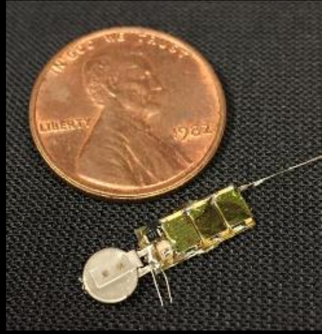
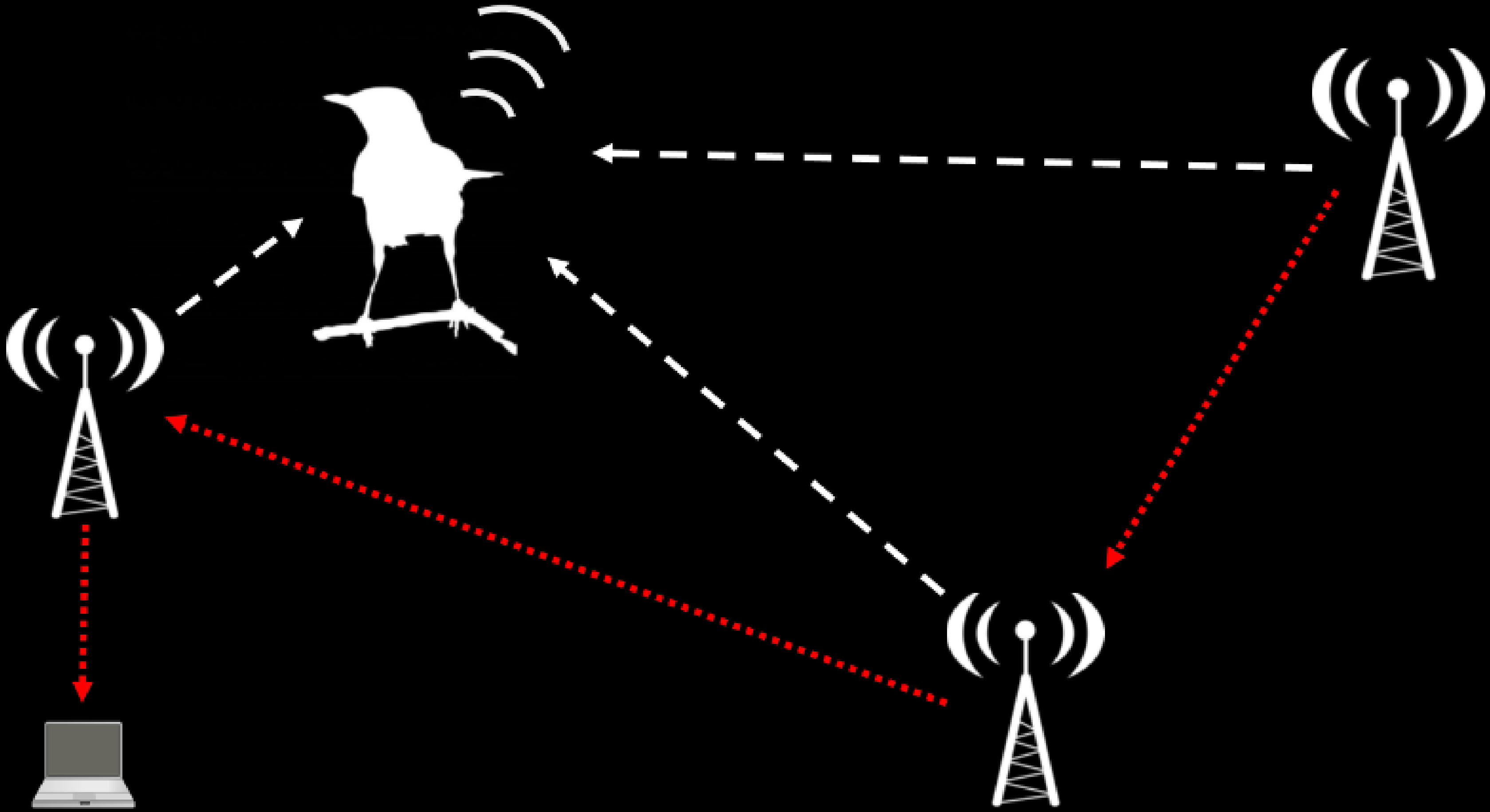
AMRUPT

