proposal should include 2-3 references and the relevance of these references to the proposed work should be described in your proposal. Do not propose an overly ambitious project that cannot be completed by the end of the quarter. Your project proposal will be graded independently of the final project report. The proposal grade will be based on the level of detail and clarity in your description of the proposed work, as well as an assessment as to whether you can complete the proposed work in the available time. You are strongly urged to meet with the instructor prior to the project deadline to get feedback on your project proposal. The instructor will also provide comments on early drafts of the proposal if sent at least 1 week before the deadline. On average, a good proposal will require 5-10 hours of work.

As part of your project proposal, you must create a web site for your project and post your project proposal to the web site including your name and email and that of any collaborators. You must post your project proposal and email the instructor and TAs the web site address by the proposal deadline (your email should include the project name and the names and emails of the project collaborators). Project proposals submitted in any other form will receive no credit. Your project website will be linked to the class homepage. If you have not created a website for your project by the proposal deadline it will be assumed that you are not doing a project.

- **The project is due by midnight on 3/14 (hard deadline)**, and must be posted to your project website by then. No extensions will be granted except for documented emergencies. Your final report should be around 8-10 pages. On average, a good project will require 20-40 hours of work beyond the project proposal, and projects with original research may require much more than that.
- Proper citation of published work: Be aware that a literature survey does not mean repeating verbatim what has been published in other papers (in fact this is plagiarism and will receive zero credit and will also be reported as an honor code violation): it means summarizing, comparing, and contrasting the main ideas, concepts, and results presented by other authors in your own words. You may certainly give results derived by other authors and include theorems, tables and figures from published papers, but only if you cite the exact reference each time you use such a figure, table, or proof. Exact quotes taken from published papers without reference are not acceptable and your report will receive no credit if such quotes are included.

Some Suggested Project Areas:

PHY layer techniques

- Shannon capacity of wireless channels (e.g. time-varying, with feedback or no CSI, ...)
- (massive) MIMO
- Millimeter wave (mmW) communications: channel models, modulation, MIMO, etc.
- Energy efficient (**green**) radio designs
- Software-defined radios
- Radio design under sub-Nyquist sampling or utilizing compressed sensing ideas
- Energy-harvesting radios: capacity limits, transmission strategies, performance
- Wireless power and data transmission
- Chemical and molecular communications

Multiuser systems and networks

- Multiple access techniques (orthogonal and non-orthogonal)
- Dynamic resource allocation, dynamic network slicing
- Shannon capacity of multiuser wireless channels and networks
- Interference cancellation and/or multiuser detection
- Network coding and generalized routing
- Ad hoc wireless network design, optimization, and performance
- Energy-efficient wireless networking
- Cooperative communications (ad-hoc or cellular systems)
- Hierarchical wireless networks (Hetnets, with large and small cells) or small cell networks
- Cloud RAN wireless network architectures
- Cognitive radio networks
- Spectrum sharing between cellular and WiFi in unlicensed bands (unlicensed LTE)
- Software-defined wireless networking (cloud-based management of wireless devices)
- The use of edge caching and/or computation in wireless networks
- Applying communication models/analysis techniques to neuroscience/biology/medicine