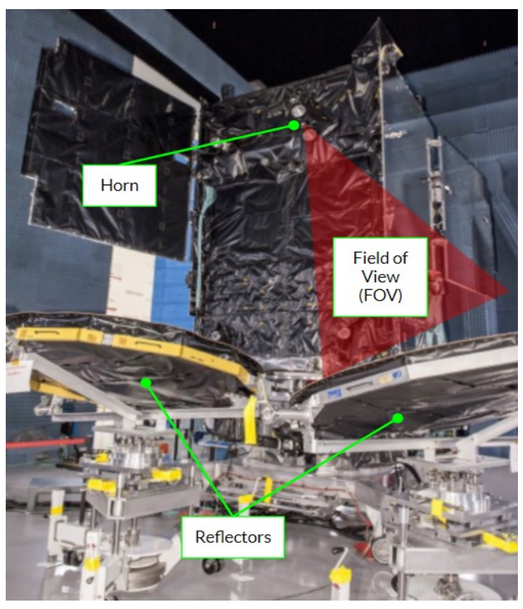
Field of View Tool

Team Members: Adriana Aldana, Aaron Lockett, David Torres, Kevin Luu, Sevag Baboomian
Faculty Advisor: Dr. Everardo Hernandez
Boeing Liaisons: Mackenzie Mason, Carrie LaPonza, Jose Armenta
Technical Advisor: Ronald Sobchik
Departments of Mechanical Engineering (ME) and Electrical and Computer Engineering (ECE)
College of Engineering, Computer Science, and Technology
California State University, Los Angeles

BACKGROUND

Accurate assembly of signal-generating horns on satellites involves manual laser-tracker measurements to verify that these horns have a clear, direct field of view (FOV) of the reflectors that they are pointed towards. CAD model comparison is used for additional verification.



OBJECTIVE

Develop automated, portable system for FOV verification that:

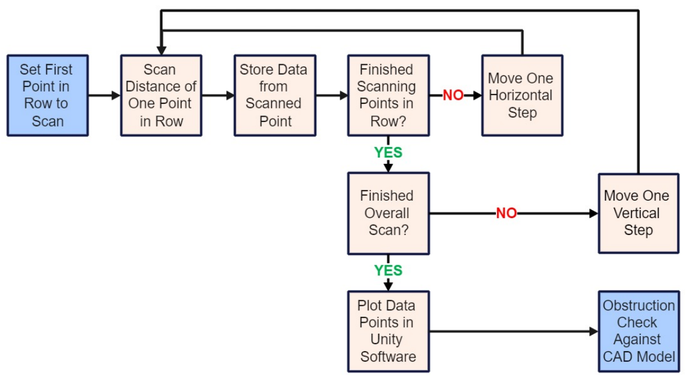
1. Self-orients and self-aligns to horn FOV path
2. Detects obstructions in horn FOV path
3. Verifies alignment of horn to reflector

SYSTEM REQUIREMENTS

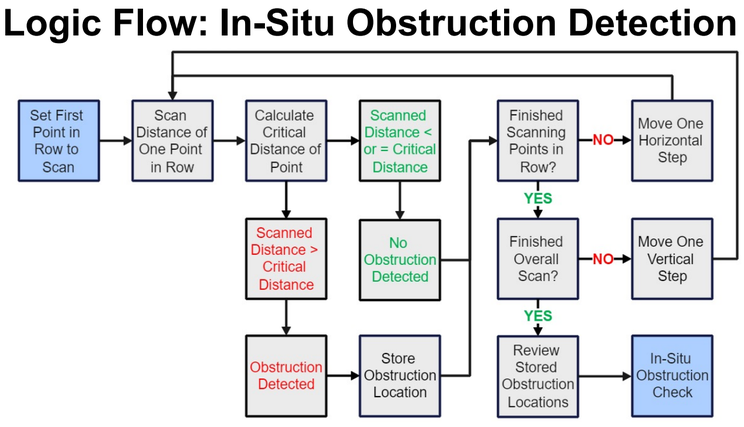
#	Requirement	Production-Level Model Capability	Compliance
1	No foreign object debris (FOD)	Aluminum-based design	Compliant
2	Electrostatic discharge (ESD) - sensitive, non-fibrous materials	Antistatic (ESD) acrylic housing	Compliant
3	No RF/Bluetooth emissions	Analog electronics	Compliant
4	Portable and mobile	Wheels, swivel handle, and batteries	Compliant
5	Technician can input FOV angle	Button pad to input FOV angle	Compliant
6	Automated FOV Tool positioning	Manual positioning required	Non-Compliant
7	Stores scan for CAD verification	Stores 3D map of scan	Compliant
8	No contact with vehicle	Positioned away from vehicle	Compliant
9	35 lbs or less	34.5 lbs	Compliant
10	Max. 3-ft long x 2-ft wide	1.2-ft long x 1-ft wide	Compliant
11	Scan heights from 2-ft to 10-ft	135º vertical sweep, 39-ft range	Compliant