(Animal Movement Research Using Phase-based Trilateration)





This week

1. What did/did not work last semester?
2. GitHub / Blackboard organization
3. Proposal preparation
   a) What is the plan for working on the proposal? Who does what? How will you coordinate?
   b) What is the scope of the problem for Spring 2018?
   c) What relevant resources have you found?
   d) Brainstorm multiple solutions
   e) Which solutions might be best?

Fall 2018 AMRUPT: What worked? What did not?

1. Equal input from all members important
2. Preparatory materials (e.g. slides, reports) submitted prior to meetings enables better discussion
3. Important not to get stalled while waiting for responses from others (e.g. TI forum moderators)
4. Important to have access to expertise
   a) Other student design courses/projects with embedded system design experience
   b) Drs. Kan, Molnar, Land, in Cornell ECE

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GitHub AMRUPT repository

1. Code: a place to store **all** materials
    a) Course materials: assignments, instructions, management plan
    b) Firmware: all code, organized by general purpose

Good documentation is essential!

In-line comments

```r
#' Create a complete ggplot appropriate to a particular data type
#'
#' \code{autoplot} uses ggplot2 to draw a particular plot for an object of a
#' particular class in a single command. This defines the S3 generic that
#' other classes and packages can extend.
#'
#' @param object an object, whose class will determine the behaviour of autoplot
#' @param ... other arguments passed to specific methods
#' @return a ggplot object
#' @export
#' @seealso \code{\link{ggplot}} and \code{\link{fortify}}
autoplot <- function(object, ...) {
  UseMethod("autoplot")
}
```

“ReadMe” file

Project Title

One Paragraph of project description goes here

Getting Started

These instructions will get you a copy of the project up and running on your local machine for development and testing purposes. See deployment for notes on how to deploy the project on a live system.

Prerequisites

What things you need to install the software and how to install them

```
Give examples
```

Installing

A step by step series of examples that tell you have to get a development env running

Say what the step will be

```
Give the example
```

And repeat

```
until finished
```

End with an example of getting some data out of the system or using it for a little demo

Running the tests

Explain how to run the automated tests for this system

Break down into end to end tests

Explain what these tests test and why

```
Give an example
```

GitHub AMRUPT repository

1. Code: a place to store **all** materials
    a) Course materials: assignments, instructions, management plan
    b) Firmware: all code, organized by general purpose
    c) Literature: resources from others
    d) System architecture: high-level diagram of current architecture
    e) Tests: empirical test results, simulation files and results
2. Issues: a list of all of the known goals of the project
    a) Special types: Questions, Enhancements
    b) Milestones: Phases of the project
3. Project: a tool for management of progress
    a) Columns: To do, In progress, In testing, Completed
    b) Ordered list of current issues, and their status

