# Lab/Prac 1: Robot Rover

Object

Inspired by the Curiosity rover and its sample/collect mission, the object of the Robot Rover contest is to build a robot that can quickly and reliably make "samples" at several marker points. In order to complete the exercise your robot will know the positions of 6 marker points. The robot must then draw a dot at each point with adequate accuracy. The markers will be located on a 10 x 6 x 5 grid. Your robot may occupy an area outside of this workspace.

Workspace

The workspace is set on your work table. It takes the form of a 10 cells wide x 6 cells long x 5 cells high, grid where the length and width of each grid cell is 4 HLU (Horizontal Lego Units) which is 32*mm*, and the height of each grid cell is 2.5 HLU which is 20*mm* (this is equivalent to 2 Lego bricks stacked on top of each other). The robot may occupy any space outside of this workspace.

Lego brick dimensions
(http://images.wikia.com/lego/images/2/25/Brick-in-mm.svg)
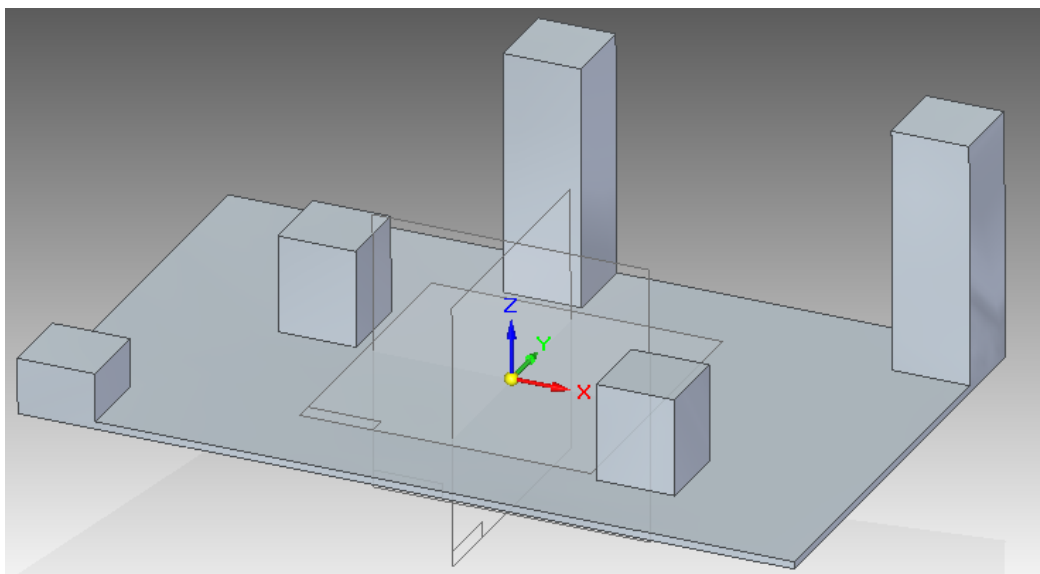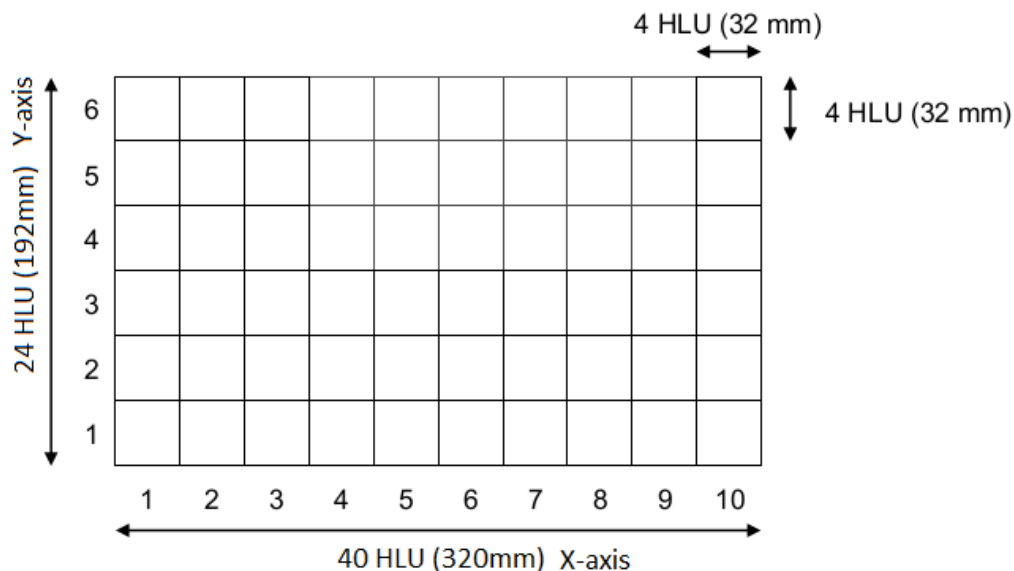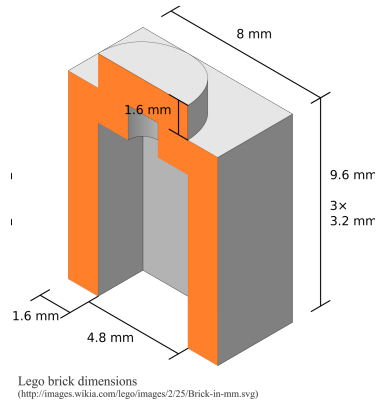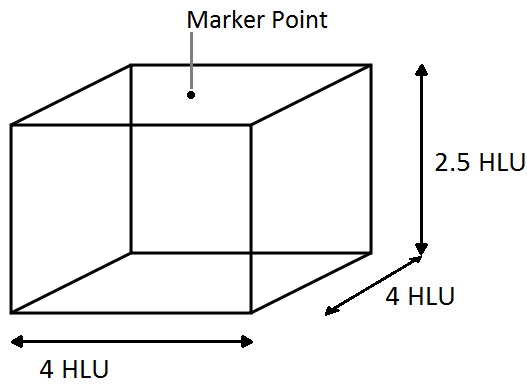
Marker Points

