

MAE 211 SPRING GRAND CHALLENGE

Request For Proposal

Issued: February 19, 2013
Pre-Proposal Due: March 15, 2013
Full Proposal Due: April 02, 2013

Introduction

This is a formal request for each team to propose a technical and management plan for your final project. This Request for Proposal (RFP) explains the project objective, mission scenario, requirement, and proposal format. Each team is expected to submit a pre-proposal, a full proposal, and a final project report during the spring 2013 semester.

Objective

Inspired by the DARPA Grand Challenge, the technical objective of this final project is to develop an autonomous ground vehicle that can navigate in both known and unknown terrain, with and without the existence of other vehicles. The main educational objective of this project is to apply the knowledge you learned during the Mechatronics class into solving a practical engineering problem. Furthermore, you will learn about how to write a technical proposal and how to work effectively in a team environment.

Mission Scenario

As shown in Figure 1, each vehicle needs to move autonomously from a pre-specified starting line to a finishing point without touching the wall or any other object. After reaching the finishing point, each vehicle needs to stop and flash a LED to indicate the completion of the mission.

The final demonstrations for the MAE 211 Spring Grand Challenge will include the following three stages:

- *Stage #1: Autonomous Navigation within a Known Terrain.* A standard track is being built by the teaching assistants. This track will be located in G22 throughout the rest of this semester. Practice with this standard track before the final demonstration is strongly encouraged;
- *Stage #2: Autonomous Navigation within an Unknown Terrain.* A second ‘secret’ track will be setup for the second stage demonstration. Detailed track information will not be released until 24 hours before the final Stage #2 demonstration;

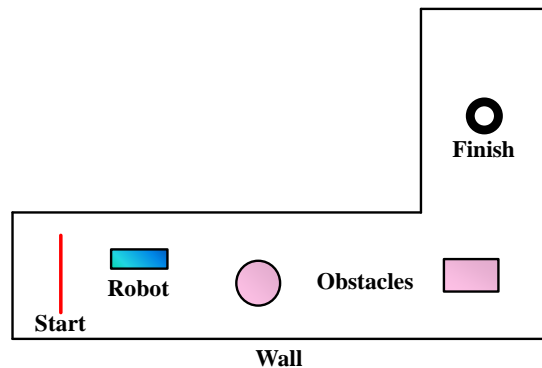


Fig.1. Autonomous Navigation and Collision Avoidance

- *Stage #3: Race.* Only teams that successfully finished the first two stage demonstrations will be qualified for the race. During this final competition, each vehicle will race with all the other vehicles (two vehicles at a time) using the Stage #1 track. You will score one point for each win and zero point for each loss. The winning team will be the one that with the highest total score.

Rule

The following rules will be strictly enforced:

1. Each vehicle must be fully autonomous without human intervention (other than starting the program);
2. Each vehicle must fit within a 20cm x 25cm x 15cm box, excluding cables;
3. The total budget for building the vehicle should be no more than \$180;
4. No interfering with the track is allowed.

Vehicles can have tethered communication and/or power cables.

Score Calculation

You will have a total of five chances for completing both the Stage #1 and Stage #2 demonstrations (e.g. two trials for Stage #1 and three trials for Stage #2). The score for each run will be calculated based on the following formula:

$$S = (300 - T) + (80 - D) + (200 - 0.1 \times W) - 10 \times C$$

where S is the score, T is the time (in sec) to completion, D is the distance (in cm) between the finishing point and the nearest point on the vehicle, W is the weight of the vehicle in grams excluding cables and batteries, and C is the total number of contacts or collisions with other objects. Vehicles that take over 300s to finish the track or stop at over 80cm from the finishing point will not receive a score. Your final score for each demonstration stage (Stages #1 and #2) will be the highest score of all trials. Team that received no score in either Stage #1 or Stage #2 demonstrations will be disqualified for the Stage #3 competition.

Pre-Proposal Requirement

The pre-proposal should include one cover page and two single-spaced pages of technical discussion in font size 12. You should provide the following information in the pre-proposal: team name, team members, envisioned technical approach, components selection, and functional diagrams of your design.

Full Proposal Requirement

The following components are required for the full proposal:

1. Cover Page (1 page)
2. Project Summary (1 page)
3. Table of Content (1 page)
4. Project Description (no more than 12 pages, single spaced, font 12)
 - a. Introduction and Objective
 - b. Literature Review
 - c. Proposed Approach and System Architecture
 - d. Equipment Selection

- e. Mechanical Design
 - f. Electrical Design
 - g. Programing
 - h. Preliminary Results
 - i. Project Management and Individual Responsibility
 - j. Project Schedule
5. References (1 page)
 6. Budget and Justification (no more than 2 pages)
 7. Appendix (no more than 2 pages)
- Clearly document your proposal for full credit.

Approval

Each proposal will be reviewed and graded by the instructor. Proposals with grade above or equal to 60% will be approved. Proposals with grade below 60% will be rejected and a revised proposal will be requested.

Final Project Score

The final project will contribute to 20% of your final grade. This means a total of 20 points with the following distribution:

- Pre Proposal: 2 points
- Full Proposal: 5 points
- Completion of Stage #1 demonstration: 2 points
- Completion of Stage #2 demonstration: 2 points
- Final Report: 5 points
- Individual contribution within the team: 4 points

Three extra bonus points will be given to the champion team of the Stage #3 race. The No.2 team will receive two bonus points and the No.3 team will receive one bonus point.

Important Dates

- Feb 21, 2013 – Finalize the Team Name and Members
- Mar 15, 2013 – Pre-Proposal Due
- Apr 02, 2013 – Full Proposal Due
- Apr 23, 24, 25, 2013 – Stage #1 Demonstration
- Apr 29, 2013 – Release of Stage #2 Track Information
- Apr 30, 2013 – Stage #2 Demonstration
- May 01, 2013 – Stage #3 Demonstration/Race
- May 03, 2013 – Project Report Due