E-BIKES REBALANCING OPTIMISATION WITH ARTIFICIAL INTELLIGENCE

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Bicycle share systems (BSS) are now widespread in major cities around the world and represent a sustainable mode of transportation. The main issue they face is rebalancing e-bikes between stations. Riders most often travel farther to find a station with available bikes, while others cannot park their e-bikes at full stations and must leave them elsewhere. This discourages people from using such sustainable transportation. To address this issue, one common solution is known as truck-based rebalancing, where the bikes are transported by vehicles between stations to maintain balance. However, this method still requires optimization to improve efficiency, reduce operational costs and greenhouse gas emissions, ensuring a more effective and sustainable rebalancing process.

This paper aims to find an optimized truck-based rebalancing solution for station-based BSS. Where the study compares two different strategies and evaluates which is most efficient based on the met-demand criteria. Divvy BSS of the city of Chicago serves as the case study to conduct this research. The first strategy used is short-term prediction for daily or multi-hour forecast using Random Forest algorithm, historical and weather data as seen in **Ashqar et al. (2020)** which was found to be the most efficient way to predict demand, followed by, identify likely deficits and surpluses at specified times to plan repositioning hours according to what **Cho et al. (2021)** suggested. Finally, a small Vehicle Routing Problem (VRP) solver is used for an optimal route within each timeslot. The second strategy is also predicting the demand with random forest however the rebalancing optimization depends on multi-stage Genetic Algorithm (GA) as seen in **Xanthopoulos et al. (2024)**.

The Genetic Algorithm demonstrates to be more efficiency regarding overall optimization. However, it necessitates considerably greater resources and processing time in comparison to the initial strategy, which employs human-driven decision-making with a Vehicle Routing Problem (VRP) solver.

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