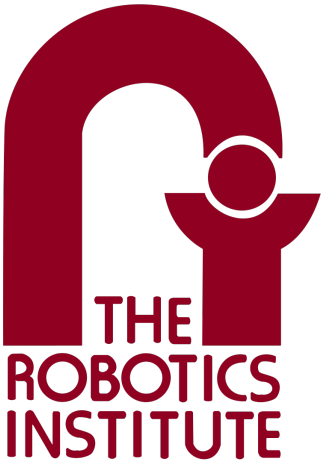
Individual Lab Report - ILR02



Lunar ROADSTER

Team I

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1 Individual Progress

The primary focus of this phase was completing the CAD design of the Dozer Assembly. Following initial feedback from both the project sponsor and the team, the design was refined, and a feasible solution for the lifting mechanism was developed. The lifting mechanism utilizes a linear actuator connected via a yoke to raise the arms, which are pivoted on the chassis at a point located behind the actuator. This configuration generates a radial motion at the dozer blade end, allowing for a targeted lift of approximately 1–1.5 inches off the ground plane. A simple linear actuator with a pivot-based mechanism is expected to achieve this motion. The pivoting action will be facilitated using a sleeve bearing (bushing) mounted on a shoulder bolt. Several linear actuators were evaluated, and a shortlist of suitable options was compiled for further consideration.

Additionally, discussions regarding the design and its manufacturability were held with Timothy Angert, whose constructive feedback led to improvements in the assembly's structural integrity. Specifically, cross members in the form of threaded rods were incorporated between the arms to enhance stiffness.

The finalized CAD model, as depicted in Figure 1, incorporates modifications necessary to accommodate new components, including the yoke, linear actuator, and arms. As a result, adjustments were required in the positioning of other elements, such as the IMU and the mast, which will be finalized in subsequent iterations. Concurrently, the manufacturing process for the assembly has begun. Moreover, Simson and I collaborated to fabricate an additional dozer blade (Figure 2). The .dxf file for the arm components has been shared with Tim for CNC routing. (Figure 3).

