# Autonomous Navigation for Rover with Ackerman Steering using GPS

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## Abstract

This paper describes the control of a rover with Ackermann steering and an independent rear propulsion unit that is directed to a predetermined location based on the GPS location of the target and moves automatically there. Detailed hardware and software implementation information and practical implementation experience are presented.

## Ⅰ. Introduction

Autonomous driving is an essential area of study for academics and researchers in the present day, as it provides an alternative and safe mode of transportation. Among the applications for autonomous vehicles (AV) are space exploration, search and rescue missions, agricultural tasks, and military missions [1]. Without assistance from a human, these vehicles can perceive their immediate surroundings and navigate safely. Rover are among the most prevalent and significant autonomous vehicles. Rover must overcome numerous obstacles, including obstacle avoidance, path creation, optimization, trajectory tracking, and others [2]. In this research, we take into account autonomous rover navigation with Ackermann steering. The rover will move in the direction of the target based on the GPS position.

## Ⅱ. Method

### 1. Ackermann Steering

Numerous concept decisions must be made during the design process of a mobile robot in order to choose a suitable solution for each construction aspect while keeping in mind frequently contradictory requirements. The selection of the chassis type is among the most significant.

Ackermann steering, also known as "kingpin steering," eliminates the variation in the steering wheel's angle during turns. This difference is due to the fact that each wheel has a different radius, requiring the inner wheel to be tilted slightly more than the outer wheel. This principle significantly decreases tire slippage, which is important especially at higher speeds. It is accomplished by a double pivoting system with angled pivots. The angle must ensure that the kingpin axis, pivot end, and rear axle center are aligned (as shown on Fig. 1). A threaded rod can be used to detent the static toe-in in order to improve driving behavior. [3]

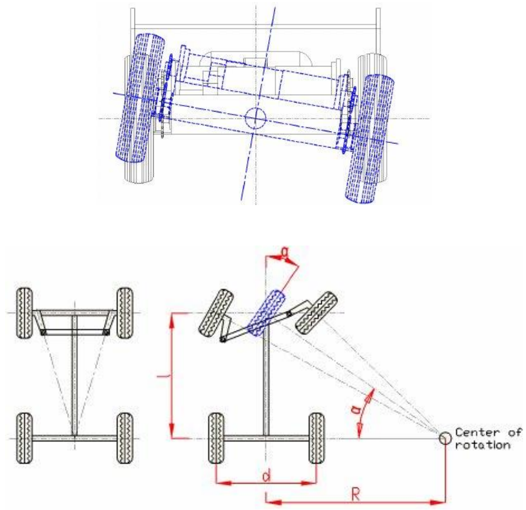


Fig 1. Ackermann Steering Concept

### 2. PID Controller

The PID controller allows for the regulation of the step response rate of the closed control system. To implement our hypothesis, which involves installing the PID controller in our system, we must determine the steering model, the radius rover's turn, and the DC and servo motor specifications.

### 3. Experiment

The rover used in the tests (Fig. 2) is equipped with a telemetry module for communicating with the base station. Installed on the rover is a GPS module that determines the rover's position. We use the rover's GPS, which is connected to the ardupilot software, to figure out the coordinates of each spot where the rover will go (Figure 3). The next action is to set the rover's PID (Fig. 4). In this experiment, we set our rover's speed to 5 km/h, and the speed drops by 30% when it turns.

Fig 2. Rover

Fig 3. Setting “Target Position”

Fig 4. Setting “PID”

## Ⅲ. Conclusion

Rover testing results are shown in figure 5. In the picture, it can be seen that there are two lines, each of which is yellow and red. The red color denotes the rover's path, and the yellow line connects each target the rover will aim at.

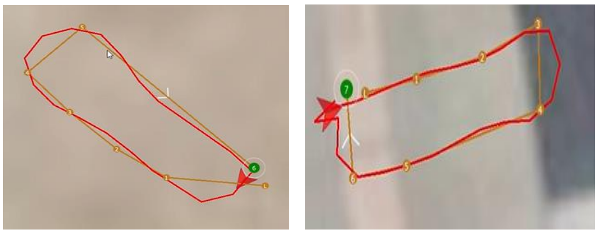

Fig 5. Actual Path

According to figure 5, the target rover is moving in the direction of the target position point rather than along the line that connects all of the targets. In order to draw the conclusion that the rover is capable of moving automatically to a location that has been correctly determined while the error value obtained is less than 20 cm at each position point. Figure 6 depicts the PID signal that has been configured for the rover.

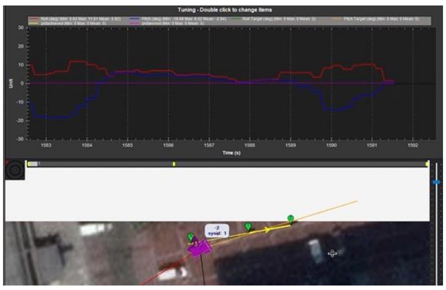

Fig 6. PID Signal

## ACKNOWLEDGMENT

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