PREDICTING BIKE AVAILABILITY IN DOCKLESS BIKE SHARING SYSTEMS

Thesis presentation I - Luuk van der Meer – October 24, 2018

TOPIC

- Several studies have focused on bike availability in **station-based** bike sharing systems.
- They predicted the **number of available bikes** at a **docking station** at a given moment in the future.
- **Dockless bike sharing** is the new generation of bike sharing systems, where bikes are **not** bound to stations anymore.
- How can we **predict bike availbility** in these systems?

TODAYS PRESENTATION

- Data gathering
- Literature review
- Proposal

DATA GATHERING

Challenges

- The data of dockless bike sharing systems is not available as open data.
- Usually no reply from dockless bike sharing operators on data requests

DATA GATHERING

Finally, I got data!

- JUMP Bikes.
- Dockless bike sharing operator with electric bikes.
- US company, also expanding to Europe.
- Data from San Francisco & Washinton DC.
- Every minute the location of the available bikes.

LITERATURE REVIEW

Challenges

- Almost **no research** done in the specific field of dockless bike sharing.
- A broad range of methods used in other fields (e.g. demand predictions for docked bike sharing, car sharing, taxis, public transport and ambulances, crime predictions, ...), that could *possibly* be of use.

  → needed to choose **one** suitable method

LITERATURE REVIEW

2015 IEEE Intelligent Vehicles Symposium (IV)
June 28 - July 1, 2015. COEX, Seoul, Korea

On the prediction of future vehicle locations in free-floating car sharing systems*

Simone Formentin, Andrea G. Bianchessi and Sergio M. Savaresi

Abstract— **The free-floating car sharing model is a recently introduced vehicle rental model, which allows customers to return the car anywhere within the operation area, without relying on depot stations. Driven by the flexibility of such a model, the popularity of car sharing has increased rapidly during the last years. However, some critical issues still arise when a user needs to make plans of vehicle usage, since no information is available on future vehicle locations. In this paper, the Vehicle Distance Prediction (VDP) approach is proposed, aimed to predict the distance of the nearest available vehicle at a given future instant. This technique shows great potential also for the service manager, *e.g.* vehicles could be moved in advance by the staff to balance the fleet distribution. The effectiveness of the proposed prediction approach is assessed on a real dataset taken from a car sharing service in Milan, Italy.**

I. Introduction

plans prefer not to use free-floating car-sharing services, as usually they are not willing to accept to walk for more than 500 meters [12].

In this paper, the *Vehicle Distance Prediction (VDP)* approach is presented. The idea is to use past vehicle-locations data to compute a prediction of future vehicles locations and provide the distance from the nearest vehicle to the users, who are then allowed to make future plans of the vehicle usage. This technique could be useful also to manage the car-sharing service, allowing the staff to move vehicles in advance to cover the zones without vehicle availability.

To the best of our knowledge, the scientific literature which addresses the problem of predicting the future locations of fleet vehicles is quite poor and nothing has been

PROPOSAL

Outline of the proposed prediction model

- User gives the **location** and **timestamp** for the prediction.
- From historic data the **distance** from this location to the **nearest available bike** is calculated for several timestamps in the past → a **time series** of distances.
- An **autoregressive** (AR) model is fitted on this time series.
- The **distance to the nearest availabe bike** at the requested timestamp in the future is predicted, including the **probability** of the prediction.

PROPOSAL

Advantages of this approach

- Data can take on any (positive) value instead of only integers.
- No need to work with grid cells.
- More useful prediction for the user.

make plans about future vehicle use. As a matter of fact, free-floating car-sharing services allow users to make a reservation only a few minutes in advance (only to have the time to reach the vehicle). Therefore, users have no guarantee that they will find a car within a reasonable distance at any desired time in the future.

Common users simply guess that the future picture will be close to the current one (current locations of all vehicles are usually provided by car-sharing companies through their web-sites). However, this guess is likely to be inaccurate, especially when the requested prediction horizon is some hours in the future. It follows that users who need to make

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allows to employ time series with [6] where the values are constrai making optimal time series pre without approximations;

- the performance of the method resolution of the gridding of the

The remainder of the paper is as the problem is formally stated and t to predict future vehicle locations is imental setup used later on to asse presented in detail. Section III prese starting from the system architecture data processing to obtain the final p parison with the benchmark user app analysis, with numerical validation, i IV. Some concluding remarks end th