# Mobility for Wheeled Ground Systems

Bridger Jones A02314787

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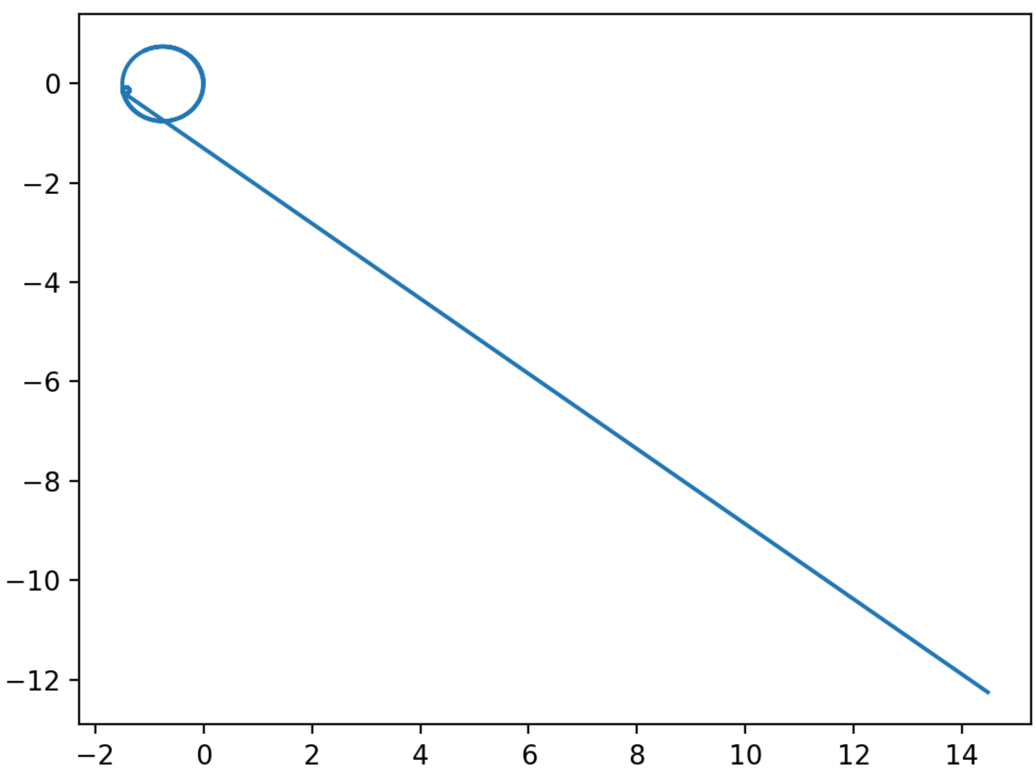
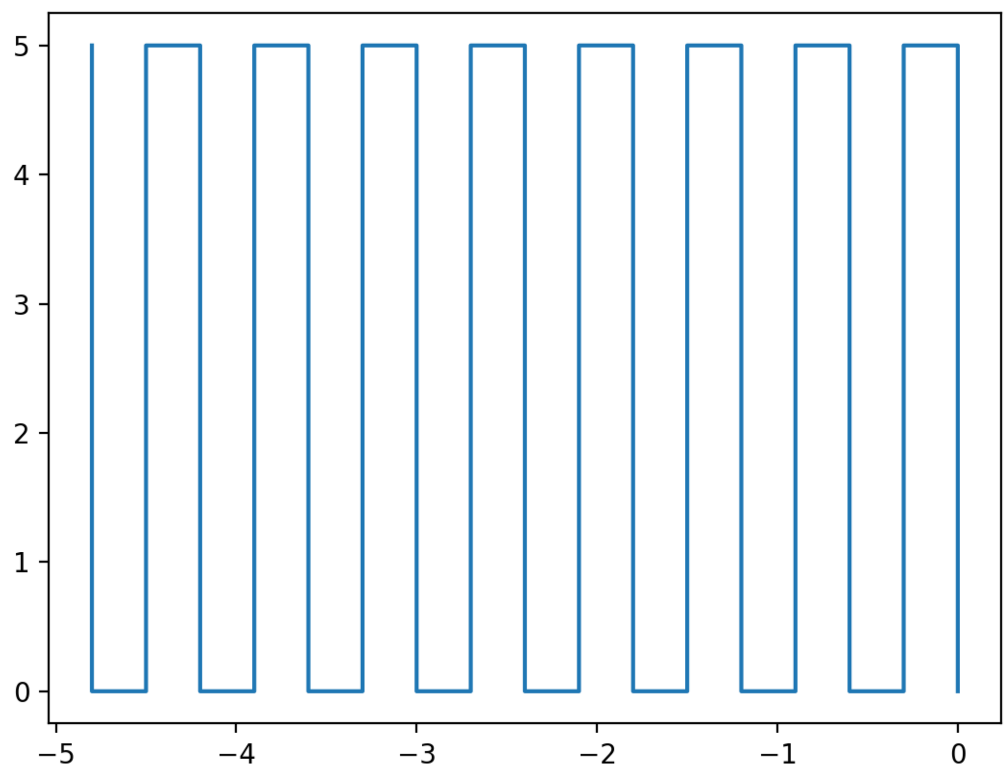
## Problem 1

