HU SlamERs

Team #1: Autonomous Platform: Embedded System

Team #2: Autonomous Platform: 4WD Chassis

Team #3: Autonomous Platform: 3D-Design

Dr. M.E. Amoo

Department of Electrical Engineering and Computer Science

College of Engineering and Architecture (CEA)

Room 3008, L. K. Downing Building

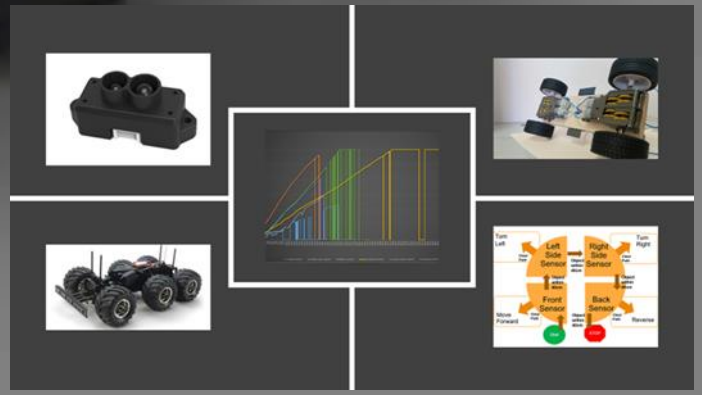
Howard University

Team #1:

Autonomous Platform: Embedded System

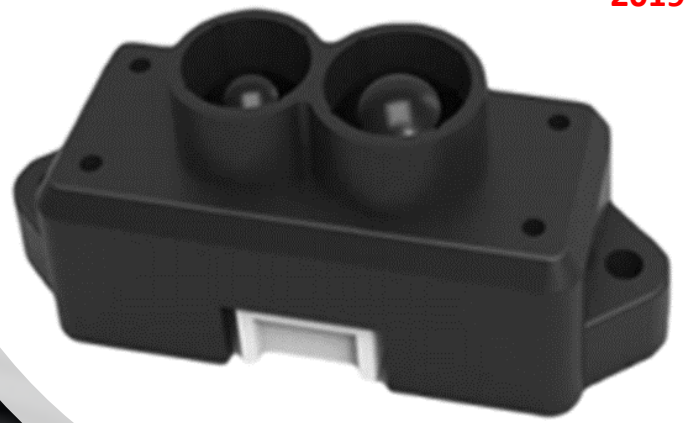
HU SlamERs

Project Description



SlamERS #1: Autonomous Platform Embedded System Design:

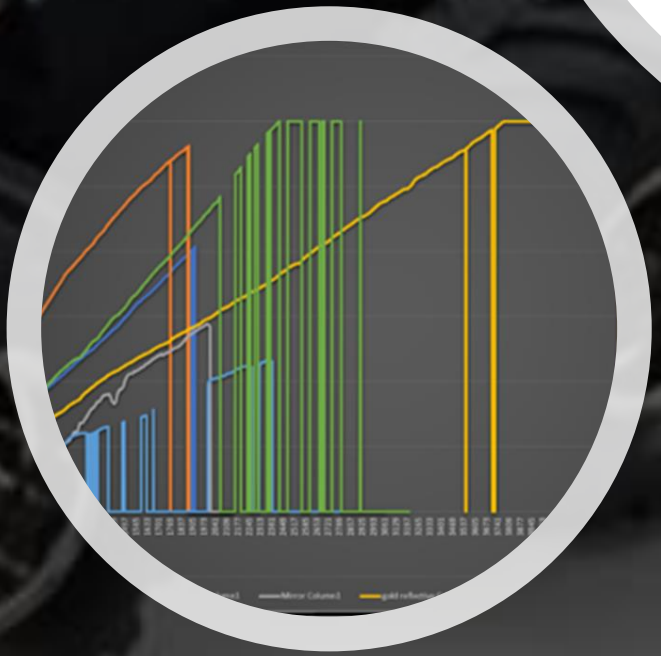
Slam: Excellence in Research
Dr. M. E. Amoo
(mamoo@howard.edu)
2019



Motivation:

A wheeled autonomous platform is needed to facilitate mobile scientific experiments and remote sensing in adverse environments.