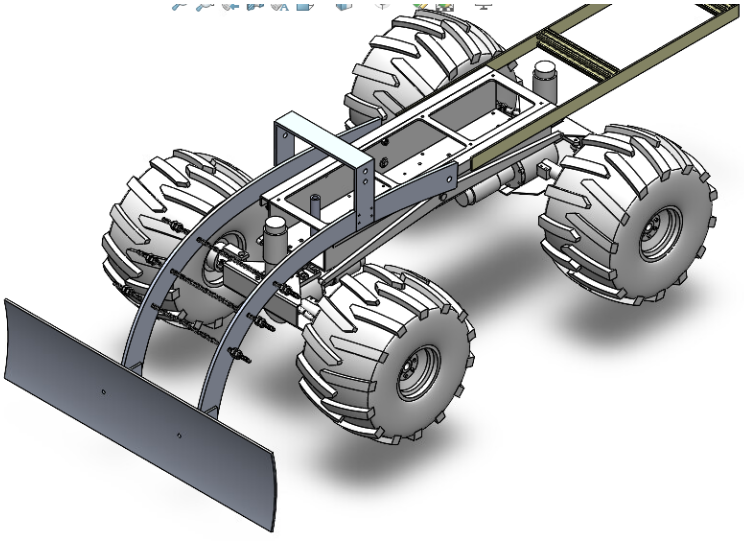

Figure 1: Dozer Assembly CAD

Figure 2: Dozer Blade, manufactured in collab. with Simson

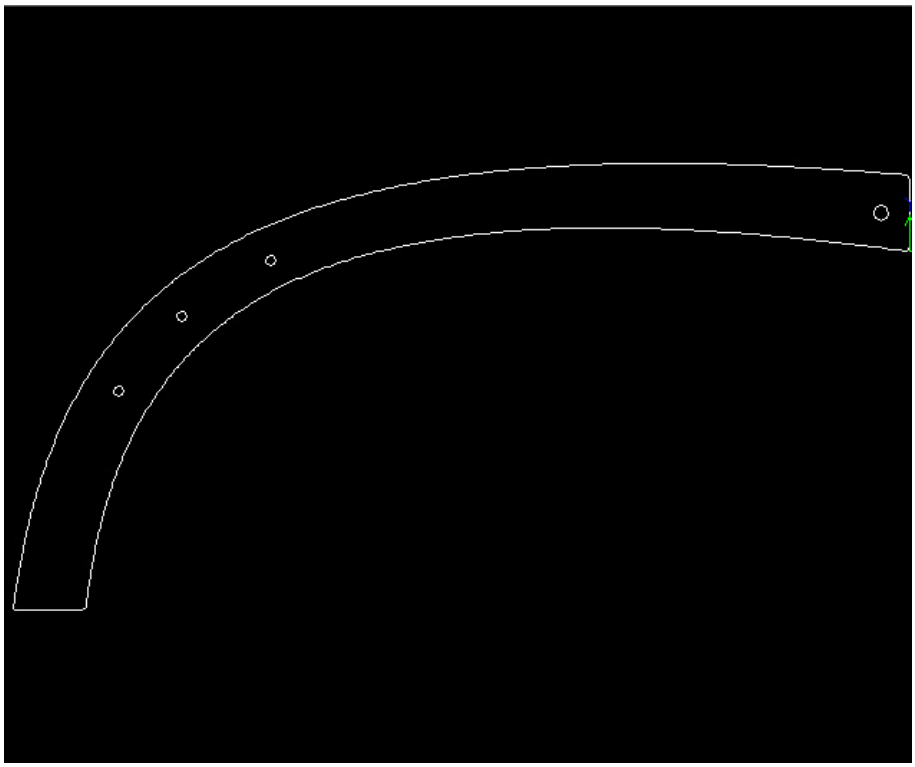

Figure 3: .dxf file for Dozer Arms for CNC Routing

2 Challenges

One significant challenge encountered while working on an existing design is the lack of insight into the original designer's thought process and methodology. This issue became particularly evident while designing new components and modifying existing ones. Specifically, determining the optimal placement for the pivot points and actuator required careful consideration to avoid interference with other components and existing mounting locations. To address this, minor adjustments were made to the positioning of certain elements, such as the mast and the IMU. The optimal placement of these components will be finalized in subsequent iterations.

Another challenge arose from the use of non-standard dimensions in the existing design and assembly. This necessitated extensive effort in identifying and sourcing proprietary components, such as shoulder bolts and sleeve bearings, to ensure compatibility. The process of selecting appropriate parts significantly contributed to the overall design time.

3 Teamwork

The team completed many individual and collaborative tasks this week, which are listed here:

- **Ankit**: He fixed the rover's drive system with new motors, improved the steering assembly, and introduced limit switches with Bhaswanth for added robustness. He collaborated with me on the dozer assembly design and interfaced the IMU with ROS2, enabling Bhaswanth and William to advance localization. He also

took ownership of the PCB assignment to help the team prioritize other tasks. Ankit also collaborated with me to finalize the lifting mechanism of the dozer assembly.

- **Bhaswanth**: He worked with William on setting up the total station and localization stack while also visualizing the rover's pose in Rviz. He attempted to get existing limit switches working, connecting to Ankit's steering improvements and collaborated with Simson on integrating the ZED camera for navigation.
- **William**: He worked on establishing the localization infrastructure, including the total station, TX2 relay, and LAN network for data transmission. His work is also with Simson's mapping efforts, as the maps will serve as the world frame for localization. My completed design of the assembly will be followed by work on the tool planner software, where we will be collaborating extensively.
- **Simson**: He processed the point cloud data from the FARO Scanner, set up ZED 2i and RealSense cameras, and tested mapping to generate a 2D costmap for localization. He also designed the electrical circuitry diagram, which will aid me with integrating the actuator. We also collaborated in dozer assembly design discussions and in manufacturing the dozer blade. integration and collaborated on fabricating the dozer blade.

4 Plans

From now until ILR3, my focus will be on the development of an active dozer assembly actuated using a linear actuator. To determine the most suitable actuator for this application, multiple linear actuators will be evaluated based on performance criteria, and their positional feedback will be interfaced through the RoboClaw motor driver. Additionally, I will oversee the complete manufacturing process of the dozer assembly to ensure design integrity and functional reliability. This phase is directly linked to Test T04 of the testing plan, which involves a comprehensive evaluation of the assembled system.

Following the validation of the dozer assembly's functionality, the next phase will involve the development of a tool planner. This planner will utilize a mapped representation of the environment to determine optimal grading locations, specifying when and where the dozer should engage in terrain modification. Additionally, it will define the necessary adjustments to the dozer blade, including lift height and grading extent. This phase will require close collaboration with other team members to integrate planning strategies with the overall system architecture.