This is the path plot for the commanded paths with a deltaTime=0.01.

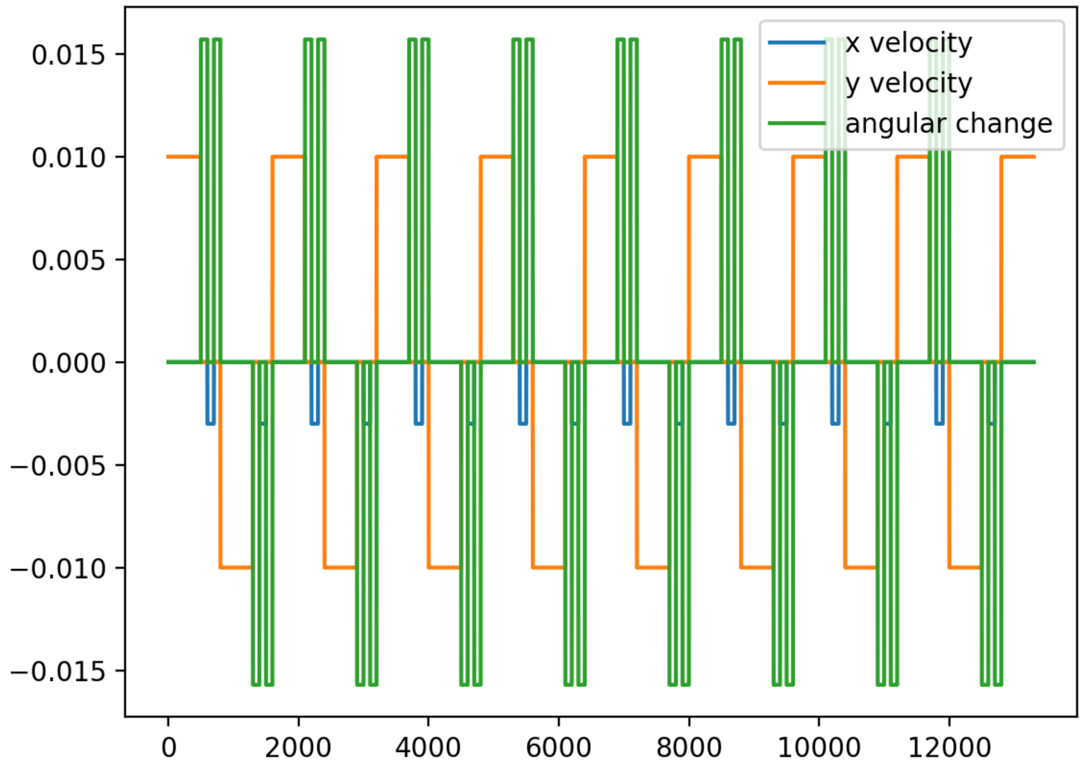


## Problem 2

This is the path plot for covering a 5M by 5M surface with a .30M by .50M skid steer robot. This robot turns in place to accomplish the turns using only the $v_{left}, v_{right}$.