OVERALL DESIGN APPROACH

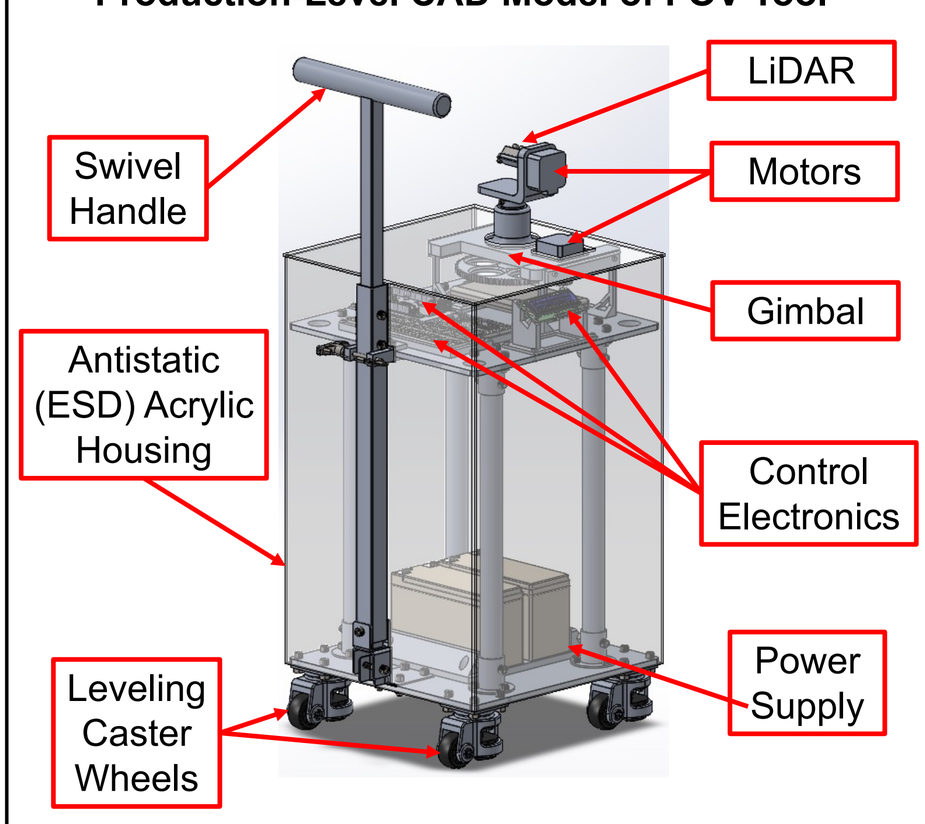
Logic Flow: CAD Model Obstruction Detection



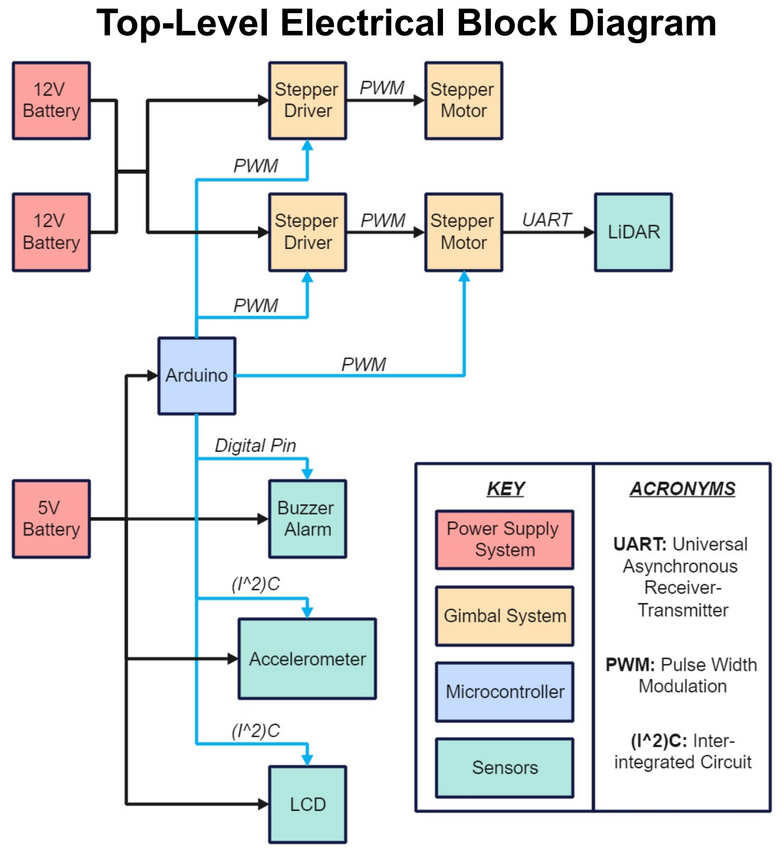
Logic Flow: In-Situ Obstruction Detection



