

COM-304 Software Radios & Radars Project Guidelines

<https://github.com/samhy99/COM-304-BladeRF>

<https://github.com/hailanzs/COM-304-Radars>

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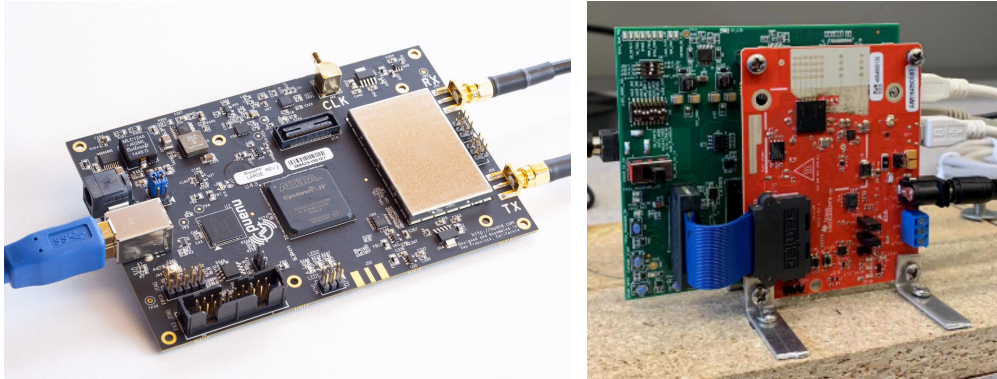


Figure 1: Hardware platforms available: BladeRF (left), mmWave Radar (right).

1 Introduction

The primary goal of this course is to give students hands-on experience with solving real-world challenges by working in teams to program different hardware platforms and ultimately build their own projects. We want you to get familiar with working on a project from start to finish. How do you organize a project's timeline, and team and ultimately design and implement something from scratch? By the end of this course, you should have a taste of each of these aspects of project and group work.

The goal of the communications & sensing project is to get familiar with the hardware of your choosing software-defined radio or millimeter-wave radar and propose a communications/sensing project that you will implement. This is a flexible project and here you can get creative! For both platforms, we have multiple devices available. We propose some example projects in this guideline document that you can use or build upon, however, it is encouraged to think outside the box and come up with your own project!

1.1 Hardware Platforms

Millimeter-wave (mmWave) Radar: The radar platform we will use is TI's AWR1843BOOST radar board combined with the DCA1000EVM data capture board.

Software Defined Radio Platform (SDR): The SDR platform used is BladeRF which you will use in conjunction with an omnidirectional antenna.

Both of these hardware platforms have guidelines on setup and more information on how they work linked in their corresponding github repos which you can find at:

- <https://github.com/samhy99/COM-304-BladeRF>
- <https://github.com/hailanzs/COM-304-Radars>

2 Project Proposal Guideline

We expect you to come up with all the details of the project: implementation, techniques, etc. The course staff are not responsible for providing the details of these projects, that's your responsibility for whichever project you decide to work on. You are welcome to consult with the course staff on ideas and plausibility of your ideas and how they might be implemented. Nevertheless, we will provide a few ideas, which you can see in the lecture slides (Lecture 2).

In addition to checking these suggestions out, it might be useful for you to skim the recent (last couple of years) proceedings of the following conferences for some project inspiration: MobiCom, MobiSys, SIGCOMM, NSDI, SenSys for papers related to wireless.

These are just a few ideas, but there are many more possibilities out there!

3 Evaluation

Evaluation of this project will be dependent on the project. However, at a high level, we will evaluate based on the following criteria:

1. **Project Reports:** You will have to submit 3 reports: proposal, progress report, and final report. More details will be found in 4. Your project proposal will essentially guide what you and the course staff should expect from you in this project.
2. **Implementation:** You will be graded on your implementation: attention to details, understanding of the system, design choices, and does your project do what your proposed?
3. **Demonstration:** We will have demos and a final presentation for each of the project towards the end of the course. This will also give you a chance to check out the projects other students are working. Please stay tuned for details!

Because each project can be vastly different, we will take each project as a case by case basis. However, the structure of what you should be expected to be graded on will be outlined in your project proposal, which course staff will discuss and adjust accordingly with the groups.

4 Reports Instructions

During the project, you will need to submit three reports and make the final presentation of your project. Each of these reports are expected **one from each group**. The individual work is expected in the weekly progress updates. Below, you can find instructions for each stage.