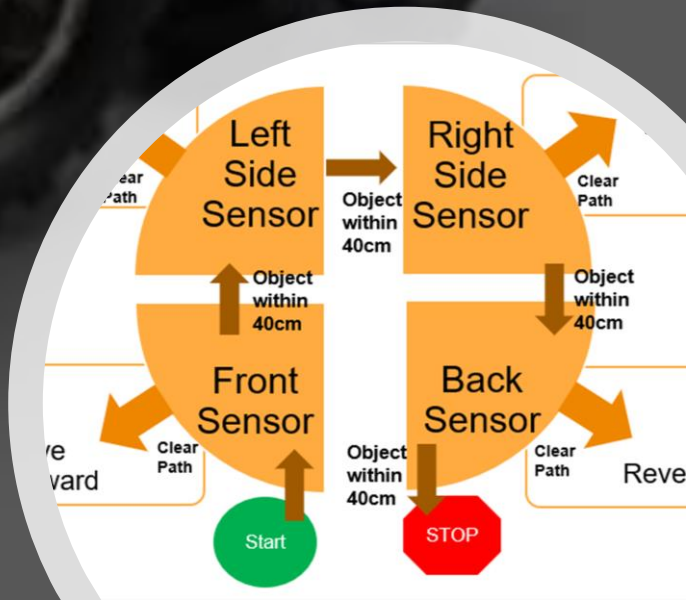
- It is impractical to use Commercial off the Shelf (COTs) chassis' because one-fit-for-all-purpose designs rarely match the intended use/function.
- The platform must be stable and robust enough to carry a custom built mobile scientific experimentation station in adverse/unknown environments.
- There is a strong desire to improve agility, while reducing cost and maintaining quality.



Objective:

Integrate previous work into a working prototype and test in off-road terrains (sand, gravel, dirt, under-brush and heavy foliage) and adverse weather conditions (wind, rain, ice, heat) by:

- Integrating IR and Lidar sensors, motor control chips, and autonomous algorithms into one embedded PIC-based system.
- Test and evaluate off-road performance.



SlamERs #1: Autonomous Platform Embedded System Design:

Slam: Excellence in Research
Dr. M. E. Amoo
(mamoo@howard.edu)
2019

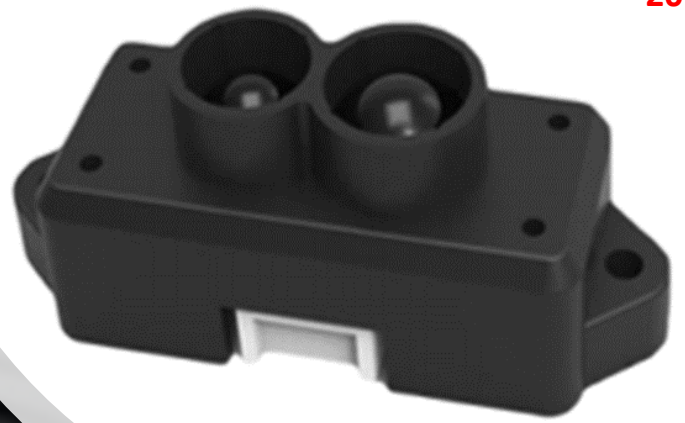
FAS Requirements

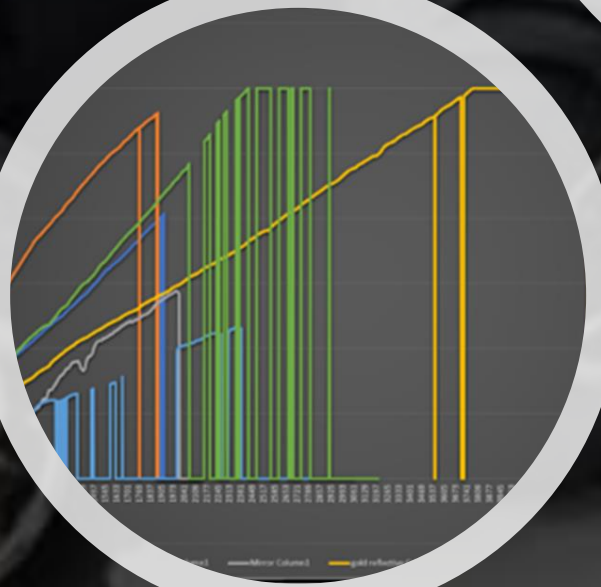
- System board dimensions: ~3 in (width) x 7in (length) x n in(height)
- PIC-based microcontrollers.
- Bang-Bang algorithm
- Water-proof
- Stable and robust in environments exposed to during operation

