# 1 – Abstract

Masters of Engineering Degree (Mechanical)

**Project Title:**

Cornell Mars Rover

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**Abstract:**

With the increase in difficulty of the University Rover Challenge guidelines concerning the terrain traversal requirements, the Cornell Mars Rover project team needed to modify its existing suspension design to satisfy these stricter requirements. The new guidelines included the necessity to be able to traverse a half-meter shear face, as well as the necessity to have a greater amount of clearance for traversing obstacles. These changes placed greatly increased strength and geometric demands on the suspension systems of rovers that needed to be met if success was to be achieved in the competition.

In order to implement a solution to these issues, the suspension system was redesigned to use 90° vertical motors to power the wheels in place of the previously-used horizontal motors. Further, strength was strategically added to the suspension system in order to provide maximum resistance to the impulse force that would be experienced by the suspension when traversing the half-meter shear face. This was done while minimizing the increase in mass of the system.

Specifically, the rocker portion of the suspension underwent a significant redesign, having essentially everything except its general geometric properties modified. The distance between the rocker plates was increased, plates were used to encase the motors, and strengthening elements were added. All of these changes were necessary, however, in order to adapt the system to the 90° vertical motors and to ensure structural integrity would be maintained even under the most extreme loading conditions.

In addition to the rocker redesign that occurred, the battery enclosure also required modifications. The previous design left space for the drive batteries to move in, causing vibrations and the potential for power loss to the drive motors. Further, it did not allow for the housing of the CPU battery, which was a desired trait of the new design. Additionally, this redesign allowed for the attachment of an undercarriage camera, which could be used to observe the operation of the drill underneath the rover.

Finally, significant amounts of remachining were required after initial assembly and throughout the testing stages as additional issues arose. The main issues arising in this area were the interactions of crucial parts with the pivot D-shaft of the rockers and the internal coupling in the motors. Both of these issues posed serious complications for the functionality of the drive system. The former was addressed via the implementation of more precise tolerancing and the replacement of aluminum with steel, while the latter was addressed via modifications made directly to the inner mechanisms of the motors to allow for the addition of a set screw system that would increase the effectiveness of the coupling.