NASA Lunabotics Mining Competition
BP-1 Excavating Autonomous Rover
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NASA Lunabotics Mining Competition
The 3rd annual NASA Lunabotics Mining Competition is an autonomous excavating robot competition hosted by NASA at the Kennedy Space Center in Florida on May 21-26, 2012. 60 teams from around the world will compete with their custom designed prototype rovers.

The Goal of the Project:
The goal of the project is to design, build and test an excavating lunar rover in preparation for the 3rd Annual NASA Lunabotics Mining Competition.

The Design Specifications Include:
• Mass < 80 kg
• Compact footprint 1.5m x 0.75m x 0.75m
• Set-up and removal time < 10 minutes
• Must be capable of mining 10 kg of BP-1, simulated lunar soil, in 10 minutes
• On board power source
• Cannot use Earth-bound material/devices like sonar, pneumatic air tires, open or closed-cell foams etc…
• Fully autonomous and remote control operation
• Minimizes energy usage
• Minimizes communications bandwidth
• Dust tolerant design and maximizes dust free operation
• Must have E-stop button

Vision
Active Environment Modeling
The Lunabot uses a depth capable vision system (XBOX Kinect Sensor) to gather a high volume of points in 3D-space, representing objects in its view. Frame by frame, the information is then stored in memory, creating a 3D map. Additionally, a 2D planning grid, indentifying obstacles, walls, and destinations is developed from this stored information.

Planning
A* Search Shortest Path
An A* Search algorithm is used to efficiently traverse the planning grid between two locations. This algorithm will guide the robot to its destinations, avoiding obstacles like craters and rocks in its path.

Motion Control
Drive System
The Lunabot is driven by four Bosch 18V cordless drill motors, each producing 600 in-lb of torque. Drill motors are a cost effective alternative to servo motors, although provide no feedback for position control. For this project we will rely on the capabilities of the vision system for feedback.

Bucket Arm Actuation
The front bucket is actuated by a drill motor, geared down 33:1. The torque required to lift a loaded bucket is reduced by use of a battery counterweight. The back of the bucket is secured by an electro-magnet and is electrically released for dumping.

Electronics and Computing
The drill motors are controlled using a Galil 8-axis motion controller and three 25A motor amplifiers. The vision algorithms and active environment 3D mapping is processed using an onboard Mac Mini. All components are powered from Four 18.5V 5000mAh lithium-polymer batteries.

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