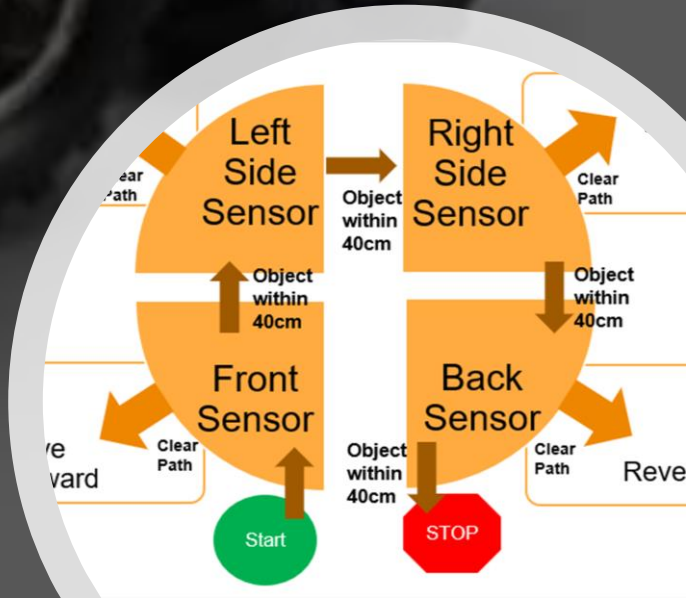
Stretch goal

- Minimize weight (materials) and power (i.e. batteries & motor type)
- Record and transmit speed, trajectory, location.
- PID algorithm

The design will be evaluated based on: Requirements, design, weight, cost, use and validation of modeling and simulation, and off-road test results (stability & robustness), projected longevity.







HU SlamERs

Team #2: Autonomous Platform: 4WD Chassis

Project Description

Slam: Excellence in Research
Dr. M. E. Amoo
(mamoo@howard.edu)
2019

SlamERs #2: Robust Chassis for an Autonomous Platform:

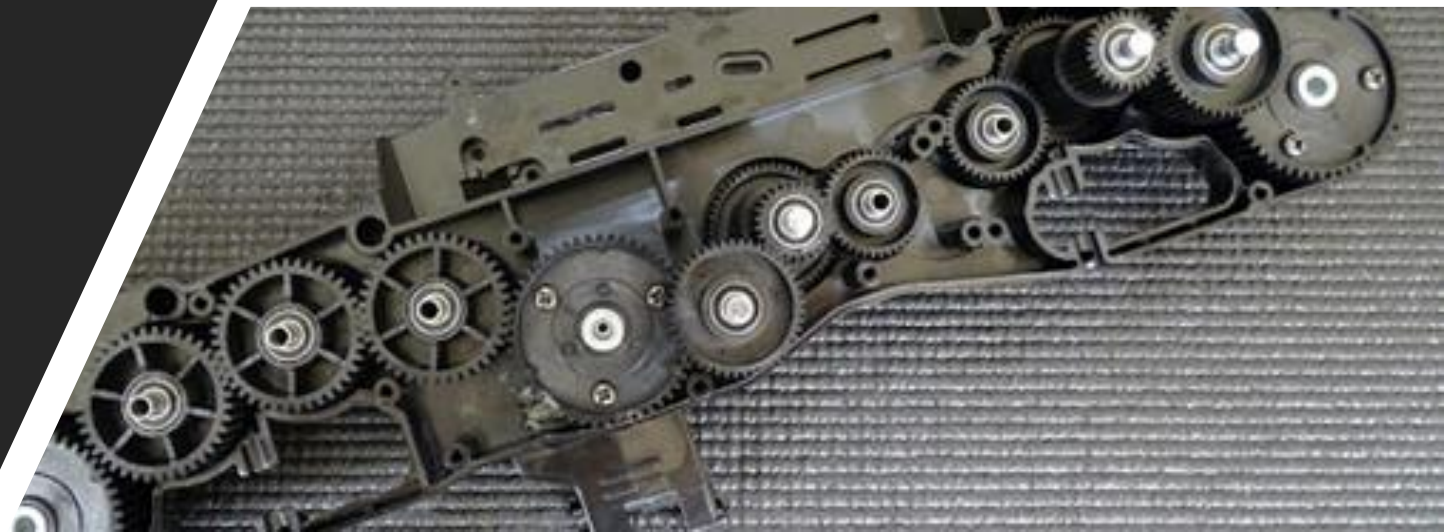
Motivation: Wheeled autonomous platforms need to be stable and robust in adverse environments. As a case study, design, prototype, test, and produce a 4WD chassis.

