Survey on Traffic Flow prediction

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Abstract

This document is a short survey for short term traffic flow prediction approaches. There are several kinds of approaches so far. 1) Time series approaches 2) probabilitstic graphs 3) nonparametric techniques 4) kalman filter. I will list related papers and compare the classic approaches in this article.

1 Introduction

Why traffic flow prediction?

1. Better traffic modeling for intelligent traffic system(ITS).

2. Better traffic management to avoid congestion and accident.

Traffic flow prediciton is the critical problem in ITS.

2 Task of traffic flow prediction

X_i^t is the observed traffic flow quantity at the i_{th} observation location at time interval t.

1. **Input:** Observed traffic flow sequence at i_{th} loaction, $\{X_i^t\}$, which $t \in \{1, 2, \ldots, T\}$.

2. **Output:** Traffic flow at given time $X_i^{t+\Delta}$, which Δ is the time prediction horizon .

3 Approaches

3.1 Time series

Time series approaches aims to finding patterns of the temporal variation of traffic flow and then use that information for prediction. Of all these kind of models, (Autoregressive integrated moving average)ARIMA model is mostly used and often used to compare with.

1. Bayesian time series model for short-term traffic flow forecasting, 2007

2. Short term traffic forecasting using time series methods, 1998

3. Predictions of urban volumes in single time series, 2010

4. Combining Kohonen maps with ARIMA time series models to forecast traffic flow, 1996

The time series analysis method are implemented in a library of python - `Statsmodels`

- **Advantages:** Each step has clear meaning; mature statical analysis method.

- **Disadvantages:** 1) often need linear architecture 2) has a delay of prediction as the results, which can be seen as a lag of prediction based on the historical data. As shown in Figure 1, there is a typical lag in the prediction. 3) Show relatively bad results compared to Deep Learning methods in recent papers.

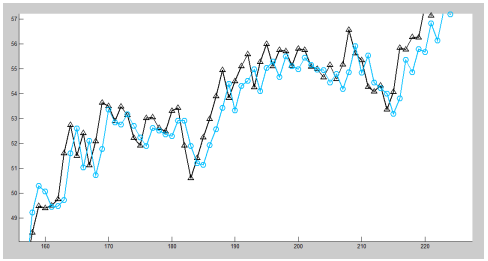

Figure 1: Time series ARMA prediction

3.2 Probabilistic graph approaches

This method look at the problem from a probabilistic graph persepective, such as Markov chain, Markov Random Fields and Random fields. From the standpoint of Bayesian theory, the value of an

object node can be inferred by its neighbor nodes. So forecasting the incomplete data is possible.

1. Variational inference for the infinite mixtures of Gaussian processes with applications on traffic flow prediction, 2011
2. A Bayesian network approach to traffic flow forecasting, 2006
3. Short tern traffic flow forecasting based on Markov chain model, 2003

- **Advantages:** Prediction from probilitistic view and the second paper claims to work when data is incomplete.
- **Disadvantages:** 1) Time-consuming, difficult to converge(Gaussian Process) 2) Not thorough experiment in the paper

3.3 Nonparametric techniques

Applied to scenarios that data is of high uncertainty and complex nonlinearity. Such as artificial neural networks, support vector regression and local weighed learning.

1. Online-SVR for short-term traffic flow prediction under typical and atypical traffic conditions, 2009
2. Traffic prediction using multivariate nonparametric regression, 2012
3. An online approach based on locally weighted learning for short-term traffic flow prediction
4. Short-term traffic flow prediction: Neural Network approach
5. Deep architecture for traffic flow prediction: Deep belief networks with multitask learning
6. Traffic flow prediction with big data: A Deep learning approach

3.4 Kalman Filter

Dynamic Prediction of Traffic Volume through Kalman Filtering Theory.