Fundamentals of Traffic Operations and Control
Nikolas Geroliminis
Exercise
Bus bunching

Introduction

In this exercise we will do an analysis of bus operations with data from a real case study. The provided data corresponds to real measurements gathered from the bus operators in the city of Geneva (one specific day in September 2014 and one specific bus line). The objectives of this exercise are to analyze the bus trajectories, identify if there is bunching of buses in this specific line and propose a simple solution to avoid this phenomenon that affects the reliability of the service.

Data description

The provided *.mat* file contains all the bus data which consists of a collection of events located in time and space and can be used to describe the trajectories of the buses. These events are recorded every time a bus passes some particular places, e.g. the bus stops. More precisely, the data file contains the following:

- 4 vectors of length 2852x1 where each row corresponds to one event and include:
  - *boarding*: number of passengers that are waiting to board to the bus at the stop related to this event
  - *course*: the ID of the trip that this event belongs to (each trip goes from the beginning to the end of the bus line)
  - *dist_btwn_stops*: distance covered between this stop and the previous one [m]
  - *ts1*: time that the bus arrived at the specific bus stop [h] (real number in (7, 21), e.g. only buses with departure time between 7:00 and 21:00 are considered)
  - *ts2*: time that the bus departed from the specific bus stop [h]
- 2 cell arrays of size 2852x1 where each row corresponds to one event and include:
  - *Libelle*: the name of the bus stop that corresponds to this event
  - *stopID*: the bus stop ID that corresponds to this event

1) Plot in a space-time diagram the trajectories of all buses for this line. The time of the day should appear on x-axis and the distance (in meters) on y-axis. Comment on the trajectories. Do you see any bus-bunching? Pick 4 bus stops and plot the distributions of headways (in minutes) for all the events.

   Note: You should use the average distance of all the recorded events for calculating the distance between two consecutive stops. The vector dist_btwn_stops contains some NaN elements. These refer either to terminal stops or to measurements that are not available and should be ignored when calculating the distance between the stops.

2) Assume that the average time needed for boarding to the bus is 0.5 sec/passenger in all stops. Pick a bus-bunching instance from your diagram with the trajectories and propose a simple strategy that could prevent this from happening. The bus can skip some passengers that want to board and leave them for the next bus. This will decrease the waiting time of the bus at the stop and increase the waiting time of the following bus. Plot the new trajectories around that time of day that demonstrate the mitigation of bus-bunching.

3) Based on your experience from the course, describe a strategy related to traffic management in a few sentences. (Hint: speed of each bus can be controlled.)