Advanced Traveler Information Systems: Qualitative Level of Display of Congestion under Indian Conditions

Sai Vikas
Pavitra Tejaswi
Rini J G
Prabhas
Varaprasad
Dept of Civil Engineering, IIT Madras
Introduction

• Need to improve the efficiency of road transportation in India
• Development of Intelligent Transportation System
  ➢ Advanced Traveler Information Systems
• Effectiveness of traffic systems measured by density
• Need for prediction of future density
Literature Review

• Asha et. al, 2011
  - Objective: Estimation of traffic density for Indian conditions
  - Model based on the flow conservation equation and the fundamental traffic flow equation
  - Obtained a Mean Absolute Percentage Error (MAPE) of 10 to 40%

• Ameena et. al, 2009
  - Objective: Prediction of traffic density in Indian traffic conditions
  - Used historic technique, technique using ANN and model using non-linear Extended Kalman Filtering technique
  - MAPE obtained: 38.57%, 32.47% and 40.83% respectively
Methodology

Data Used

• Temporal data of speed and density collected using videography and GPS

• Simulation by VISSIM for more data

• Calibration of ANN models: three days' simulated data

• Validation: Remaining two days' data
Methodology (contd..)

Location and Schematic Representation of Study Stretch
Methodology (contd..)

Estimation

- Identification of peak and off-peak hours
- One model developed without any segregation, three models developed were compared for a better reliable model
- ANN
  - Input node – speed
  - Output- density from the simulated data.
  - Hidden layer- three nodes with inverse transfer function
  - Output layer- one node with simple linear function
Methodology (contd..)

Prediction

- Separation of data
  - time for which density is rising
  - time for which density is falling
- Separate ANN models developed to predict the density after 30min, 60min and 90min.
- ANN
  - Input node- current density
  - Output node- density corresponding to the time after specific interval, from the simulated data
  - Hidden layer- four nodes with simple linear transfer function
  - Output layer- one node with simple linear function
Methodology (contd.)

Trend Analysis of Density

Rise
3:30am to 10:40am +
5:40pm to 7:30pm
Fall
10:40am to 5:40pm +
7:30pm to 3:30am
Results

Full Data Estimation ANN
Results (contd..)

Peak Hour - Estimation ANN
Results (contd..)

Off Peak Hour - Estimation ANN
Results (contd..)

Full Data Prediction ANN
Results (contd..)

Prediction ANN for the time when density is rising
Results (contd..)

Prediction ANN for the time when density is falling
### Results (contd..)

<table>
<thead>
<tr>
<th>Purpose of the use of ANN</th>
<th>Data used</th>
<th>Time</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimation of the density</td>
<td>Complete data</td>
<td>Current</td>
<td>96.3%</td>
</tr>
<tr>
<td>Estimation of the density</td>
<td>Peak hour speed data</td>
<td>Current</td>
<td>91.5%</td>
</tr>
<tr>
<td>Estimation of the density</td>
<td>Off-peak hour speed data</td>
<td>Current</td>
<td>95.8%</td>
</tr>
<tr>
<td>Prediction of the density</td>
<td>Complete data</td>
<td>after 30 min</td>
<td>87.95%</td>
</tr>
<tr>
<td>after an interval</td>
<td></td>
<td>after 60 min</td>
<td>77.3%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>after 90 min</td>
<td>68.5%</td>
</tr>
<tr>
<td>Prediction of the density</td>
<td>Density data when rate of</td>
<td>after 30 min</td>
<td>88.55%</td>
</tr>
<tr>
<td>after an interval</td>
<td>change of density is positive</td>
<td>after 60 min</td>
<td>82.1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>after 90 min</td>
<td>81.26%</td>
</tr>
<tr>
<td>Prediction of the density</td>
<td>Density data when rate of</td>
<td>after 30 min</td>
<td>85.6%</td>
</tr>
<tr>
<td>after an interval</td>
<td>change of density is negative</td>
<td>after 60 min</td>
<td>79.1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>after 90 min</td>
<td>70.4%</td>
</tr>
</tbody>
</table>
Real- Time Implementation

- Estimation of Density
  - Artificial Neural Network for full-data
  - Input- Speed
- Prediction of Density
  - Artificial Neural Networks according to fall-time and rise-time
  - Input- Estimated Density
- Estimated density to show the current level of congestion
- Predicted density to show the future forecasted level of congestion
Discussion and Conclusion

- Model using complete data set for the estimation and that using the data set separately for time where density is falling and density is rising, for the prediction is more reliable
- Insufficiency of data => Limited current study
- Use of Support Vector Machine and Ensemble Forecasting for higher accuracy
- Effect of Location on Network parameters
Real- Time Implementation (contd..)
References


Thank You