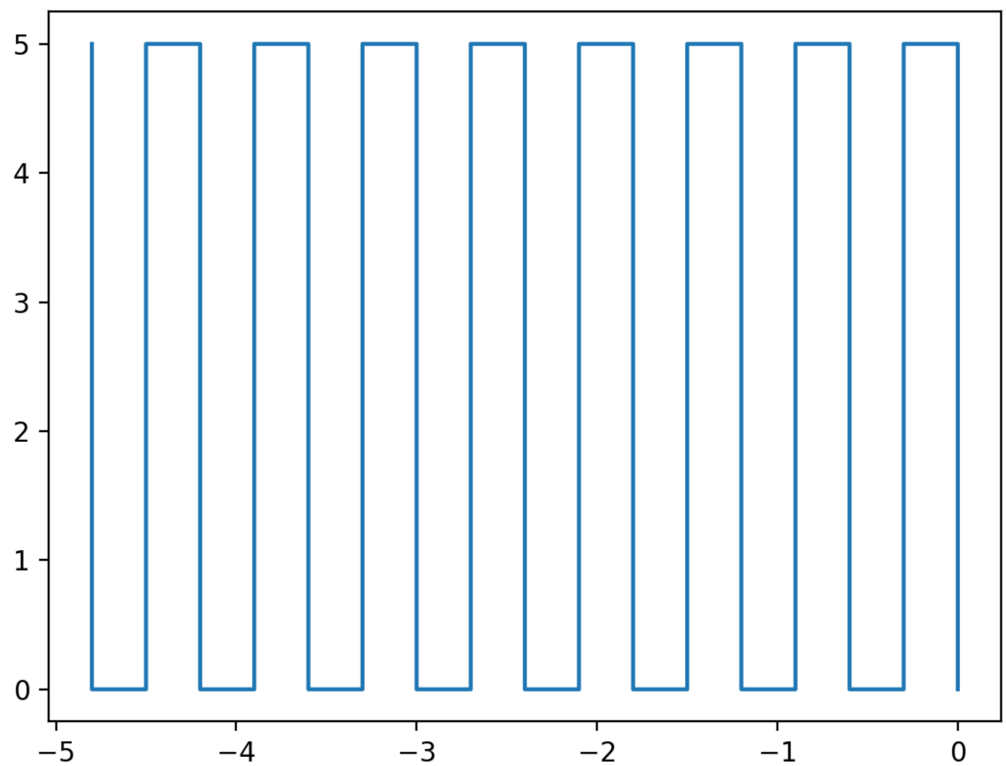
This is the trajectories plotted against time. In the simulation this was equivalent to tracking each change in x velocity, y velocity, and theta. You will see that there are about 13 seconds of samples. You can clearly identify the points where the robot was turning in place and changing directions. There is a method in the code that is called turtlefy that shows an animation of the robot traversal. It is rather slow though. Sorry. :)