Each marker point will be specified by a coordinate {x, y, z} e.g. {10, 2, 0}. All locations in the aforementioned grid are valid sample points. The point will be located in the centre of the top side of each grid cell. A z-value of zero corresponds to the work table surface. The marker point has regions of interest. The target centre is circle that fits perfectly inside the 4 centre studs (4.8 mm or ~1/2 HLU). The target square is 2 HLU, the outer square is 4 HLU.

Centre (4.8 mm OD - 4 points)

Target (2 HLU square - 2 points)

Region (4 HLU square - 1 point)
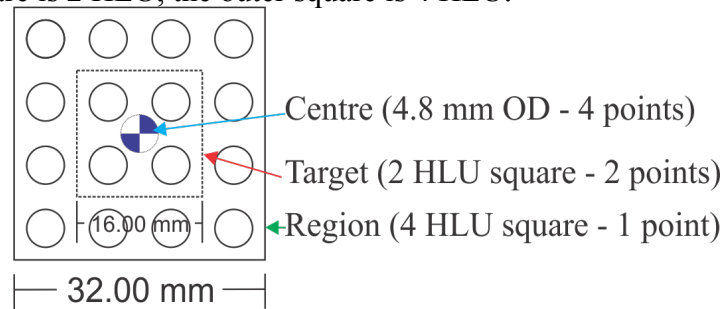
Play

Scoring

Scoring is based on the number of marker points the robot can sample in the time given. A higher score will be achieved by being more accurate. If the robot tool point begins on a marker point, this will not be scored. A sample inside the target centre with score four (4) points. A sample inside the target square will score two (2) points and a sample inside the outer square will score one (1) point.

Data Entry

The team may opt to be given marker points all at height zero, or to be given marker points at different heights - this has a bearing on the final grade. The assembly data may be entered into the code or into the robot's user interface once the marker point locations have been announced. Teams will have at least two minutes from announcement of the points to being called for placement.

Placement

The robot is to be placed in its starting position within 30 seconds of the judges' call. Any team that has a badly damaged robot may appeal to the judges for extra placement time, which may be granted at the judges' discretion. No software may be loaded during this time, but adjustments are permissible. Any team that does not have its robot ready will be penalised by half the amount of time that they are late in placement. That is, if a team takes 40 seconds to get ready after the call for placement, they will have 5 seconds less to demonstrate.