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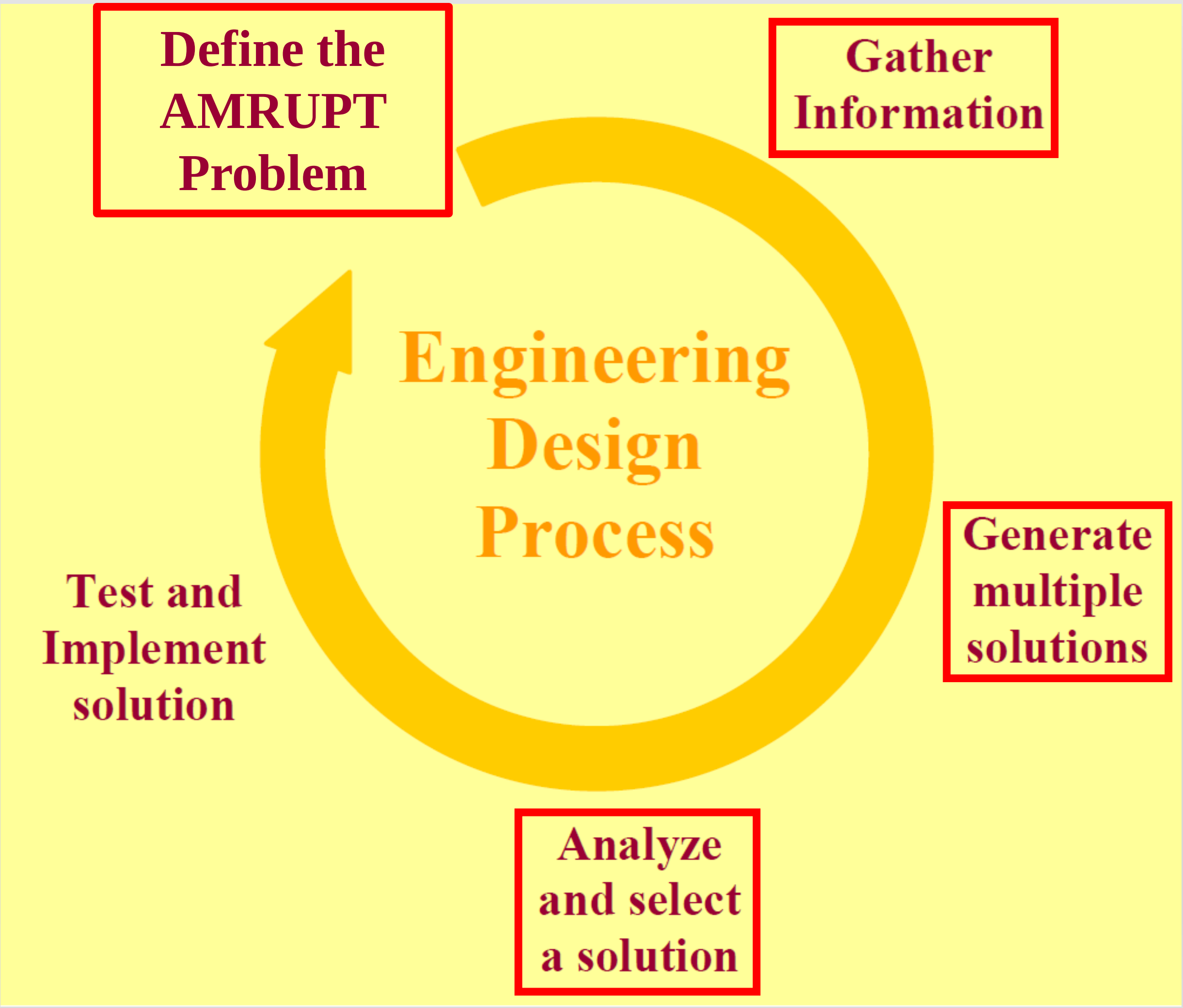
Proposal prep: Who does what? How will you coordinate?



Khandani, 2005

Project Proposal

Meeting notes on proposal structure (and who does what)

1. Executive summary (everyone coordinates)
2. Technical approach (everyone specializes on independent subsection, then integrates to make final proposal)
   a) Obtaining I/Q data (ESSENTIAL, define options then split subsections across people)
      i. Operation of RF switch / LFM / or LO-demod-mixer, depending on which option chosen
      ii. CC1310 firmware
      iii. Simulate required I/Q sample rates, bit-depths, susceptibility to noise for different solutions (e.g. LFM synchronization of mult. CC1310s, oversampling with RF switch on one CC1310, demod / mixer option)
      iv. Empirical test results (develop standardized tests, identify what needs to be tested)
   b) Data transfer to RPi (IMPORTANT, but secondary to Obtaining I/Q data)
   c) Ground-node to Mobile-node communication protocol (LOW priority, though ultimately important)
   d) Use figures judiciously (especially flow diagrams)
3. Literature search (each is responsible for literature on own subsection)
   a) Guerin, Jackson, Kelly good ref for whole-system architecture

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Meeting notes on project scope

