Abstract

With the growth in population throughout the world increasing, the need for transport, particularly around urban areas, the existing methods cannot keep up with the current demand. A better, more sustainable transport system must be found in order to keep up with the demand. Shared mobility-on-demand systems can improve the current systems of urban mobility. Autonomous vehicles partnered with the increase in demand for shared mobility apps such as UberPool, proves there is a clear want and need for this kind of technology. It seems only natural that optimizations are made in this area.

The main area of research needed for this kind of system is how to match requests with vehicles. This is a large area of research which focuses on using machine learning techniques to optimize matching. It mainly looks at research areas such as, predicting the demand of rides and using the shortest path as an optimizer. Whilst a lot of progress has been made in the area of shared mobility-on-demand systems, the methods that have been tested so far have been unrealistic. They focus on how models, e.g. Reinforcement Learning models, will work in an ideal simulation without taking into consideration real world attributes.

The main aspect that affects the time and profitability of a ride is traffic congestion. This is uncontrollable and will always be present when dealing with mobility systems. For this reason it must be taken in consideration before such models are implemented to the public. This research project will develop a model to take into account the congestion on the routes, to optimize ride time for clients and to optimize profits for the vehicle. This project will look specifically at congestion as the main real world attribute, that will have an effect on SaMOD. This thesis proposes a congestion-aware multi-agent reinforcement learning based solution to optimize request-matching sharing on SaMOD. It will simulate on a map of Dublin, as Dublin has yet to have a SAMoD study.

We evaluated the solution against a second scenario which was not congestion-aware. We looked at metrics that affected the rider, the vehicle and the environment. When the agents were congestion-aware, we saw a large increase in the number of shared miles however, this also increased the total distance that each vehicle travelled per hour. The passengers saw a larger wait time when the agents were congestion-aware, however they benefited from a lower travel time.