Production-Level CAD Model of FOV Tool

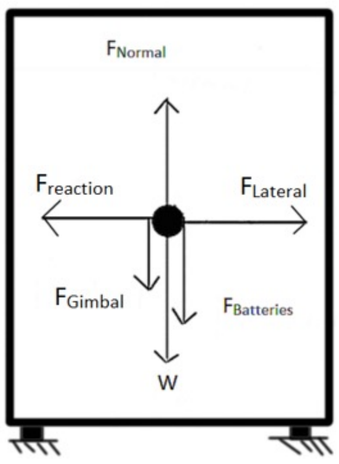


Top-Level Electrical Block Diagram

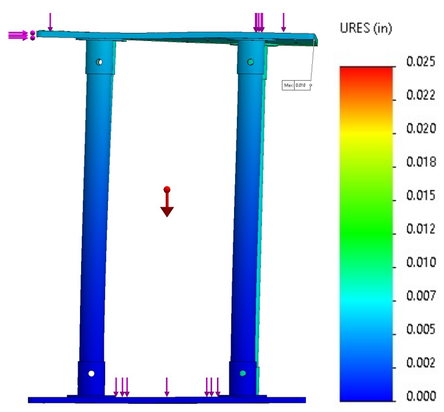


MECHANICAL ANALYSIS

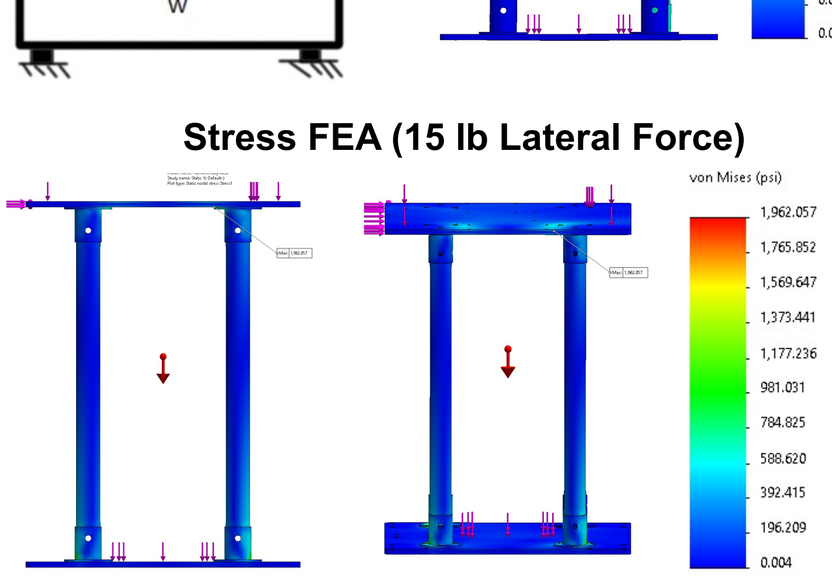
Displacement FBD (15 lb Lateral Force)



Displacement FEA (15 lb Lateral Force)

