

Dynamically Routing Reserve Buses to Reduce Passenger Wait Time

Abstract

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Even with the technological and analytical advances available today, passengers waiting at stops for public buses still suffer from long waiting times and witness the bus bunching problem. The bus bunching problem is the phenomenon by which a group of two or more buses which were scheduled with even headways along the same route arrive at the same location at the same time. External influences to the bus route such as pedestrian and vehicle traffic, local event crowds and construction delays can often drastically effect the punctuality of a bus. This is because urban bus transportation networks often still operate on a fixed schedule basis. This can leave passengers waiting at their stop for an elongated period of time and result in further delays in their day, especially in situations where a scheduled bus unexpectedly reaches capacity.

Buses in urban public transportation networks are not typically re-routed off their designated route until the route has been completed. There are several approaches that have been proposed in order to reduce bus bunching, optimise bus routing and therefore reduce passenger wait time. Bus holding methods researched in previous works propose holding the bus at control points on different conditions. Approaches adopting self-equalizing headways between buses and utilising a speed change & holding control model have been proposed in previous studies. However, although these approaches can reduce bus bunching and slightly reduce passenger wait time, these systems would not adapt to cater for a sudden large unexpected influx of passengers.

This paper outlines a new approach to allow for a small surplus of reserve buses to have the ability to be dynamically routed to areas in need of extra passenger capacity. The aim is to reduce passenger wait time at bus stops, particularly investigating the behaviour when a large unexpected influx of passengers arrives at a bus stop or area of bus service and fills a bus to capacity. A web application was developed using Leaflet JS, D3.js and the Graphhopper API which allows for the input and adjustment of parameters such as traffic density and the volume of passengers waiting at bus stops. The application can simulate a bus's journey along its typical route and, if the bus reaches capacity, the journey of dynamically routed reserve buses will be simulated and the journey statistics will be displayed at the end for comparison.

The findings of this work can be summarised as follows: using dynamically routed reserve buses, particularly during events involving a scheduled bus unexpectedly reaching capacity, is feasible to potentially reduce passenger wait time compared to the average scheduled bus. The reserve bus must be waiting within close proximity to the problem area to produce significant reductions but with further work this distance could be increased and thus the feasibility of a reserve bus implementation increased.