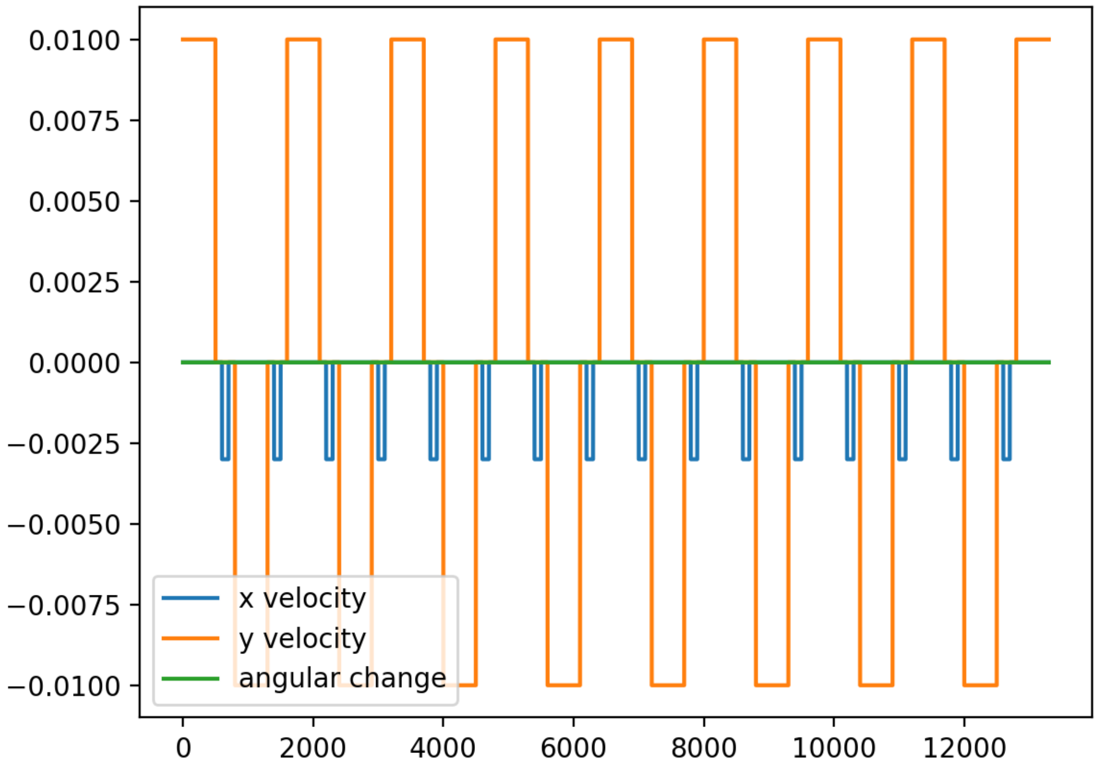
## Problem 3

This is the path of the robot assuming that we have swedish wheels. The main difference between this path and the skid steer implementation above is that this robot is holonomic. This robot can accomplish the same path without a need to change theta. In this case the robot always orients itself to 0Radians. A unique challenge with this robot is that there would need to be a simulation for x velocity, and y velocity for every wheel. Since rotation is controlled by these 4 wheels individually, it is likely that more error would be introduced. The robot would need to have some form of automatic correction to maintain its heading of 0Radians throughout the whole path. This simulation does not simulate the 4 individual wheels. It assumes that it can travel in every direction.

This is the plot of the path.



This is the graph of the velocities and change in theta over time.




## Conclusion

There are some major factors that are not being represented in this situation. In the case of the skid steer configuration, there is no feedback or internal system that is verifying the optimized path finding. Friction is ignored in the simulation which would introduce potential challenges and error into the path. There are a few moments when part of the robot may protrude from the 5M by 5M barriers. If this was a wall, this would cause a collision. Error in the path would also potentially cause some areas to never be covered. This would make for a very poor roomba as there would always be a dirty corner. With the swedish wheel implementation, there would have to be some form of internal correction system for the heading angle of the robot. This tiny angle errors are not represented in the simulation but it would have to be accounted for in a field experiment. Friction would be a significant challenge as each wheel would have its own motor. I think that coverage would actually be better with this robot because it could fit into corners without to many crazy maneuvers. An important difference between the swedish wheeled robot and the skid steer is that the swedish wheeled robot can rotate in its relative frame while moving. The skid steer must be stopped to rotate in place, or it must accomplish the turn within the confines of the turn radius and $\Phi$.