# Synthetic Aperture Radar Imager

## Team 18

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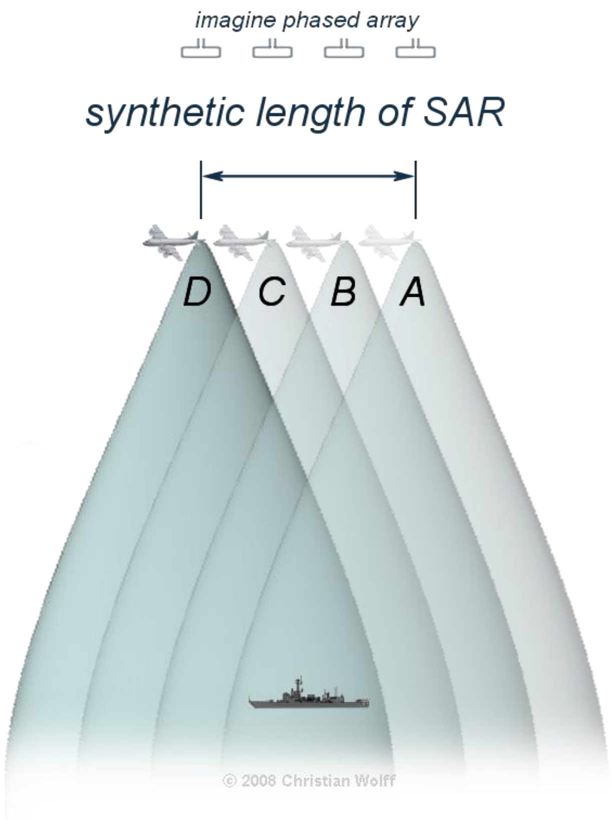
DATE: 10/22/2015

# Outline

- Introduction to SAR
- Last Year: Overview
- Project Description
- Design Concepts
- Design Evaluation
- Risks and Challenges
- Schedule and Future Plans

# SAR Application





[1]

