Analysis of *Terrain-Adaptive Wheel Speed Control on the Curiosity Mars Rover: Algorithm and Flight Results*

Robert Vandemark Diane Ngo

2020
November

Contents

Abstract

Throughout recent decades, the topic of space exploration is desirable towards scientists and researchers. Mars is the nearest planet that is possible to explore in great detail. There are many challenges pertaining to exploring unknown territory, through long distance, and difficulty of remotely operating robots. NASAs approach to exploring and researching Mars was through the Sample Return Rover, created in 1997 by the JPL Jet Propulsion Laboratory. The scope of this project focuses on the Mars Rover, its wheel-slip detection (traction control), and path-planning towards a desired object.

Introduction

The Mars Rover is a Sample Return Rover designed by the JPL NASA Laboratory. It consists of a chassis with a central revolute joint on both the left and right sides of the robot. The central revolute joint is connected to two links (on each side), for the front and rear wheels. Each respective link is connected to another link downward that is connected to a wheel. The front links are revolute so that the robot can turn left and right.

Primitive designs of this robot had a large amount of damage to the rovers wheels. This wheel damage reduced the longevity of the Mars Rover mission by a great amount. NASA had to counteract this damage through researching the cause of the wheel damage. The rover did not properly avoid terrain obstacles nor did it deal with traction loss. The goal for this project is to recreate the traction control algorithm and simulate the results. The algorithm for the traction control is a velocity-based algorithm. One wheel on the rover will be rotating much faster than the others. The traction control system then applies a brake to that wheel to reduce its slip and then reducing wheel slip.

Bibliography

[1] Arturo Rankin Amanda Steffy Gareth Meirion-Griffith Dan Levine Maximilian Schadegg Mark Maimone Olivier Toupet Jeffrey Biesiadecki. "Terrain-Adaptive Wheel Speed Control on the Curiosity Mars Rover: Algorithm and Flight Results". In: *Journal of Field Robotics* (2018), pp. 699–728. DOI: `http://dx.doi.org/10.1002/rob.21903`.

[2] T. L. Huntsberger P. S. Schenker and G. T. McKee University of Reading (UK) P. Pirjanian Jet Propulsion Laboratory (USA). "Robotic Autonomy for Space: Cooperative and Reconfigurable Mobile Surface Systems". In: i-SAIRAS 2001. Canadian Space Agency, St. Hubert, Quebec, Canada, 2001.