

Modal

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Aeronautics Research Support

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Centrally Coordinated Schedules and Routes of Airport Shuttles with Los Angeles Airport (LAX) Terminals as Application Area

Develop a CENTrally COordinated Shuttle system (CENCOS) to effectively coordinate shuttle schedules and routes in order to minimize curb congestion at the pick-up and drop-off points.

WHAT IS THE NEED?

A critical problem facing U.S. airports as they respond to growth in services and operations is the limitation of curbside parking for shuttles to pick-up and drop-off passengers during peak hours. Today, shuttle companies and airport operations work independently without any schedule coordination, leading to frequent congestion near the pick-up and drop-off points that negatively affects passenger traffic leading to unnecessary idling, delays, and congestion with negative impact on air quality and quality of service to passengers. Accurate prediction of arrival times at the pick-up and drop-off points depends on traffic conditions, which are time varying, as well as on the schedules of other shuttles sharing the same curbside spots. Without any form of central coordination, a single shuttle company cannot accurately develop a schedule that maintains a high quality of service at a reduced operational cost. This problem is exacerbated by existing and growing shuttle services provided by the airports themselves, centralized car rental facilities, and public transportation hubs.

Furthermore, the transition of conventional shuttles to electric ones and the possibility of autonomous shuttles adds additional complexities that necessitate the use of a centralized shuttle coordination system for optimum performance.



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WHAT ARE WE DOING?

The Researchers will consider the Los Angeles International Airport (LAX) terminals as the study area and collect all information regarding shuttles serving the airport as well as relevant traffic data and update the digital twin of the LAX traffic developed by the PI in 2018 with the support of Los Angeles World Airports (LAWA). They will develop the CENCOS system based on a co-simulation optimization approach for scheduling the airport shuttles of different companies serving the airport with the objective of minimizing cost due to delays, energy consumption, and congestion at the curbside where the pick-up and drop-off points are located, while improving the quality of service. They will also incorporate electric and automated shuttles in the CENCOS system and evaluate cost and energy savings and benefits to environment as the percentage of electric shuttles increases for each shuttle company. The researchers plan to incorporate automated shuttles on fixed routes in the CENCOS system and evaluate the impact to the overall cost and performance.

The researchers plan to use Monte Carlo microscopic traffic simulations integrated with the United States Environmental Protection Agency (EPA) Motor Vehicle Emission Simulator (MOVES) to quantify benefits to congestion, environment and operational cost benefits. The design, analysis and evaluation results with LAX as an example will be presented in the final report with conclusions and directions for future steps.

WHAT IS OUR GOAL?

The goal is to develop a Centrally COordinated Shuttle system (CENCOS) which can effectively coordinate shuttle schedules and routes in order to minimize curb congestion at the pick-up and drop-off points, reduce operational cost, improve quality of service with considerable benefits to mobility and environment. Such a system should also support emerging technology trends including burgeoning electrification and automation.

CENCOS will be designed using a co-simulation load balancing approach where the digital twin of the traffic network is part of the optimization procedure in order to take into account complex traffic dynamics and interactions of vehicles and generate accurate predictions of traffic states at the various links to be used by the optimizer. The system will receive demands and desired schedules from all shuttle companies and generate schedules and routes that minimize an overall system cost while meeting the performance and operational cost goals of each shuttle provider.

WHAT IS THE BENEFIT?

The project falls under the area of mobility. A centrally coordinated airport shuttle system is expected to reduce congestion at the pick-up and drop-off locations at airport curbs and transportation hubs with significant benefits to the environment and fuel economy. A well operated airport shuttle system with accurate schedules will lead to less traffic at congested airport lanes during peak hours. Incorporating and analyzing new technologies such as electric and autonomous shuttles, and quantifying their benefits to operational cost and the environment, is also very relevant to mobility in general. Airports such as LAX generate a lot of traffic and congestion at the airport lanes that will affect traffic in arterial streets and highways feeding and accepting traffic from the airport.

WHAT IS THE PROGRESS TO DATE?

Update October 1, 2022 - December 31, 2022

Numerical experiments were performed for the proposed centrally coordinated shuttle scheduling and routing system. The system shows the benefits with respect to combined time and energy cost. The final report was also finished in this period and submitted.

IMAGE

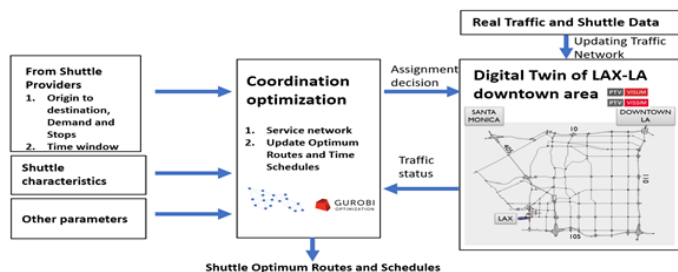


Image 1: Centrally Coordinated Shuttle System (CENCOS) for LAX