Land Drone

The need:

The Canadian border with the United States is the longest shared land border in the world. While the US and Canada are close allies and share many values the integrity of the border remains important for both countries. A large number of policies ranging from import tariffs to immigration policy differ between the two countries. Maintaining the integrity of this border is critical to the implementation of these national policies. However, much of the border, particularly on the US side is quite remote and inaccessible. Patrolling the border is expensive and if done from the air can be ineffective because of heavy tree cover and the need to maintain continuous monitoring of the large border area. Most importantly, patrolling of this type of border can present significant safety issues for agents assigned to certain areas. A land drone that could deal with the complex terrain using low cost components would meet cost objectives while providing an effective presence on the border. The ability to respond on the ground to indications from airborne or stationary monitoring systems would close gaps in coverage due to tree cover and distance between ground based sensors.

http://www.dailymail.co.uk/sciencetech/article-2544534/Russia-takes-Google-Photographs-amphibious-drones-suggest-country-developing-robotic-ground-army.html

This is not an original idea (http://www.newsweek.com/2014/07/18/time-start-worrying-about-ground-drones-258048.html) but is one which is seeing less western innovation. However geography in Russia makes them a leader in this area (http://www.dailymail.co.uk/sciencetech/article-2544534/Russia-takes-Google-Photographs-amphibious-drones-suggest-country-developing-robotic-ground-army.html) just like Maine could be a leader in the west.

The key project design objective:

The project will focus on the completion of a test course in early April 2016. The course will require the land drone to be programmed with a series of GPS coordinates and to complete the course in a prescribed time period. The course will include uneven terrain, snow, ice and water depending on the conditions and weather during the competition. Scoring will be dependent on time to complete the tasks as well as data quality and availability at the end of the course. Data will include optical, acoustic and complete position data during the complete course. Tentatively it has been determined that all designs will use a standard 30cc chain saw engine and an Arduino Due to ensure that the same basic platform is available for all of the groups in addition to backup hardware in case of problems in the field. There are no constraints on the way that the standard power source is used to propel the device including gasoline electric, walking, wheeled or tracked vehicles.

Who is the final customer for this device;

The US Customs and Border Protection Agency which is part of the Department of Homeland Security will be the final customer. In addition the design will be open at the end of the class so that developing counties can use the system to help identify problem areas in remote areas with famine, security or other challenges. The goal for this year will be to develop a process where the vehicles can compete over a closed course in a fixed time period with the goal of creating a new intercollegiate design challenge based in Maine.

Who will be supervising and evaluating the outcome of the project:

Project review will include oversight by experts from industry including a technical panel for ground vehicle interaction, vehicle dynamics, controls, sensor integration, drivetrains, safety and reliability.

UMaine Mechanical Engineering technical contact point:

Professor Peterson will supervise the mechanics, materials and manufacturing issues related to the project evaluation of this project. Mr. Abbadassa will provide oversight on the testing and construction of the machines.

The core Mechanical Engineering classes required as background for the project:

Controls
Design I & II
Dynamics
Strength of Materials
Material Science

Resources available:

This project is unique in that a wide range of people and equipment can be provided for the project. The design, build and test equipment used for the project is available in Crosby Laboratory. The multiple competing teams for this project will share infrastructure needed for the development of the vehicles. Depending on the number of groups this may also include a collaborative effort to build a dyno for testing of the vehicles. Any infrastructure developed for the testing of the machines would need to be done in a manner that does not constrain the designs.

End of year deliverables:

The first term design documentation will be required for these competition teams, but unlike the rest of the teams the actual documents including drawings and software will not be public until two weeks prior to the spring competition. The final documentation must not only be complete, but must also include any changes to the design which occurred during construction (an "as built" design package) which will be checked against the actual vehicles. The complete design including drawings, schematics and software will be posted on the web site at the end of the term.

To complete the test course and achieve a score for the team for the defined tasks. The most critical portion of the project is to cover the complex terrain which will be encountered and to travel to each of the predefined GPS coordinate points. Sensor data including acoustic and optical data must be delivered to the GPS location defined as the end of the course. The data only needs to be logged onto a drive for the 2015-16 competition and will not be used as a part of the control system. However, this work will provide a foundation for future autonomous response to sensor data. Data for the 2015-16 competition may be stored locally on the drone, although an appropriate uplink option will be explored and integrated into the design if an alternative to managing the economics and power budget issues associated with a multiple carrier cellular modem. The final competition event must be completed at a predetermined time and under defined conditions.