Automated vehicles and central business district parking: the effects of drop-off-travel on traffic flow and vehicle emissions Dataset

Dataset available at: https://doi.org/10.25338/B8DG7P

(This dataset supports report **The Impacts of Automated Vehicles on Center City Parking Demand,** https://doi.org/10.7922/G2X928J)

This U.S. Department of Transportation-funded dataset is preserved by the California Department of Transportation in the digital repository Dryad (https://datadryad.org), and is available at https://doi.org/10.25338/B8DG7P.

The related final report **The Impacts of Automated Vehicles on Center City Parking Demand**, is available from the National Transportation Library's Digital Repository at https://rosap.ntl.bts.gov/view/dot/50716.

Metadata from the Dryad Repository record:

Abstract: The potential for automated vehicles (AVs) to reduce parking to allow for the conversion of on-and off-street parking to new uses, such as new space for walk, bike, and shared -micro-mobility services, and housing), has sparked significant interest among urban planners. AVs could drop-off and pick-up passengers in areas where parking costs are high or limited. Personal AVs could return home or park in less expensive locations and shared AVs could serve other passengers. However, reduced demand for parking would be accompanied by increased demand for curbside drop-off/pick-up space with related movements to enter and exit the flow of traffic. This change could be particularly challenging for traffic flow in downtown urban areas during peak hours when high volumes of drop-offs and pick-ups events are likely to occur. Only limited research examines the travel and greenhouse gas effects (GHG) of a shift from parking to drop-off/pick-up travel and the effects of changes in parking supply. Our study uses a microscopic road traffic model with local travel activity data to simulate vehicle travel in San Francisco's downtown central business district to explore traffic flow, VMT, and GHG effects of AV scenarios in which we vary (1) the demand for drop-off and pick-up travel versus parking, (2) the supply of on-street and off-street parking, and (3) the change in demand for parking and drop-off/pick-up travel due to a significant change in price of using curbside space.

Methods:

- Demand Modeling: We selected the microscopic road traffic model (Simulation of Urban MObility or SUMO) to simulate the traffic flow effects of the AV scenarios. SUMO is an open-source, highly portable, multimodal, microscopic road traffic simulation package designed to handle large road networks (Behrisch et al., 2011). The SUMO simulation used local travel activity data from the San Francisco Bay Area MATsim (SFBA-MATsim) model (Horni et al., 2016; Jaller et al., 2019; Rodier et al., 2018). This model was developed and calibrated with the official San Francisco Bay Area Metropolitan Transportation Commission's Activity-Based Travel Demand Model (MTC-ABM). The geographic focus of this study is the central business district (CBD) in the City of San Francisco. We selected individual daily activity tours with at least one vehicle stop in st

CBD during the 24 hours (an average weekday) from the SFBA-MATsim model. Arrival and departure times for vehicle tour stops are in increments of seconds in the SFBA-MATsim model. We also converted transit vehicle stops to AVs stops for purposes of the scenario simulation. From the SFBA-MATsim model, we obtained about 900,000 travelers making 1.8 million trips with about 1% of the trips representing internal trips and the remainder had at least one stop in the study area. Total simulated vehicle trip volumes in the network were adjusted to match roadway supply (see discussion below), transit supply, and model year congestion levels.

- Network and Traffic Analysis Zones: The SUMO simulations use transportation analysis zones (TAZ) that are consistent with both MTC-ABM and SFBA-MATsim models' zone system. The TAZs in the study area are among the smallest in the region and include small numbers of census blocks. For this specific network, there are 45 TAZs in total. We used the SUMO network editor to import the OpenStreetMap for the San Francisco CBD roadway network. We edited the OpenStreetMap roadway network to exclude minor roads. Major roads in the CBD were included in the final network to increase the efficiency of SUMO simulations.

