Mars Sample-Return Rover

ENPM 662 Final Project

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1 Abstract

Space exploration is still a topic of interest because technology is continuously developing. Exploring and researching Mars is the most convenient way to trial and test new space technologies since it is the closest planet to Earth that is able to conduct research on. NASA approached Mars exploration through the Sample-Return Rover, a robot that can explore unknown terrain autonomously and be able to collect samples. The earliest primitive model was launched in 1997, and the latest one being 2020 with the Curiosity Rover. This project focuses on recreating the earlier version of the rover in SolidWorks and being able to simulate the exploration in a 3D environment with Gazebo.

2 Introduction

This project focuses on the Mars Sample-Return Rover, developed by NASA's Jet Propulsion Laboratory (JPL). Exploring the unknown is fascinating with the challenges that are present. Robotics is a field suitable to approach these challenges because they have the capability to operate autonomously. The model will be created in Solidworks and then simulated in Gazebo. The report explains the elements of the project, starting with the rover's geometric aspects such as its mechanical design, joints, links, and arm. The rover consists of the vehicle base with the chassis and wheels, and an attached four degree-of-freedom (4DOF) arm.

The rover's chassis has an interesting structure with the front and rear links are connected with one joint, but have independent movement. With a total range of 180 degrees, the rover can scale steep cliffs because of the design. The front wheels can also rotate side-to-side so that the rover can turn. Attached to the chassis is a 4DOF arm. It rotates at its base, an elbow joint, and the wrist joint can rotate sideways and and up and down. The end-effector on the arm allows for sample-collection.

With the challenges of unknown terrain and inability to remote control the robot, extensive research and testing has to be made before launching the robot. The scope of this project focuses on the Sample-Return Rover. Model assumptions will be discussed. Afterwards, the design of the robot will be explained with analysis of the kinematics of the vehicle and the arm.

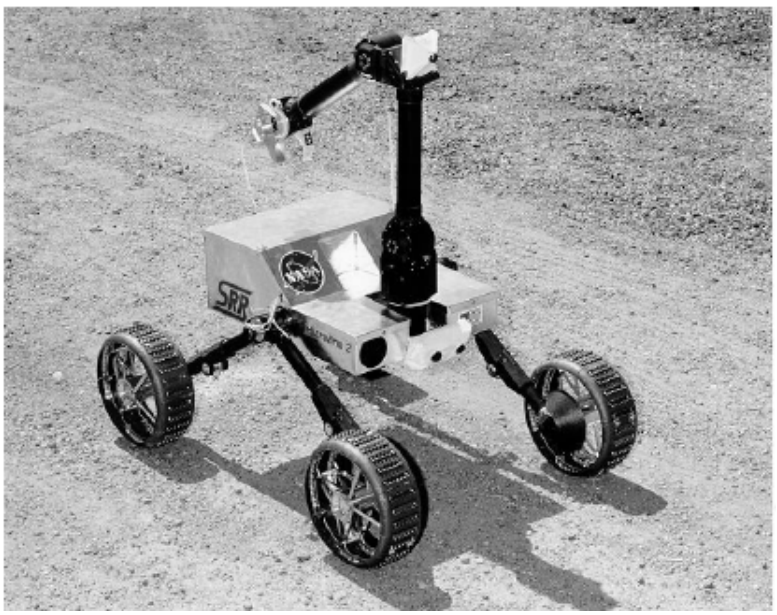

Figure 2.1: Early Model of the Sample Return Rover

Motivation

Space robotics is a big area of interest. Not only has there been the Sample-Return Rover, but there is also the CubeSat, BioSentinel, and many others. The Sample-Return Rover is a great choice for this project as the information gained from the class will be used on the rover.

3 Robot Design

The robot base comprises of four legs, with two on each side that are concentric. The robot arm that is attached has four degrees of freedom.