# High-Resolution SAR Image

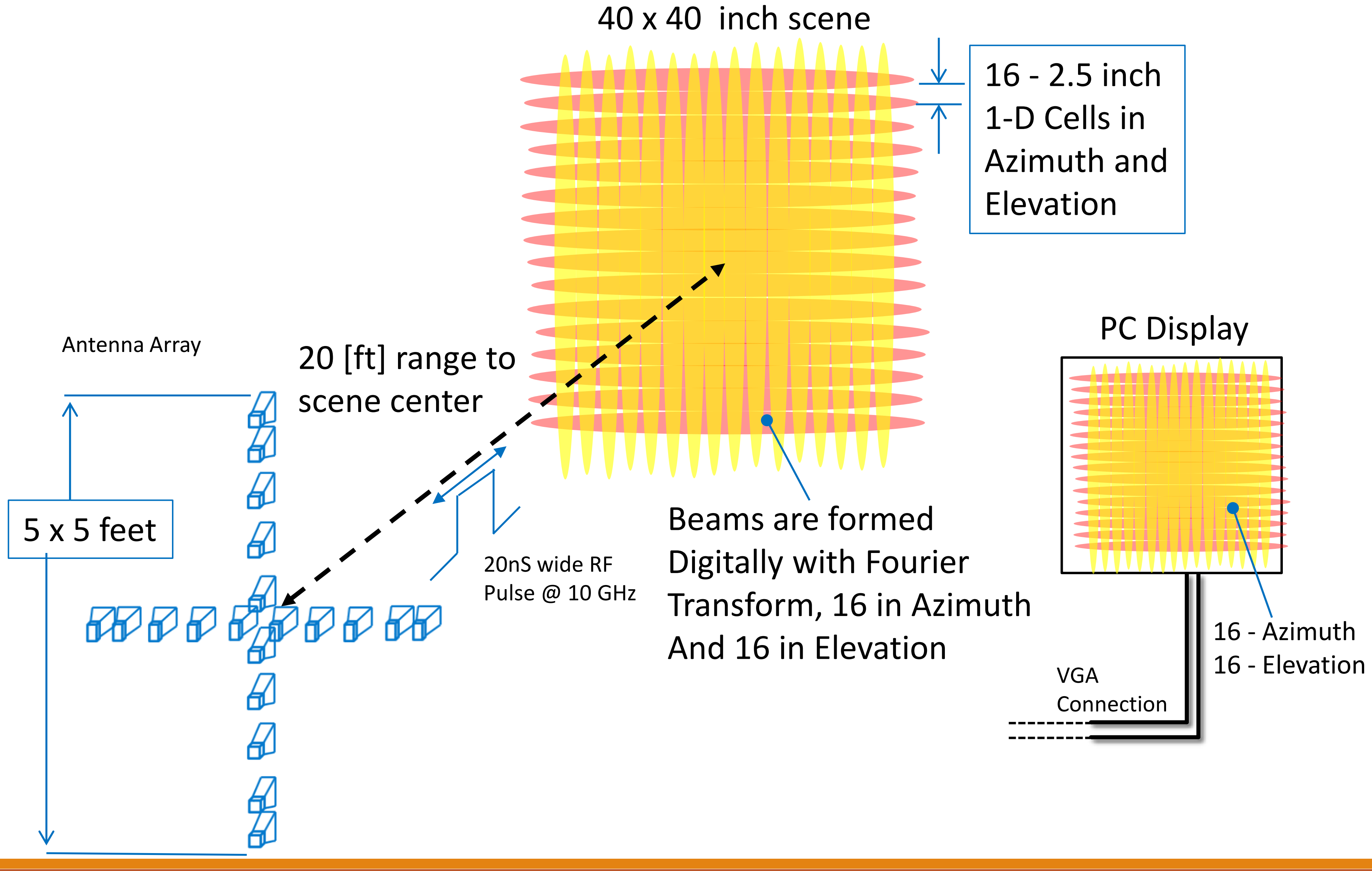

[2]

# Project Proposal

- Create a Synthetic Aperture Radar
  - Weapons detection for homeland security
  - Stationary
  - Low resolution
  - Concealable
  - Low Cost
  - Relatively mobile


[3]

# Imaging Radar Operational Concept

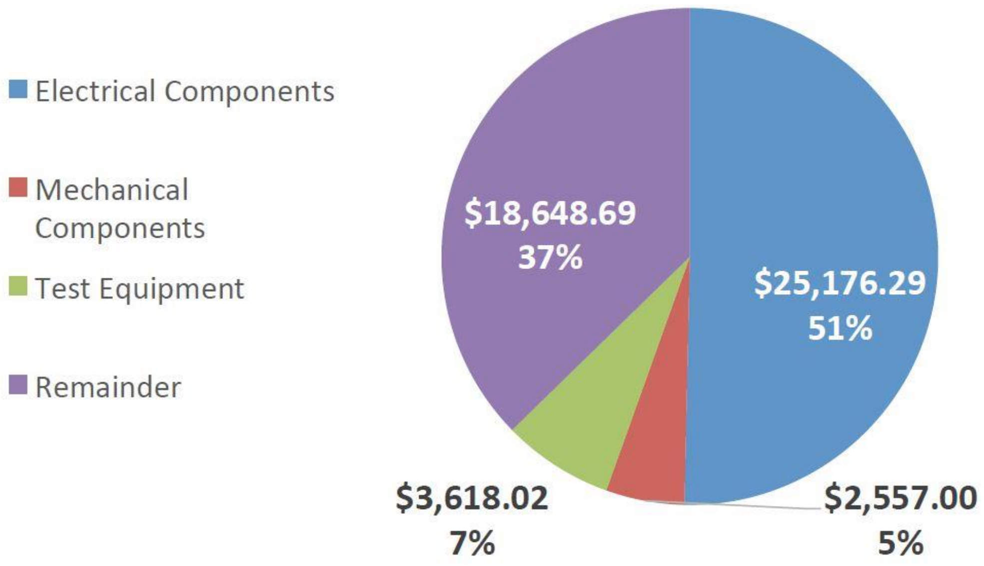



[4]

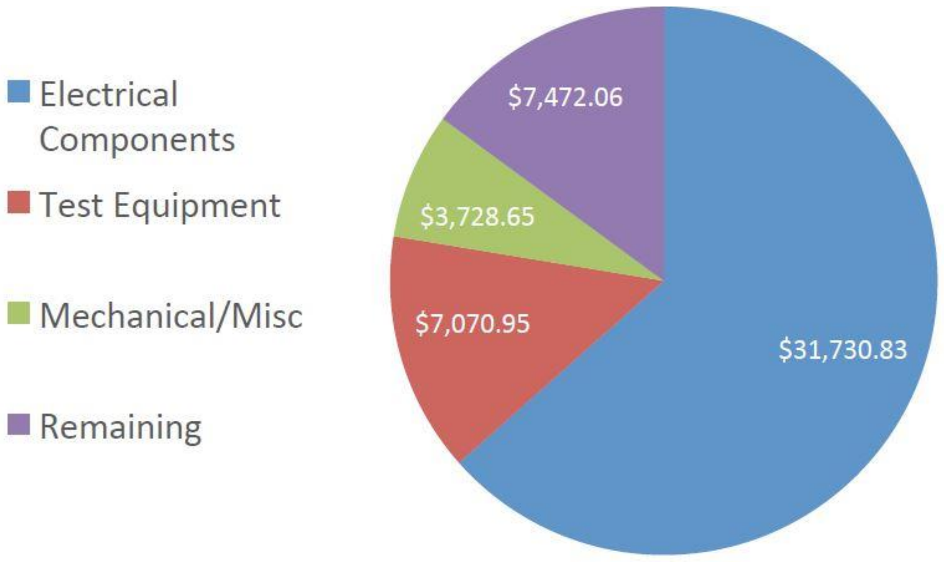
# First Generation: Overview

- Able to produce limited results
- Electrical components and equipment rental consumed most of the budget
- Fabrication issues
  - 3 week delay
  - Poor craftsmanship
  - Additional modifications needed
- Needs Improvement:
  - Stability
  - Weight
  - Horn adjustment

