CHASSIS - In-Flight Self-Stabilizing Rover

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Introduction

• Problem Statement :

Current Search & Rescue rovers are restricted by having to be placed down upright. A self-stabilizing rover that will allow people to throw it into hard to access areas without worrying about landing upside down would be greatly beneficial

• Customer Requirements:

- Individual hub motors for every wheel
- Independently Steerable
- Lightweight (less than 4kg)
- Withstand drop from 2m
- Dimensions (LxWxH): 650mm x 500mm x 350 mm

Features

• **X-frame chassis** for symmetry and strength.

• **Aluminum extrusions** for a modular design

• Interchangeable **leg mount** for mounting suspension components or connecting straight to the wheel

• **Top plate** manufactured using 5052 Aluminum for high corrosion resistance and workability with 3mm grid pattern holes for mounting electronic components

• **Undertray** to protect the rover's frame and electronics from impact and debris

• Steering Mechanism is obtained using servomotors and the impact force observed by servomotor gear is reduced using bearings

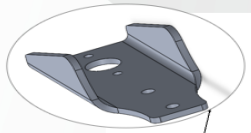

Figure 3 : Leg Mounting Plate

Figure 1 : Rover chassis (Isometric View)

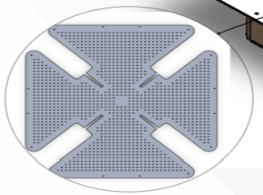

Figure 4 : Top Plate

Figure 5 : Servo Mounting Plate

Figure 7 : Leg Mount

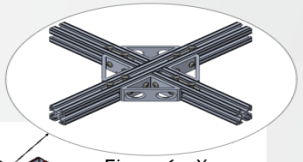

Figure 6 : X-Frame

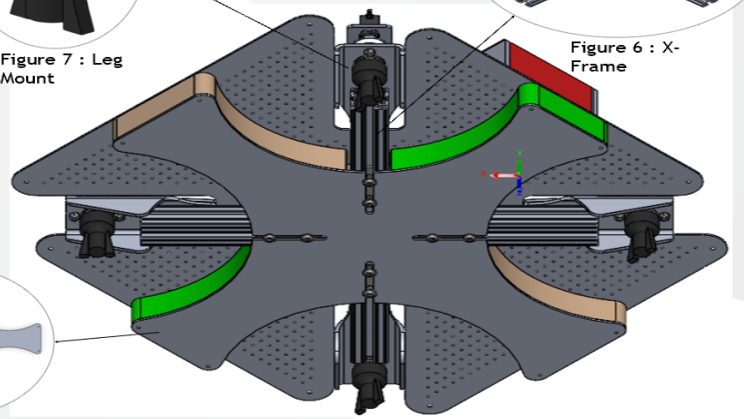

Figure 2 : Rover Chassis (Bottom view)

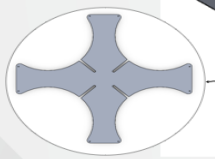

Figure 8 : Undertray

Results

• Developed mounting locations and space for electrical and suspension components

• SolidWorks simulation was used for stress analysis

- X-frame successfully passed load test using a static normal load of **500 N**
- This gives an estimated maximum load capacity of **51.2 kg**

• Final chassis weight : **7.6 kg**.

• Final chassis dimensions (LxWxH) : **580mm x 615mm x 123mm**

Discussion

• Design Limitations:

- Cannot be thrown upside down
- Landing on the side will likely result in electrical component damage

• Potential future improvements:

- Decrease chassis size to help reduce weight
- Develop a roll cage that protects from roll-overs or side landings

REFERENCES

1. A. Ramirez, *"Project 1 and 2 - Self-Stabilizing Robot Car in flight."* University of Calgary, Calgary, 2022.
2. D. Gonzalez, M. Lesak, A. Rodriguez, J. Cymerman, C. Korpela, *"Dynamics and Aerial Attitude Control for Rapid Emergency Deployment of the Agile Ground Robot AGRA."* IEEE International Conference on Intelligent Robots and Systems (IROS). Pp 1-8, 2022.
3. "Logos," *University of Calgary*, 23-Mar-2023. [Online]. Available: https://www.ucalgary.ca/brand/brand-standards/logos. [Accessed: 26-Mar-2023].