1. What is the desired functionality of the Spring 2018 AMRUPT protype?
    a) Operates with a single tag
    b) Only a single receiver
    c) Detects Angle of Arrival (AOA)
        a) Also detects distance? (Highly unlikely)
            i. Via triangulation (requires multiple ground nodes; unlikely, but would be GREAT)
            ii. Via phase-integer-disambiguation (requires *phase III* approach [i.e. multi-frequency signals]; highly unlikely)
2. Other deliverables?
    a) Simulations demonstrating what's needed to reconstruct RF signal, to generate sufficiently accurate AOA estimates
    b) Empirical test results

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Gather pertinent information

1

Indoor Passive Device Ranging by Low-directivity Antennas with Centimeter Precision

Yunfei Ma, *Student Member, IEEE,* Xiaonan Hui, *Student Member, IEEE,* Pragya Sharma, *Student Member, IEEE,* and Edwin C. Kan, *Senior Member, IEEE*

***Abstract*—Compared to the high-directivity patch and horn**

synthetic aperture radar (ISAR) techniques to form a large

Accurate Indoor Ranging by Broadband Harmonic Generation in Passive NLTL Backscatter Tags

Yunfei Ma, *Student Member, IEEE*, and Edwin Chihchuan Kan, *Senior Member, IEEE*

***Abstract*—Millimeter-precision meter-distance real-time indoor ranging capability is challenging due to multipath reflections in a rich scattering environment. Traditional continuous wave (CW) phase-based ranging methods, although simple and flexible, are vulnerable to phase offsets and interferences. We improve the previous CW approach by passive broadband harmonic nonlinear-transmission-line (NLTL) tags. Since phase information is now contained within the second harmonic rather than the fundamental frequency, interferences and phase errors caused by direct reflections of the interrogating signal are greatly reduced. By the broadband property of NLTL, a heuristic multi-frequency CW method is formulated to resolve the phase integer ambiguity and to further improve ranging accuracy and robustness even under large phase errors. We present theoretical and simulation analyses, followed by experimental verification.**

reader attempts filtering out these interferences as dc offset after demodulation, but has the following difficult issues.

1) Large interference can cause a jamming problem in receivers without sufficient dynamic range.
2) Phase noise in unknown interferences raises the noise floor dramatically, which decreases receiver sensitivity and limits the reading range [10].
3) As the input power level at the receiver approaches the 1-dB compression point, the phase shift in the receiving channel becomes more power dependent due to nonlinearities, which makes phase offset calibration difficult [11].
4) In an environment with moving scatterers such as the

3D Real-time Indoor Localization via Broadband Nonlinear Backscatter in Passive Devices with Centimeter Precision

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ABSTRACT

ror was 3.5 *cm* in the indoor environment. Presently, the

The Optimization for Hyperbolic Positioning of UHF Passive RFID Tags

Haishu Ma, Yi Wang, Kesheng Wang, and Zongzheng Ma

***Abstract*—This paper presents a fine-grained positioning method for radio frequency identification (RFID). The proposed method applies hyperbolic positioning to locate ultrahigh frequency passive RFID tags. In our design, finding the tagged object's location is formulated as an optimization problem. Phase values, collected by the moving antenna, are exploited to achieve the optimal solution. The intuition of hyperbolic positioning lies in that the difference of distances from a target tag to two antennas can be inferred from phases. When integrating hyperbola curves together, optimization method can be performed to achieve the object's location. Particle swarm optimization is then applied to enhance computational ability. For random phases, polynomial regression is employed to model the relationship between phase values and distances. We implement a prototype of hyperbolic positioning optimization to pinpoint the RFID tag's location**

I. Introduction

RADIO frequency identification (RFID) has been widely adopted in supply chain management and warehousing for the purpose of automatic identification and tracking of objects. A typical RFID system is made of tags, reader, and antenna. RFID reader can communicate with the tag in an electromagnetic field. Whenever a tag enters the interrogation region, it can be detected by the RFID reader [1]. Depending on the power output of reader and the types of tag, the read range of RFID system can be as far as tens of meters [2]. Under many circumstances, it is not enough to only identify whether the RFID-tagged object is within the read range. For example, a robot arm can reach for a target object, pick it

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For next week

1. Project proposal due Monday February 19th!

2. We will discuss your proposed management plan