# First Generation: Budget




Initial Estimate




Final Budget [5]

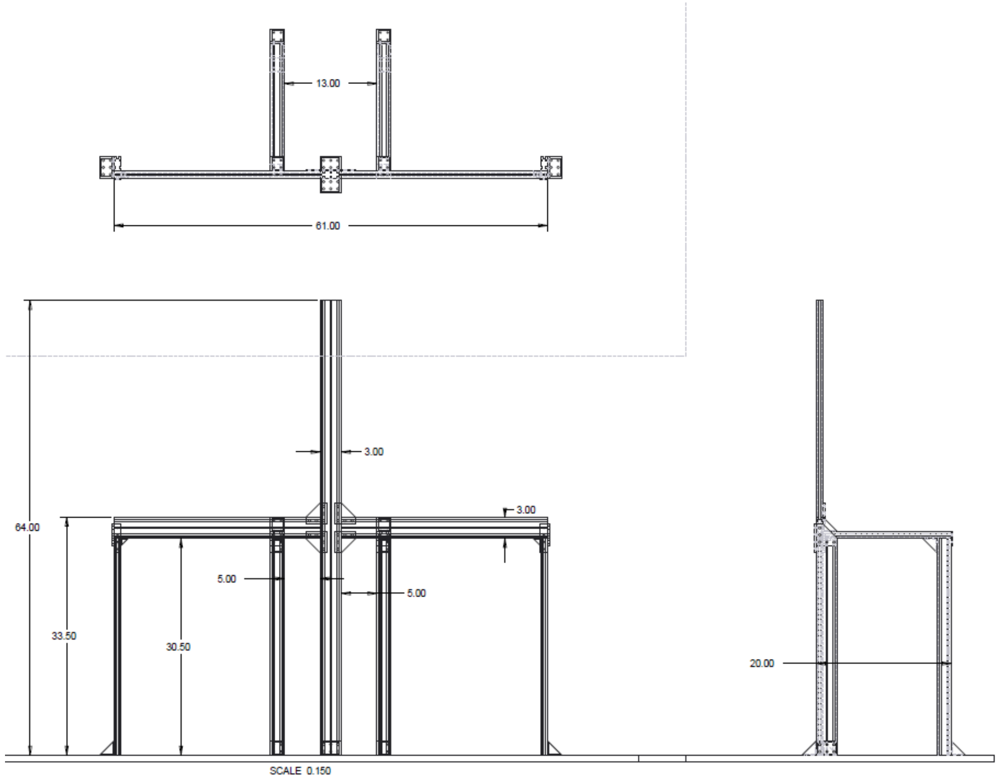
# Second Generation: Focus

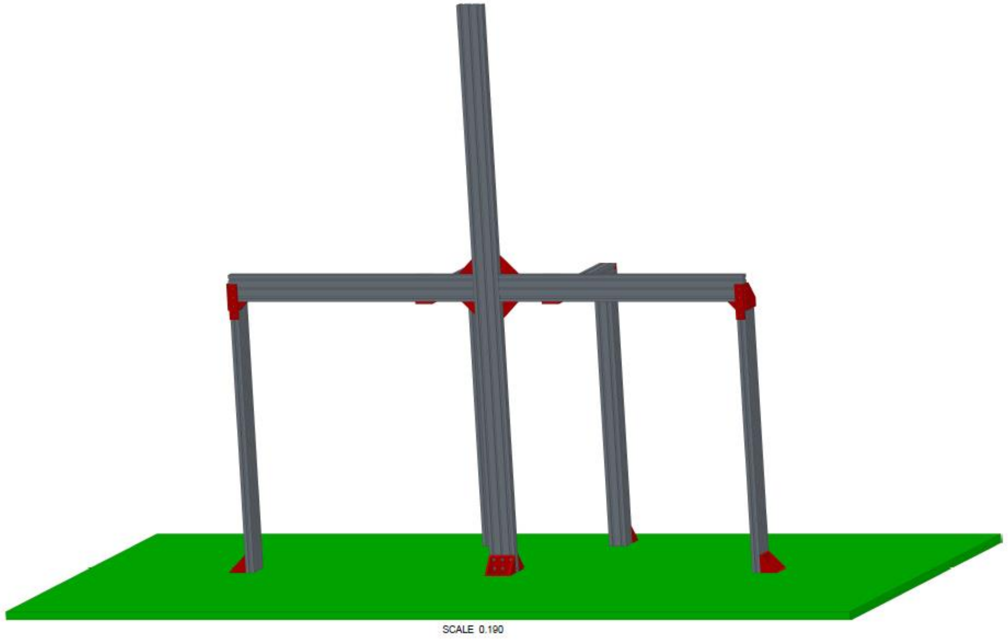
- Mobility
  - Attach wheels
- Weight
  - < 80 lbs
- Horn Adjustment
  - Aligned within 1ft circle at 20ft away
- Stability
  - Movement causes artificial phase shift
  - Max movement: 1/72 inch
- Cost
  - Minimize