- Parking Supply Data: The San Francisco (SF) Parking Census is the source of the parking supply data used in this study (http://sfpark.org/resources-overview/). The San Francisco Municipal Transportation Agency (SFMTA) collected the parking supply data: 97% through field surveys and 3% through remote resources. The on-street parking supply in the dataset includes metered on-street spaces, non-metered demarcated spaces (parking stalls), and non-metered un-demarcated spaces (unmarked curb length). For non-metered spots, we apply a standard 17 feet per parking space, which is the length needed by an average sedan to park between two vehicles. If there was a short length of curb space that could only support one vehicle, we used 12 feet as the length of the parking spot. For any unmarked perpendicular parking, we used a standard of eight feet and six inches of curb space. We did not include controlled parking and restricted parking spaces in the data set. We used ArcGIS to model the parking data and transferred the data to SUMO using spatial analysis tools. The data set included 1,351 on-street parking locations with a total capacity of 20,019 parking spots within the study area. For off-street parking, there are 356 locations with a total capacity of 65,404 parking spots.

How to run the model?

- Preparation:
  1. Install SUMO from: http://sumo.sourceforge.net/
  2. Download the datasets, and unzip the zipped files.

- Method 1: Use the following command to run one SUMO simulation: *sumo-gui -c san_francisco.sumo.sfg*. Modify the scenario number (Scenario_Set_X) in *san_francisco.sumo.sfg* to switch between different scenarios.

- Method 2: Inside each scenario set folder (Scenario_Set_X), use the bash script *run.sh* to run the simulation. You can use this command: *bash run.sh*. Simulation configurations have been properly set in run.sh. This method allows you to run multiple simulations simultaneously. SUMO input files are those that are used as input to run SUMO. They typically reside in the **Scenario_Set_x** directory hierarchy, including the following folders **edge_dump_config, parking, rerouter** and **trips.**

- **edge_dump_config folder** contains configuration files that define what edge-based output files will be produced.
- **parking folder** contains parking supply datasets.
- **rerouter folder** contains configuration files that define how vehicles will be re-routed in the road network.
- **trips folder** contains vehicle travel trips.
- Other supporting data:
    - **san_francisco_plans_0.01.xml, san_francisco_plans_0.05.xml, san_francisco_plans_all_7.xml** are original personal daily activity plans. It is extracted from the whole Bay Area MATSim travel demand model for the study area. **0.01, 0.05** and **all_7** correspond to 1%, 5% and 100% sample rate, respectively.

SUMO output files, analysis data, and visualizations are files generated by SUMO runs, or by postprocessing. They typically reside in a directory hierarchy starting with **results** and **plots**.

- **results folder** contains simulation output, including emission, queues, edge-based traffic, summary and so on.
- **plots folder** contains visualizations files generated by postprocessing.

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Dataset description:
This dataset contains 1 .zip file collection described below.

doi_10.25338_B8DG7P_v5.zip:
This collection contains 5 .zip files, 10 .xml files, and 2 .cfg files, listed below. The general explanation of files is provided below. This was taken from the metadata within the Dryad repository.

Inside each scenario set folder (Scenario_Set_X), use the bash script *run.sh* to run the simulation. You can use this command: *bash run.sh*. Simulation configurations have been properly set in run.sh. This method allows you to run multiple simulations simultaneously. SUMO input files are those that are used as input to run SUMO. They typically reside in the **Scenario_Set_x** directory hierarchy, including the following folders **edge_dump_config, parking, rerouter** and **trips.**

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National Transportation Library (NTL) Curation Note:
As this dataset is preserved in a repository outside U.S. DOT control, as allowed by the U.S. DOT's Public Access Plan (https://ntl.bts.gov/public-access) Section 7.4.2 Data, the NTL staff has performed ***NO*** additional curation actions on this dataset. NTL staff last accessed this dataset at https://doi.org/10.25338/B8DG7P on 2020-09-30. If, in the future, you have trouble accessing this dataset at the host repository, please email NTLDataCurator@dot.gov describing your problem. NTL staff will do its best to assist you at that time.