AA 222 Project Proposal - Optimization of Hydrogen Fuel Stations

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1 Problem

Over the past few years, significant progress has been made in the development of hydrogen fuel cells in the automobile industry. Although battery power continues to dominate the consumer market, hydrogen power is seen as a viable fuel source for commercial markets like the trucking industry. Numerous manufacturers are currently developing hydrogen power semi-trucks, with Toyota planning to deliver a demonstration vehicle by the end of 2021. However, the largest roadblock continues to be the lack of infrastructure, namely the limited hydrogen refueling stations across the country.

Unlike traditional electric charging station, the initial startup costs of a hydrogen refueling station is very high, costing 1 to 2 million dollars for each station. Because of this, it is important for new stations to be placed in ideal locations to maximize the usage of the technology.

For this project, we plan to address this problem, creating a model to find the optimal location for the placement of new hydrogen refueling stations.

2 Approach

To help simplify the scope of the problem, a model of a transportation grid will be created to mimic the routes the trucks will take. Rather than create a network that corresponds to roads in the real world, a custom network will be created instead to scale back the complexity of the problem.

Inside the network, distribution centers will be established at various locations, with each center having predetermined locations for where packages must be shipped. This will ultimately determine the routes the trucks will take. To simplify the problem further, we will assume that trucks only have one destination for all packages, rather than stopping off at multiple destinations to drop off various packages. Optimal paths can be determined by using path optimization algorithms like A* or can also be hard coded for simplicity.

With the optimal paths for the trucks determined, we can narrow down our search of the best locations for hydrogen refueling stations in the network. A mixed integer programming method will most likely be used to perform this optimization.

3 Success Criterion

Success for this problem will be defined by the total amount of fuel required to deliver all the packages. Beside the fuel used to deliver the packages from the centers to the final locations, fuel will also be spent driving to the refueling stations. The refueling locations that require the minimum amount of hydrogen fuel will be deemed the best in this optimization.