# Concept Generation

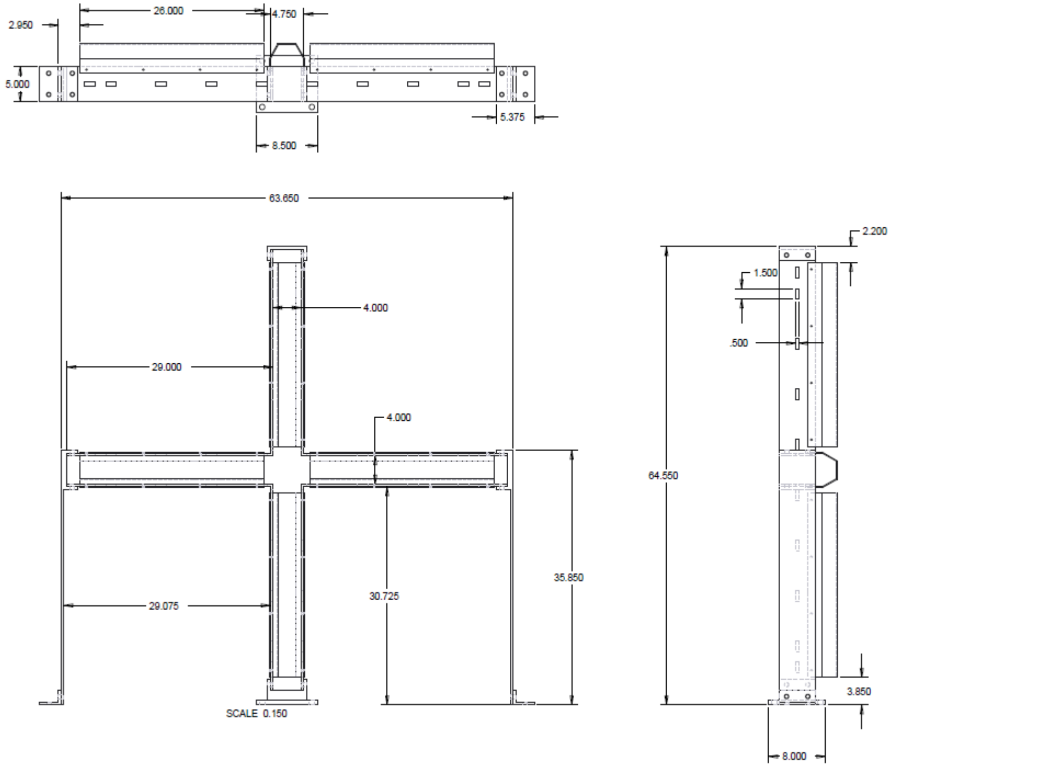
- Project was divided into multiple parts:
  - Structure
  - Horn holders
  - Base
  - Hardware Box (EE Team)

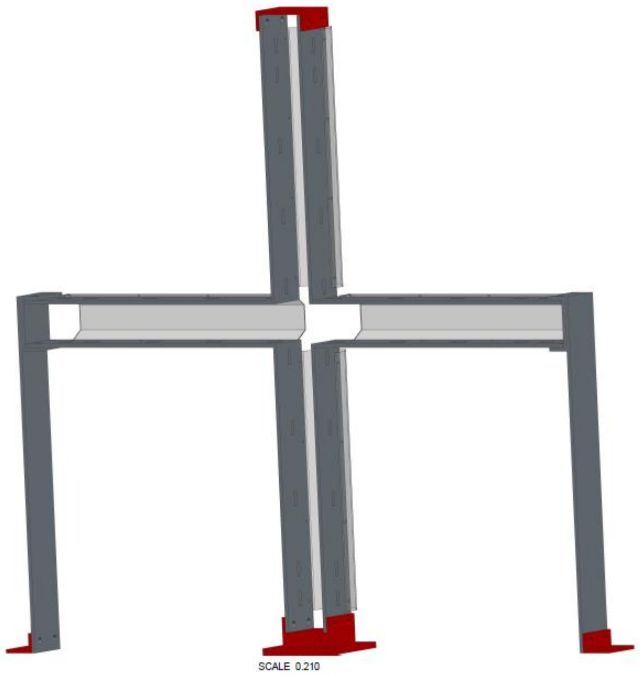
# Design Concepts – Structure Design A (80-20)



# Design Concepts – Structure Design B (Fabricated Al)



# Concepts Evaluation – Structure Pros

## DESIGN A (80-20)

- Modularity makes it easy to assemble
- Provides limitless translational horn placement along the beam
- Simple to order and machine
- Lightweight compared to equivalent solid cross section

## DESIGN B (FABRICATED AL)

- Thicker cross section allows more sturdiness and deformation resistance
- Larger bolts and hardware can be used in assembly
- Larger surface area for ground contact