- It is impractical to use Commercial off the Shelf (COTs) chassis' because one-fit-for-all-purpose designs rarely match the intended use/function.
- The chassis must be stable and robust enough to carry a custom built mobile scientific experimentation station in adverse/unknown environments.
- There is a strong desire to improve agility, while reducing cost and maintaining quality.

Objective

Design, prototype, test, and produce a 4WD chassis, which is stable and robust enough to carry the required load (mobile science/experiment system) in off-road terrains (sand, gravel, dirt, under-brush and heavy foliage) and adverse weather conditions (wind, rain, ice, heat).

- A small, commercial off the shelf (COTs), prototype will be supplied for a scale-up reference.
- Use engineering analysis and tools such as modeling and simulation to validate design selection and experimental results
- Design, prototype, test, and build a functional 4WD chassis.



SlamERs #2: Robust Chassis for an Autonomous Platform:

Slam: Excellence in Research
Dr. M. E. Amoo
(mamoo@howard.edu)
2019

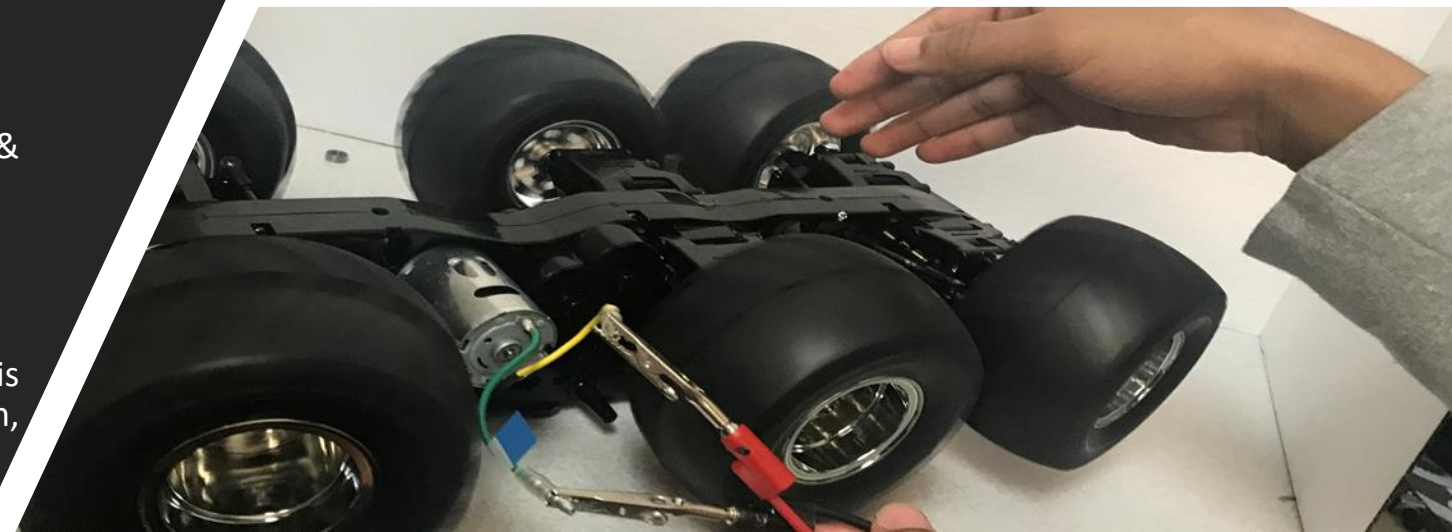
FAS Requirements

- Dimensions: ~2ft (width) x 4ft (length) x n ft(height)
- 4WD, shock absorb suspension system, accurate steering at all speeds.
- Maximum speed 20 mph
- Min payload: 10 lbs
- Stable and robust in environments exposed to during operation
- Max percentage of COTs: 20% (i.e. tires, servo motors, dc motors, batteries)