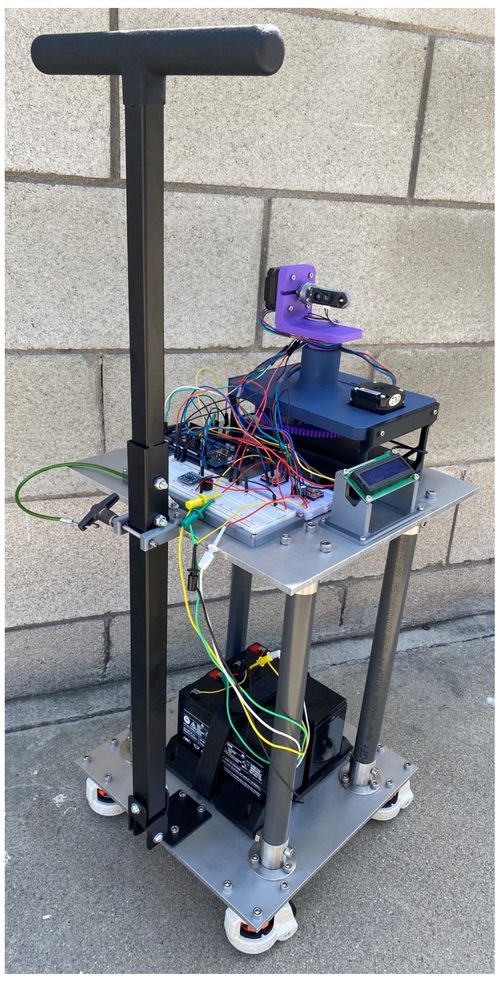


Stress FEA (15 lb Lateral Force)



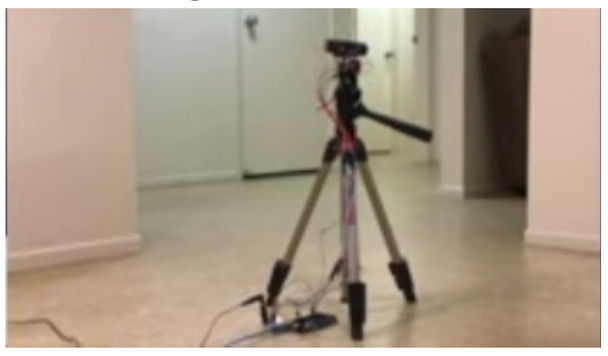
RESULTS

Prototype of FOV Tool

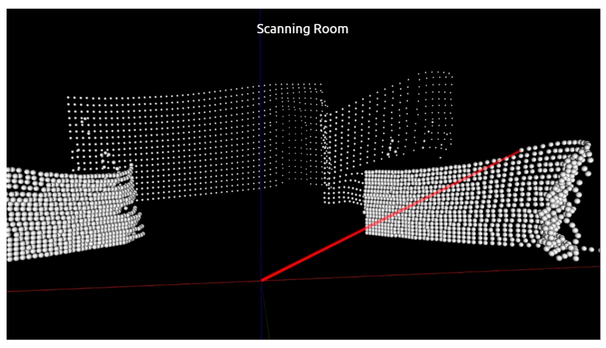


Hypothetical Results for the Arduino LiDAR Scanning Process

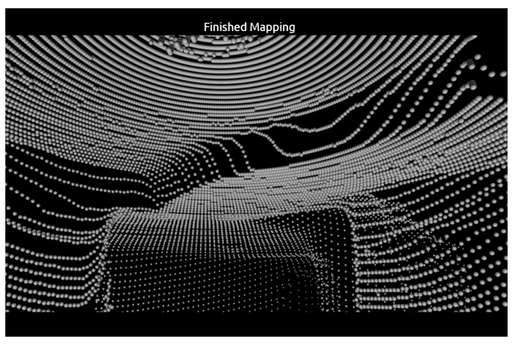
Scanning of the Actual Room



Scanning Process of Sample Area



Finished LiDAR Point Cloud of Sample Area



**Images Courtesy of Travis Ledo, Arduino Lidar Scanning*

ACKNOWLEDGEMENTS

Team 30 would like to thank Everardo Hernandez, Ronald Sobchik, Mackenzie Mason, Carrie LaPonza, Jose Armenta, Dr. Michael Thorburn, Kurt Sawitskas, Sergio Perez, and Sergio Marquez for guidance and support with this project.



(Sevag, David, Adriana, Kevin, Aaron)

MAJOR CONCLUSIONS

- Obstruction detection accomplished with current design functionality
- FOV verification automated by the FOV Tool, minimal technician input required
- FOV Tool is 4x more efficient than manual FOV verification process
- Alignment verification can be accomplished by adding gimbal arm extension for better positioning of gimbal and LiDAR to horn-reflector configuration
- Self-orientation and self-alignment can be accomplished by adding object-recognition camera and motorized leveling caster wheels