# Concepts Evaluation – Structure Cons

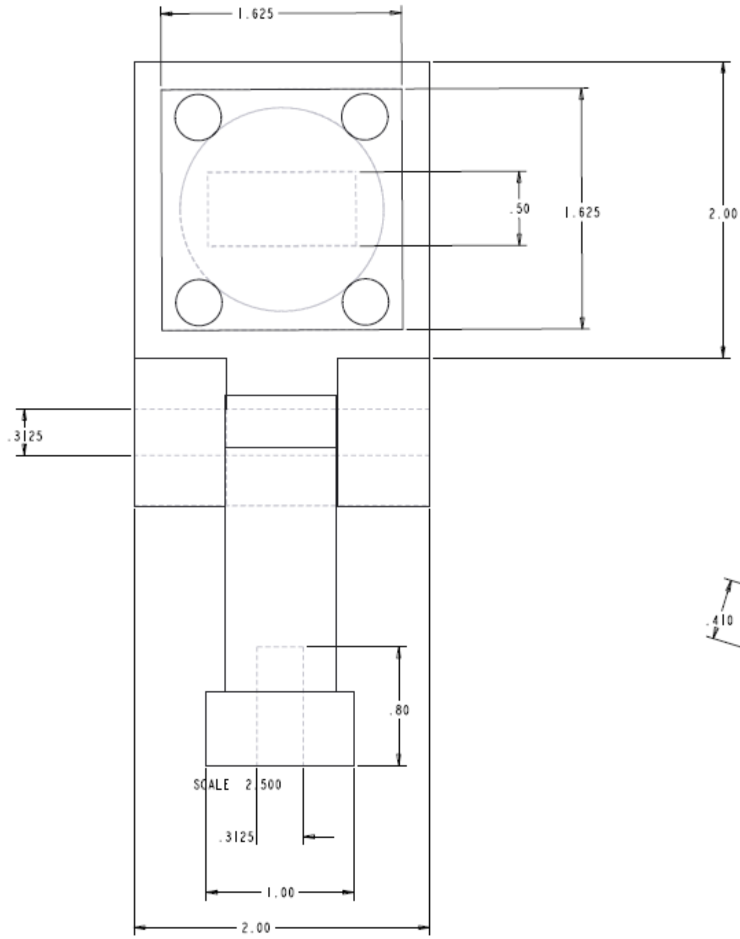
### DESIGN A (80-20)

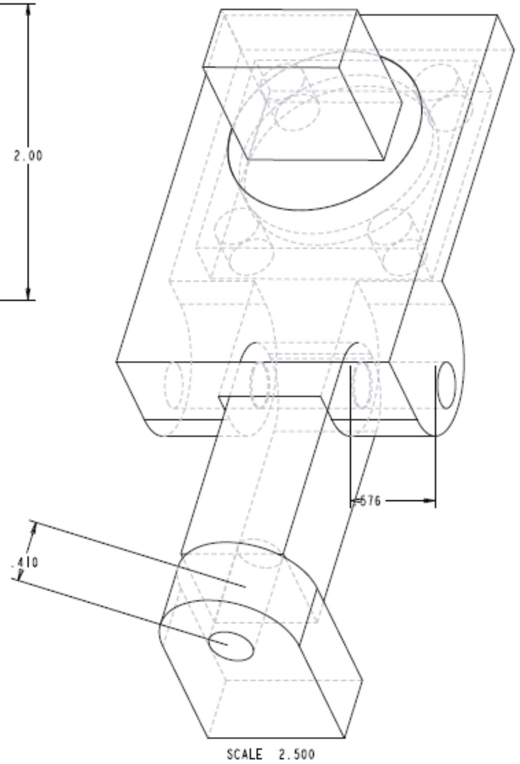
- Fasteners might not carry weight or force well
- Offers little waveguide/horn protection to the elements
- Component box could deform support beams

### DESIGN B (FABRICATED AL)

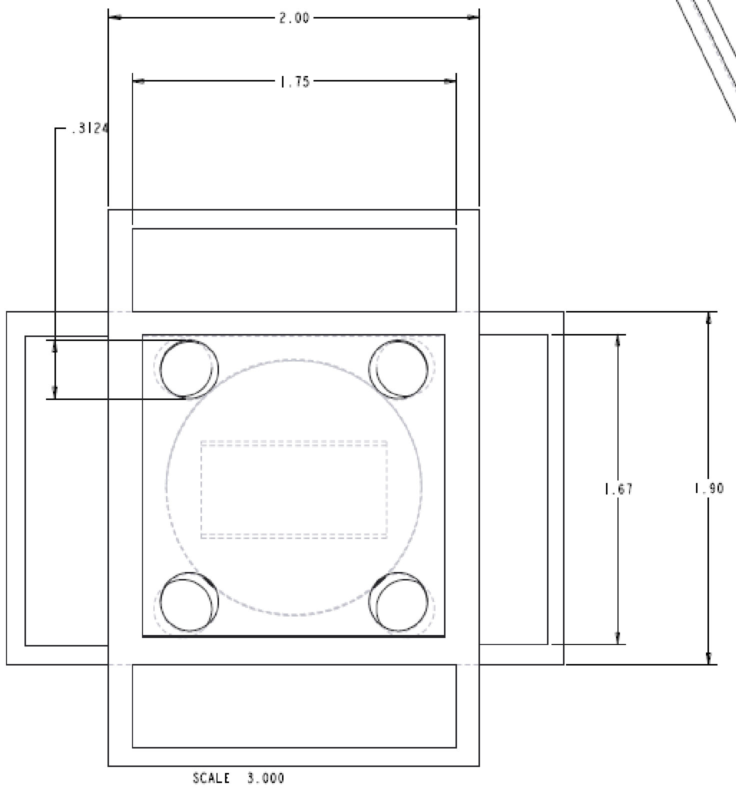
- Additional time to manufacture and assemble
- More weight than 80-20
- Back mount of component box causes additional stress on arms
- More expensive

