

#### Hima E. Shaji, Arun K. Tangirala and Lelitha Vanajakshi IIT Madras





Arun K. Tangirala (IITM)

**RESEARCH OVERVIEW** 





• Traffic data – travel time, speed, flow, occupancy etc.

• Traffic data – travel time, speed, flow, occupancy etc.



• Traffic data – travel time, speed, flow, occupancy etc.



• Traffic data – travel time, speed, flow, occupancy etc.



• Traffic data – travel time, speed, flow, occupancy etc.



• Traffic data – travel time, speed, flow, occupancy etc.



• Traffic data – travel time, speed, flow, occupancy etc.



• Traffic data – travel time, speed, flow, occupancy etc.



- Why traffic data analysis?
  - Prediction of traffic parameters
  - Control traffic and reduce congestion
  - > Identification of shortest path between a pair of origin and destination
  - > Dynamic route guidance, incident detection, freeway ramp metering control etc.

• Traffic data – travel time, speed, flow, occupancy etc.



- Why traffic data analysis?
  - Prediction of traffic parameters
  - Control traffic and reduce congestion
  - Identification of shortest path between a pair of origin and destination
  - > Dynamic route guidance, incident detection, freeway ramp metering control etc.

Figure source: Mori, U., Mendiburu, A., Álvarez, M., & Lozano, J.A. (2015). A review of travel time estimation and forecasting for Advanced Traveller Information Systems. *Transportmetrica A: Transport Science*, 11(2), 119-157.

Arun K. Tangirala (IITM)

#### **DATA COLLECTION**

- Data was collected using GPS units fixed on MTC buses in Chennai.
- Study stretch 19B bus route (Length- 29.4 km) Kelambakkam to Saidapet.
- GPS data was collected every 5s. (Date, time stamp, latitude and longitude of the bus location.)
- 1,024 trips over a period of 45 days.
- The distance between two consecutive GPS points was calculated using Haversine formula (Chamberlain, 2013).
- 500 m section travel times were considered.







### DATA HIERARCHY



Elsa Shaji, H., Tangirala, A. K., & Vanajakshi, L. (2018). Evaluation of Clustering Algorithms for the Prediction of Trends in Bus Travel Time. *Transportation Research Record*, 2672(45), 242-252.

Arun K. Tangirala (IITM)

#### MACHINE LEARNING IN TRANSPORTATION



# VARIATIONS IN TRAVEL TIMES



Heat maps showing travel time variations for (a) October 4, (b) October 11.

Peak and off- peak timings do not remain constant for a day over different weeks.



# VARIATIONS IN TRAVEL TIMES



Heat maps showing travel time variations for (a) October 4, (b) October 11.

Peak and off- peak timings do not remain constant for a day over different weeks.

![](_page_15_Picture_1.jpeg)

# PATTERN SEQUENCE FORECASTING

![](_page_15_Figure_3.jpeg)

Arun K. Tangirala (IITM)

![](_page_16_Picture_1.jpeg)

![](_page_16_Figure_3.jpeg)

![](_page_17_Picture_1.jpeg)

![](_page_17_Figure_3.jpeg)

#### MACHINE LEARNING IN TRANSPORTATION

![](_page_18_Picture_1.jpeg)

![](_page_18_Figure_3.jpeg)

#### MACHINE LEARNING IN TRANSPORTATION

![](_page_19_Picture_1.jpeg)

![](_page_19_Figure_3.jpeg)

#### **Results**

![](_page_20_Figure_2.jpeg)

#### Measured and predicted travel times for a sample trip

### RESULTS

![](_page_21_Figure_2.jpeg)

#### Absolute error for a sample trip

Arun K. Tangirala (IITM)

![](_page_21_Picture_7.jpeg)

### RESULTS

![](_page_22_Figure_2.jpeg)

#### **Error metrics for testing**

Error metrics	Selection-based Prediction	Fusion-based Prediction
MAPE (%)	21.02	64.06
MAE (s)	14.77	37.14
NRMSE	0.10	0.21

#### Absolute error for a sample trip

Arun K. Tangirala (IITM)

### **RESULTS**

![](_page_23_Figure_2.jpeg)

#### **Error metrics for testing**

Error metrics	Selection-based Prediction	Fusion-based Prediction
MAPE (%)	21.02	64.06
MAE (s)	14.77	37.14
NRMSE	0.10	0.21

Selection-based

#### Absolute error for a sample trip

![](_page_24_Picture_1.jpeg)

### **COMPARISON BETWEEN ALGORITHMS**

![](_page_24_Figure_3.jpeg)

Absolute error for a sample section over time of the day

<u>Manual grouping</u>: Data was split into weekdays and weekends