Initial Project Proposal
Raytheon Team
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Introduction

The Raytheon preternship team, Konrad Rozanski and Matthew Huebner, are deciding to develop a ground antenna designer program. This project will satisfy the increasing need to size and quantify the needs of satellite ground stations due to increases in the number of small satellites. This project will hopefully optimize and recommend the ground antenna size at a station based on some inputs. These inputs would be the satellite's orbit and the amount of data needed to transmit per ground contact. Using these inputs the program would also calculate the necessary downlink throughput, duration of ground contact, and some extra information on the radio frequency signal strength and antenna size needed for a ground station.

Definitions

Satellite Ground Station: A building on the ground that is set up to take in data from a satellite and transmit data back to a satellite if necessary.

Downlink throughput: The amount of data being passed from the satellite to the ground station. This is closely related to bandwidth.

Duration of Ground Contact: The amount of time that a ground station can communicate with a satellite.

Satellite Orbit: The path a satellite traces in the sky.

Azimuth: The direction of a celestial object from an observer on the ground

Pointing Angle: The angle the antenna makes with the horizontal

Design Considerations

(Assumptions, Project Requirements, Initial Risks and Alternatives, Description of Artifacts, Required Items)

Assumptions

- The project will be done in either C or C++(Unless it is deemed to be easier to use another language)
- The location of a satellite ground station is fixed.
- If there are available libraries that can help solve this issue they will be implemented
- A satellites orbit is fixed

Project Requirements

- The input the project needs is a fixed satellite orbit and and the amount of data needed to transmit per ground contact.
- Either by using pre-existing libraries or by manually doing computations, the project needs to compute the necessary downlink throughput, duration of ground contact, required antenna size, and radio frequency signal strength.
- This project needs to be completed by December 19th, and reach objectives along the way.

Initial Risks and Alternatives

- Constructing ground stations and putting satellites into orbit are huge monetary commitments for Raytheon. Making mistakes is very costly.
- Our computations need to be precise.
- An alternative could be doing computations by hand or finding some sort of pre-existing software or libraries rather than starting from scratch.
- Mistakes aren't easy to undo after a satellite is in orbit and a ground station is constructed.

Specification Items

-Inputs used to describe the whole system

1.0 Satellite orbit

1.1 Amount of data needed to transmit per ground contact

-Things needed to be established

2.0 Location of satellite ground station

2.1 Azimuth of satellite ground station

2.3 Pointing Angle of satellite ground station

Requirement Items

1.0 Time satellite is in contact with ground station

1.1 necessary downlink throughput

1.2 required antenna size

1.3 radio frequency signal strength

Description of Artifacts

-Scheduling

Matthew Huebner

- I am the athletics commissioner for my dorm(1 hrs weekly)
- I run my dorms signature event on November 3rd(1-4 hrs weekly until event)
- I have a large midterm project for Logic Design due early November(~10 hrs weekly expected)

- ND Rocket Team(3-4 hrs weekly)
- Other Classes(4-8 hrs weekly)

Konrad Rozankski
- SAE Hybrid → 3-4 hrs weekly
- Robotics Research → 4-6 hrs weekly
- Club Soccer → 2-3 hrs weekly
- Engineers Without Borders → 2-3 hrs weekly
- Student Manager for Soccer → 2-3 hrs weekly
- Other Classes → 4-8 hrs weekly

-Value
- This project brings value in that it allows Raytheon to easily compute what specifications they want to assign to their ground stations.
- Hopefully, this can be used to double check measurements so that no costly errors are made.
- Mr. Mallinger's time is deeply respected and the goal is to bring a project to him that shows the appreciation we have of the time he is giving to us.
- Raytheon isn't taking on too much risk for this project, the team is unpaid; however, Mr. Mallinger is offering his time so this project does need to produce results.

-Architecture for Implementing the Requirements
- Mr. Mallinger provided papers from industry on the constraints and inner workings of the problem we are trying to solve. Our initial plan is to go over these articles in more detail in order to understand the scope of the problem.

-Items still needed
- Possible libraries to help solve the problem
- Deeper understanding of C and other languages to determine the best language to solve this problem.

-Other

- This project may take a lot of computing power; however, we do not expect this to be an issue based on the strength of computers today.
- Safety issues arise after the program is implemented. This project is pure code, so it is hard for personal safety issues outside of stress from timelines and difficult schedules.
- The user interface may be in terminal, but it would be ideal to make some sort of GUI that would make the project much easier to use.

Traceability Matrix

Requirement Items

Spec Items	1.0	1.1	1.2	1.3
1.0	x			
1.1	x			
2.0		x	x	x
2.1		x	x	x
2.3		x	x	x

Goals and Timeline

Finish Reading and comprehending Mr. Mallinger's articles	October 21st
Write code for the first Review	November 10th
Code Review 1	November 11-15
Write code for the second Review	November 17th
Code Review 2	November 18th-20th
Develop Class Powerpoint	November 20th-24th
Submit PowerPoint Draft	November 25th
Prepare code for third Review	December 1st
Code Review 3	December 2nd-6th
Prepare final iteration of project	December 10th
Final Project Due	December 16th-19th