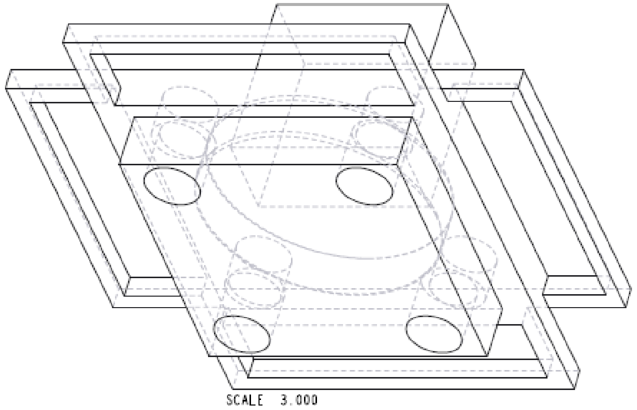
# Design Concepts – Horn Holder Design A (Articulating Arm)



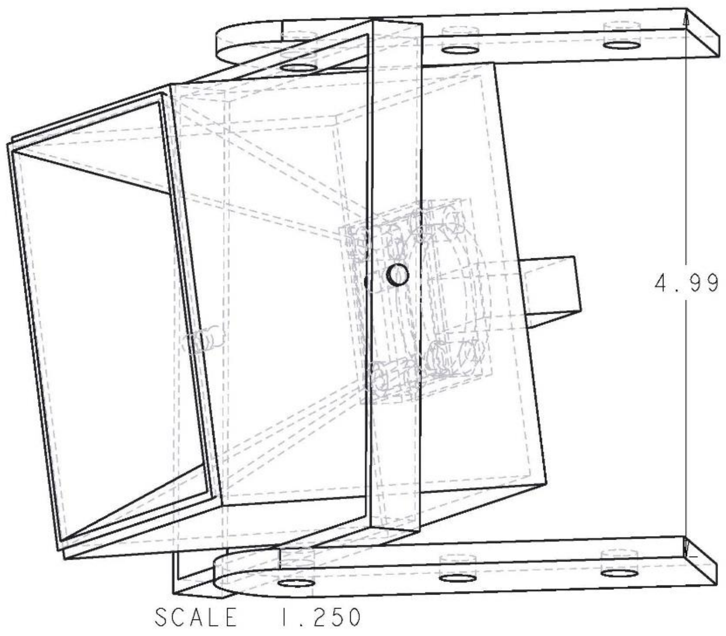



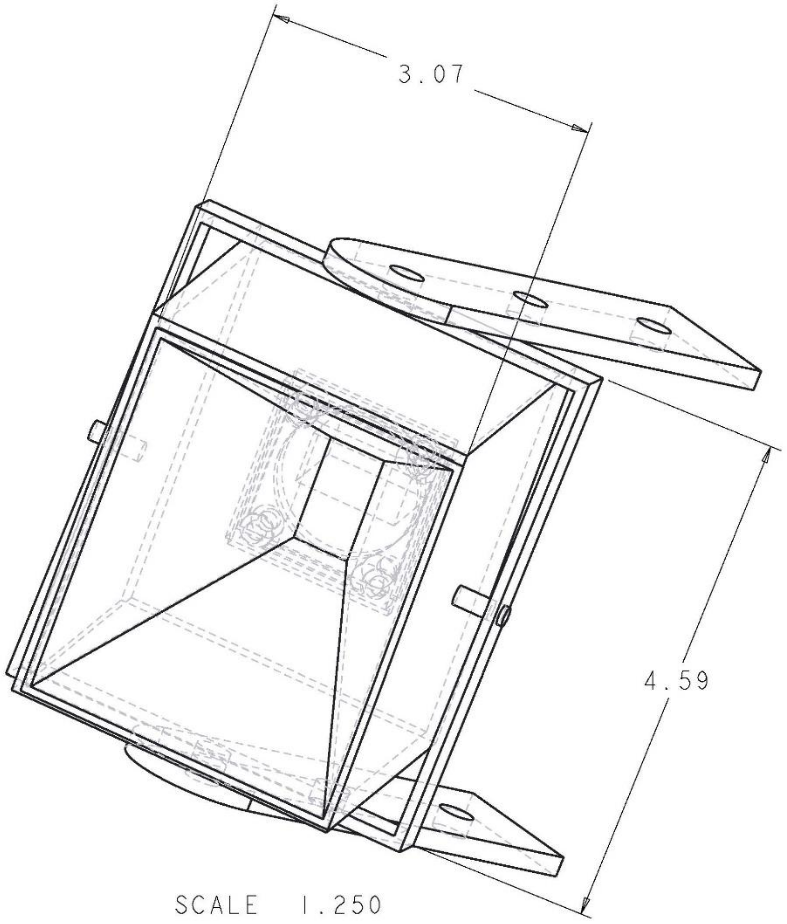
# Design Concepts – Horn Holder Design B (Handle Tilt)