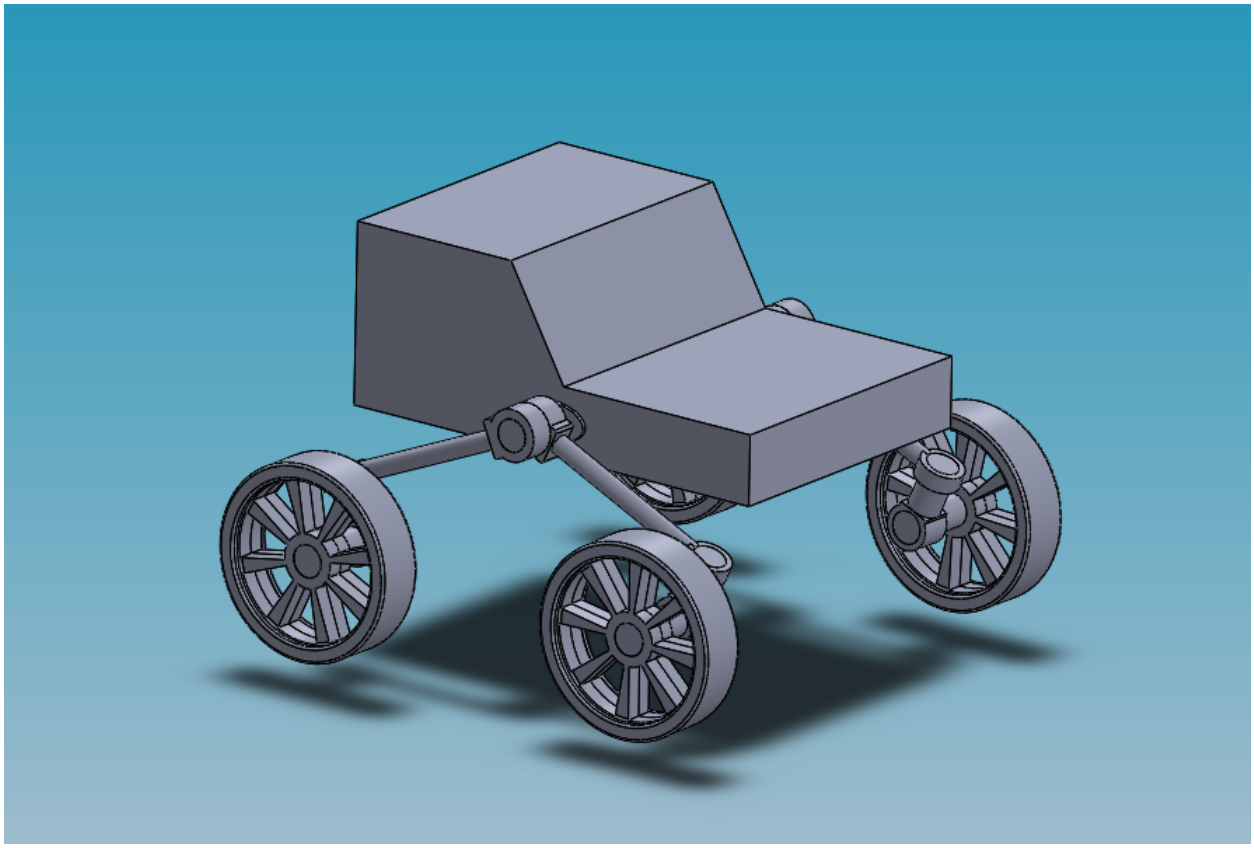

Figure 3.1: Sample Return Rover in SolidWorks

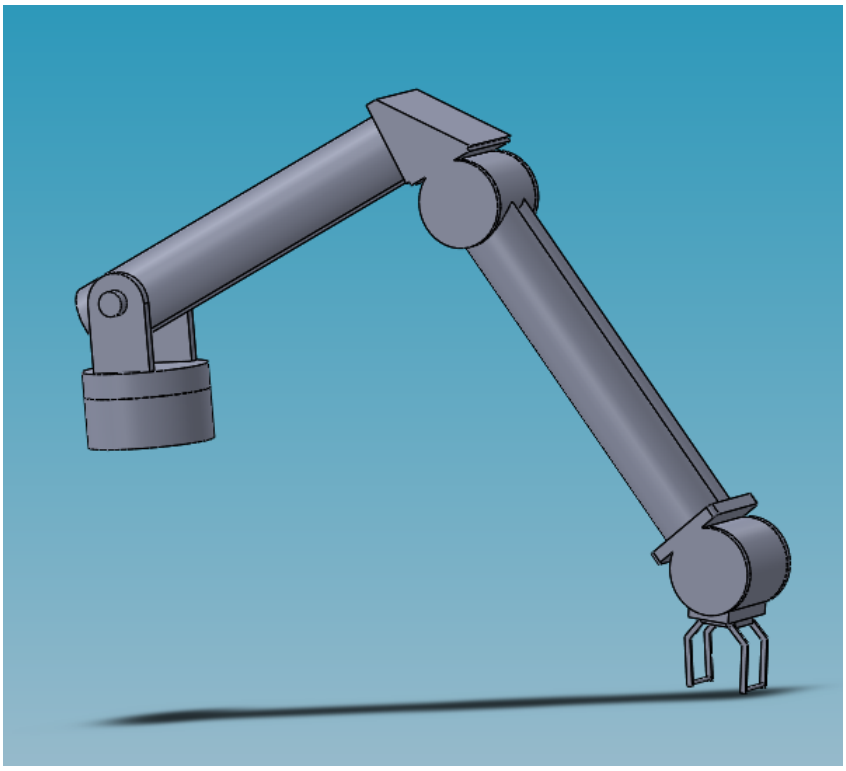

Figure 3.2: Arm Model in SolidWorks

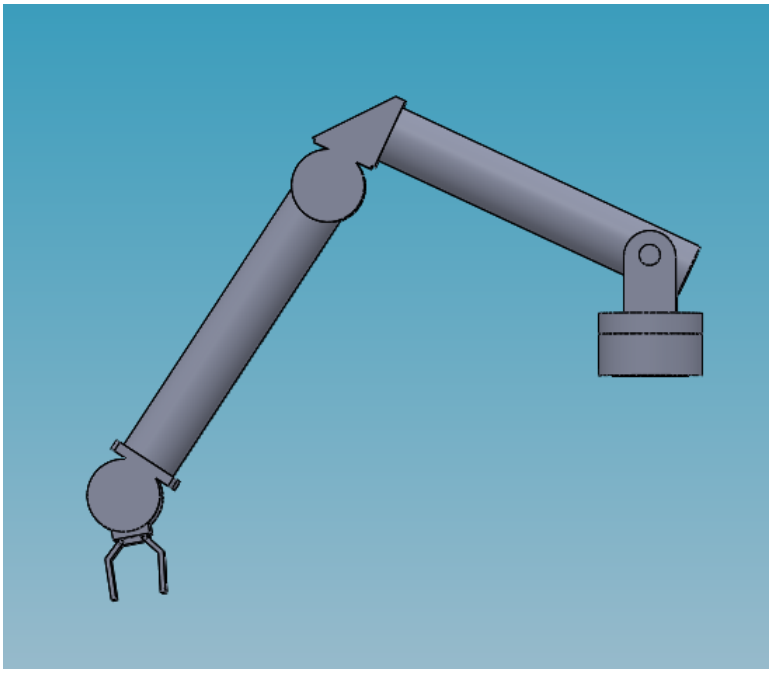

Figure 3.3: Side View of Robot Arm

Bibliography

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