Start

The starting signal will be given by the judge when the data has been entered. The robot may start with the pen tip on the first marker point. Upon the starting signal the handler clicks the start button on the user interface on the robot, or on the computer if using the Matlab Toolbox. The robot should not start before the start signal. If a robot should falsely start, it will be given a second chance. If it should falsely start again it will be disqualified from that round.

Operation

The robot will be given 60 seconds to sample the given points. The marker points will be chosen by the judges such that those that are higher (in the z-axis) do not block lower ones. That is to say that higher points will be further along the y-axis. After the reaching marker point 6, the robot can resample the points to improve the sample quality (a.k.a. score more points).

Control

Control of the robot may be done in two ways.

Using the RWTH Mindstorms NXT Toolbox for Matlab. After setup the robot should be placed in the appropriate position and wait for the starting signal. Once the robot is placed on the field, no form of input is allowed from a person unless it is to start the program.

A standalone program running on the NXT (using RobotC). After setup the robot should be placed in the appropriate position and wait for the starting signal. Once the robot has been placed on the field, no form of communication with the robot is allowed apart from entry of the coordinates through the user interface and pressing the start button.

Robot Structure

LEGO parts and connectors in your kit may be used as robot structure.
If you wish to use anything non-LEGO, you must obtain permission from the judges.
Each robot must use the supplied pen as the tool point.
LEGO pieces may not be glued together.
LEGO pieces may not be modified in any way.
String may not be used for structural purposes.
Wire may be used for electrical purposes only, not structural.
Any machine that appears to be a safety hazard will be disqualified.

Judges

The course coordinator, lecturers and tutors will act as judges. The course coordinator will act as chief judge. All decisions made by the judges will be final, and no correspondence will be entered into. Contestants may approach the organiser about possible designs that may be questionable under the rules listed above. Any queries will be treated with the utmost confidentiality and will not be divulged to any of the other contestants.

Due Date

The lab must be completed and demonstrated by August 31, 2012. There will be a sign-up sheet for demonstration times. A short, brief individual report (~1-2 pages, details in class) will also be submitted. It will be due by 5 pm on August 31, 2012 via the EAIT submission system. Early submission is encouraged.

Assessment Criteria for Robot Arm

The mark for Robot Arm is attributed to the robot's performance on the final contest day. Your robot must perform on the day to achieve a good mark. Each robot will be judged on its merits - not just on how highly it ranks in the competition. Your individual marks may vary from the group's average depending on your knowledge of the system as determined by questions asked using the contest, a peer assessment and an individual progress report. The following breakpoints show typical marks for robots of various competencies.

Excellent (7):

Multiple marker points at height other than zero are sampled. Your robot scores 20 points or higher. Your robot consistently samples all marker points, and in an optimal sequence. The tool tip reaches the centre of the marker point's grid square. Your design features clear and effective innovation. You can answer all questions quickly and confidently.

Very Good (6):

Marker points at height other than zero are sampled. Your robot scores 15 points or higher. Your robot consistently samples all marker points, and in a logical sequence. The tool point motion is smooth. Your design features some innovation. You can answer all questions.

Good (5):

Only the marker points at height zero are sampled. Your robot scores 8 points or higher. Your robot consistently samples all marker points. The tool tip mostly reaches the correct marker point's grid square. The tool point motion is a little shaky. Your design features some innovation. You can answer all questions.

Satisfactory (4):

Only the marker points at height zero are sampled. Your robot scores 4 points or higher. The marker points are sampled. The tool tip sometimes reaches the correct marker point's grid square. The tool point motion is shaky with the drawn line broken in places. You can answer most questions.

Conceded Pass (3):

Only the marker points at height zero are sampled. Your robot scores 1 point or higher. The tool tip can at least reach the correct grid square for the second marker point. The robot is unstable but is obviously heading towards the right marker point. You can answer most questions.

Poor (2):

Only the marker points at height zero are given. Your robot cannot sample any marker points. The robot cannot reach even the grid space of the second marker point. The marker points are not visited in an efficient order. The tool point motion is very unstable. You can answer some questions.

Very Poor (1):

You did not submit a robot or submitted a robot that never had a chance of performing the task on the competition day. Student members can not answer any questions about the robot. Robot is a disgrace.