# Design Concepts – Horn Holder Design C (Covered Tilt)



# Concepts Evaluation – Horn Holder Pros

### DESIGN A (ARTICULATING ARM)

- Simplest of designs
- Has proven concept (computer monitor model)

### DESIGN B (HANDLE TILT)

- Easy to adjust manually
- Rotation one point on the rear

### DESIGN C (COVERED TILT)

- Cover allows for attachments (laser alignment)
- Rotation about the center
- Modeled in compatibility with 80/20 structures

# Concepts Evaluation – Horn Holder Cons

## DESIGN A (ARTICULATING ARM)

- Pivots are not about the center or in line
- Favors mounting to the top of structure bar
- Horns on vertical column will be a challenge

## DESIGN B (HANDLE TILT)

- The method of position locking is unclear
- Challenging to use handle bars and attach to structure

## DESIGN C (COVERED TILT)

- Structure is quite complex
- Cover may affect antenna readings

# Continued Evaluation

- Continue sponsor and ECE team communication
  - Optimize structure and horn holder design
  - Adding new constraints upon feedback
- Cost vs Benefit analysis
- Submit final suggestion to sponsor
- Base platform concept generation
  - Dependent on final structure design

Aluminum Platform Truck:
McMaster-Carr ($450) [6]

# Prioritizing Engineering Characteristics

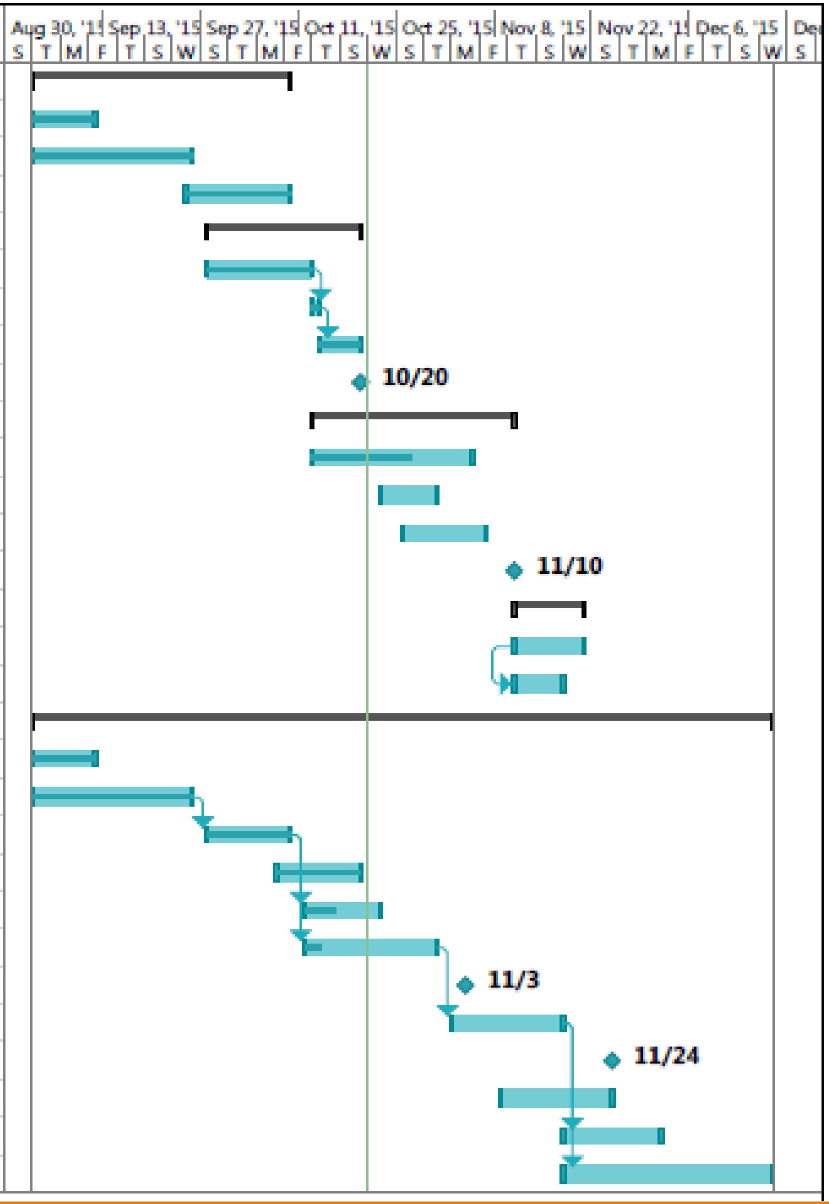
| Customer Requirements | Customer Importance | Structural Thickness | Material Used | Locking Mechanism | Axis Adjustability | Mounting Mechansim | Base size | Height Above Ground | Number of Crossbeams | Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Engineering Charateristics | | | | | | | | |
| Increased Stability | 5 | 9 | 3 | 6 | | 3 | 9 | 6 | 6 | |
| Lower Weight | 5 | 3 | 9 | | | | 6 | 3 | 6 | 9 |
| Good Images | 5 | | | 6 | 9 | 9 | | 3 | | |
| Better Horn Mounting | 5 | | | 9 | 9 | 9 | | | | |
| Cost | 4 | 3 | 6 | 3 | | 3 | 3 | | 3 | |
| Hardware Box | 2 | 3 | 6 | | | | | | | 3 |
| Portability | 2 | | 6 | | | | 9 | 6 | | 9 |
| Score | | 18 | 30 | 24 | 18 | 24 | 27 | 18 | 15 | 21 |
| Relative Weight | | 78 | 108 | 117 | 90 | 117 | 105 | 72 | 72 | 69 |
| Rank | | 6 | 3 | 1 | 5 | 1 | 4 | 7 | 7 | 9 |