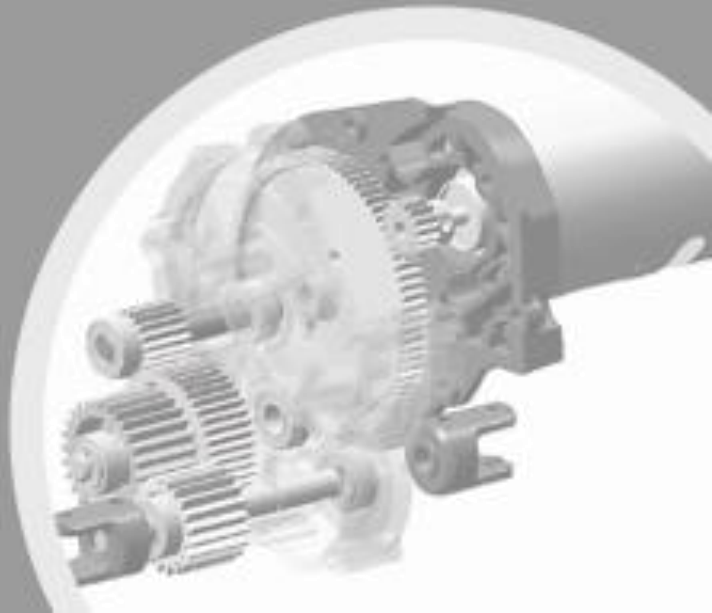
Stretch goal

- Minimize weight (materials) and power (i.e. batteries & motor type)
- Record and transmit speed, trajectory, location.

The design will be evaluated based on: Requirements, 4WD chassis design, weight, cost, use and validation of modeling and simulation, and off-road test results (stability & robustness), projected longevity.



HU SlamERs



- Team #3: 3D-Design
- Project Description

SlamERs #3: Robust Chassis for an Autonomous Platform:

Slam: Excellence in Research
Dr. M. E. Amoo
(mamoo@howard.edu)
2019

Motivation:

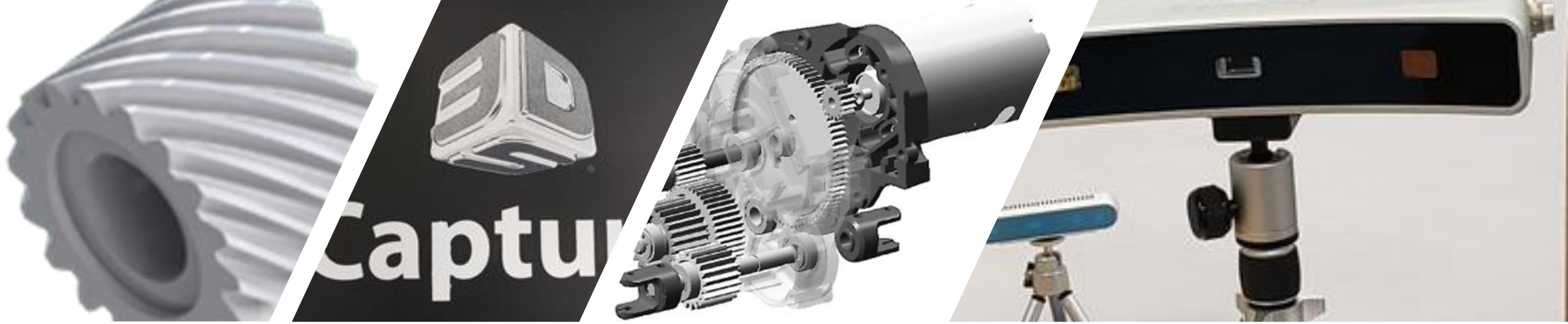
Rapid prototyping facilitates speedy fabrication of designs. Accurate 3D models are essential for 3D printing, but are time consuming and tedious to derive manually:

- A good laser scanner is prohibitively expensive ($5K+).
- The Intel RealSense 415/435 series of depth cameras are relatively inexpensive ($150 -$200).
- We need the ability to rapidly prototype and produce high quality, robust, custom parts, for an autonomous platform.

Objective

As a case study, determine whether Intel depth cameras are capable of producing highly accurate 3D models of small complex objects (gears etc):

- Compare the accuracy of the resulting models with those obtained from the Capture Laser Scanner (3D systems, Inc).
- Design an interface to convert the 3D point clouds to 3D mesh/models for use with CAD tools and 3D printers.
- Use engineering analysis and tools to validate and compare the accuracy of models obtained from both systems.



SlamERs #3: Robust Chassis for an Autonomous Platform:

Slam: Excellence in Research
Dr. M. E. Amoo
(mamoo@howard.edu)
2019

FAS Requirements

- Interface must produce standard format CAD files (.DWG, .DXF, .DGN, .STL …)
- Interface must be intuitive and easy to use.
- Accuracy comparison must be validated both by simulation and 3D printed objects

Stretch goal

1. Use both systems to produce scaled-up components as required.
2. Compare performance of platforms using the derived components.

The design will be evaluated based on: Requirements, interface design, ease of use, validation of results and accuracy.