4.1 Project Proposal

The goal of the project proposal is to create an outline of what your plans are during the semester. You should roughly organize it as follows:

1. **Introduction & Problem Statement:** Outline the problem statement. What are you trying to do, and why is it an interesting problem to look at? What techniques will you need to use to implement this idea? Here you should more specifically say *what* you plan to do.
2. **Project Plan:** Here you should give us an outline of what your goals are for the project. This is where you need to be more specific. What is the exact end system you plan to have? Include a timeline that will help course staff to gauge whether your project is too ambitious or needs a bit more to it. Additionally, you should say what you expect to get done by the progress report. You

should also tell us what *you expect is the baseline of a working project*. This should be specific. While not necessary, it will be good to put any initial technical detail that you have about your project.

3. **Extra Features:** These can be out of the box ideas that you think might not be possible in the timeline proposed, but sometimes things go well! If you have time, what extra features would you be interested in implementing on top of your current proposal.

This proposal will be reviewed by the course staff. We will approve it or suggest adjustments based on the difficulty we expect. As part of your grade is on both the ambitiousness and success of your project, we recommend you to be descriptive in this proposal.

4.2 Progress Report & Progress Demo

The progress report is intended to make sure that you are making adequate progress throughout the semester. Finishing a project in the last week is impossible given the breadth of this project. Your progress report should be at **most 2 pages** that includes:

- The steps taken so far in implementing the project and deviations from the original proposal, together with explanations.
- A discussion about the problems you encountered, the solutions you explored, and problems that you are likely to encounter as your project progresses.
- A tentative but concrete list of the action items you plan to work on until the final report and how they relate to the project's overall goal.

In addition to the written report, we will also conduct a short demo with each group. The goal of this demo is to show the course staff what basic implementation you have working. We **do not** expect everything to be working at this point. However, we should see that you have made significant progress in setting up the hardware and implementing your ideas. Your project proposal should state what you expect to have done by this point. *This will be an in-person evaluation during the first exercise session after the progress report deadline. We will communicate the exact time and date later.*

4.3 Final Presentation Guidelines

Each group will have 10 minutes to present their system with another 10 minutes set aside for the demo and any questions. You should expect the audience to have no background knowledge on the topic. A general outline for the final presentation is highlighted below:

- Introduction & Motivation: Similar to the project proposal guideline, *why is your project useful?* What problem is your project addressing?
- System Overview: Give a high level explanation of your system. A block diagram or image can be useful to illustrate to the rest of the class what you have made.
- Technical Section: Highlight one or two *key* aspects of your design. These can be parts you found interesting or particularly difficult to implement.
- Results: Include the baseline result that you proposed to finish as well as any interesting results or takeaways you had from the project(eg. videos, images, plots, numbers, etc).

We expect each team member to present a portion of their presentation.

4.4 Final Report

The final report should summarize your project as a whole. We expect to see an overview of what you proposed, and what you ended up finishing. The report should be thorough and give us a good idea of what your final system is and how you implemented it. At a minimum, you should include the following sections outlined below:

- **Introduction:** You should give an overview of what your project proposal was and what you wanted to finish, as well as what your actual final system is.
- **System Overview:** Give an overview of the system design (block diagram, images) and explain at a high level what each portion does and how they work together.
- **Detailed System Description:** Describe in detail what each portion of your system does. Highlight any specific design choices you took and why you picked those.
- **Results:** Include results (eg. plots, numbers, heatmaps, images) that help us understand what your system is capable of. You should explain the importance of each of the results you include in the report.
- **Issues:** Outline any issues you ran into that were unexpected. You can highlight algorithms or system designs that you tried but ended up not working. We expect you explain *why* it didn't work in addition to what you did to overcome these issues.
- **Links, Code:** You should include links to any material you used and your code repository.

This report should give us an idea of the path you took to finish your project this semester. Additionally, you can include more details and results that you are unable to include in your final presentation, or if some significant progress was made after the presentation. Only one person per group will be required to submit the report.

5 Timeline

Here are a few important dates to keep in mind regarding the projects deliverables:

- The project proposal is due **March 21, 2025** at 23:59.
- The progress report is due **April 18, 2025** at 23:59.
- The final presentation is on **May 27, 2025** from 15-17 in CE 12.
- The final demo is on **May 30, 2025** during the exercise session.
- The final report is due **June 6, 2025** at 23:59.