**Most Important EC's:**

1. Mounting Mechanism
1. Locking Mechanism
3. Material Used
4. Base Size
5. Axis Adjustability
6. Structural Thickness
7. Height Above Ground
7. Number of Crossbars
9. Weight

# Schedule

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | **Planning** | **27 days** | **Thu 9/3/15** | **Fri 10/9/15** |
| 2 | Schedule Regular Meetings | 7 days | Thu 9/3/15 | Fri 9/11/15 |
| 3 | Agree on Scope of Work with Sponsor | 17 days | Thu 9/3/15 | Fri 9/25/15 |
| 4 | Project Plans and Product Specs | 11 days | Fri 9/25/15 | Fri 10/9/15 |
| 5 | **Concept Creation** | **16 days** | **Mon 9/28/15** | **Tue 10/20/15** |
| 6 | Preliminary Ideas | 11 days | Mon 9/28/15 | Mon 10/12/15 |
| 7 | Refine/Eliminate Ideas | 1 day | Tue 10/13/15 | Tue 10/13/15 |
| 8 | Detailed Designs | 4 days | Wed 10/14/15 | Mon 10/19/15 |
| 9 | Propose Concepts to Sponsor | 0 days | Tue 10/20/15 | Tue 10/20/15 |
| 10 | **Design Selection** | **21 days** | **Tue 10/13/15** | **Tue 11/10/15** |
| 11 | CAD Modeling | 17 days | Tue 10/13/15 | Wed 11/4/15 |
| 12 | Failure Modes Effects Analysis | 6 days | Fri 10/23/15 | Fri 10/30/15 |
| 13 | Finite Elements Analysis | 10 days | Mon 10/26/15 | Fri 11/6/15 |
| 14 | Propose Final Design | 0 days | Tue 11/10/15 | Tue 11/10/15 |
| 15 | **Procurement** | **8 days** | **Wed 11/11/15** | **Fri 11/20/15** |
| 16 | Bill of Materials | 8 days | Wed 11/11/15 | Fri 11/20/15 |
| 17 | Purchase Orders | 5 days | Wed 11/11/15 | Tue 11/17/15 |
| 18 | **Deliverables** | **76 days** | **Thu 9/3/15** | **Thu 12/17/15** |
| 19 | Code of Conduct | 7 days | Thu 9/3/15 | Fri 9/11/15 |
| 20 | Needs Assessment | 17 days | Thu 9/3/15 | Fri 9/25/15 |
| 21 | Project Plans and Product Specs | 10 days | Mon 9/28/15 | Fri 10/9/15 |
| 22 | Initial Web Page Design | 8 days | Thu 10/8/15 | Mon 10/19/15 |
| 23 | Midterm Presentation I | 9 days | Mon 10/12/15 | Thu 10/22/15 |
| 24 | Midterm Report I | 15 days | Mon 10/12/15 | Fri 10/30/15 |
| 25 | Peer Evaluation | 0 days | Tue 11/3/15 | Tue 11/3/15 |
| 26 | Midterm Presentation II | 12 days | Mon 11/2/15 | Tue 11/17/15 |
| 27 | Peer Evaluation | 0 days | Tue 11/24/15 | Tue 11/24/15 |
| 28 | Final Web Page Design | 12 days | Mon 11/9/15 | Tue 11/24/15 |
| 29 | Final Design Poster Presentation | 10 days | Wed 11/18/15 | Tue 12/1/15 |
| 30 | Final Report | 22 days | Wed 11/18/15 | Thu 12/17/15 |



# Future Plans

- Regular meetings with group, EE team, and sponsor
- Conduct Failure Modes Effects Analysis (FMEA) on designs
- Design selection
- Propose final design
- Make Bill of Materials
- Submit Purchase Order

# Summary

- Review of SAR
- Review of last year's final product
- Project objectives
- Generate design concepts
- Prioritize engineering characteristics
- Proposed course of action for determining final design
- Discussed future plans

# References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