Transfer Learning with Graph Neural Networks for Short-Term Highway Traffic Forecasting

Tanwi Mallick¹, Prasanna Balaprakash¹, Eric Rask¹, Jane Macfarlane²

¹Argonne National Laboratory
²Lawrence Berkeley National Laboratory

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Traffic forecasting

Road network

Historic traffic metrics

Future traffic metrics

8.00 AM ... 9.00 AM

9.00 AM ... 10.00 AM

Problem: Forecast traffic in absence of location specific network and historical time series data
Transfer learning Diffusion convolutional recurrent neural network (TL-DCRNN)
TL-DCRNN model

Input timeseries → TL-DCRNN Layer → Encoder

TL-DCRNN Layer

TL-DCRNN Layer

Decoder

D-DCRNN Layer

Predicted output

Subgraphs

Copy States
TL-DCRN training

Graph partitioning

TL-DCRNN model

- Epoch 1
- Epoch 2
- Epoch n

Subgraph training
Results – LA on SFO

- D-DCRNN and D-TL-DCRNN trained on LA dataset and tested on the LA
- TL-DCRNN and DCRNN – trained on SFO dataset and tested on the LA

TL-DCRNN outperformed DCRNN on LA
Results – SFO on LA

- D-DCRNN and D-TL-DCRNN trained on SFO dataset and tested on the SFO
- TL-DCRNN and DCRNN - trained LA dataset and tested on the SFO

TL-DCRNN outperformed DCRNN on SFO
Comparison with other model

- All models are trained on LA dataset and tested on the PEMS-BAY

<table>
<thead>
<tr>
<th>Models</th>
<th>MAE</th>
<th>RMSE</th>
<th>MAPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>STGCN [16]</td>
<td>6.53 ± 2.69</td>
<td>10.07 ± 3.47</td>
<td>13.31 ± 6.38 %</td>
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<tr>
<td>FC-LSTM [4]</td>
<td>4.69 ± 1.79</td>
<td>8.48 ± 3.17</td>
<td>12.32 ± 8.78 %</td>
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<tr>
<td>GMAN [17]</td>
<td>4.05 ± 1.56</td>
<td>7.57 ± 2.51</td>
<td>8.5 ± 4.58 %</td>
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<tr>
<td>DCRNN [6]</td>
<td>3.3 ± 1.24</td>
<td>6.91 ± 2.19</td>
<td>8.21 ± 5.57 %</td>
</tr>
<tr>
<td>TL-DCRNN</td>
<td>2.13 ± 1.09</td>
<td>5.23 ± 2.29</td>
<td>5.55 ± 4.34 %</td>
</tr>
</tbody>
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TL-DCRNN outperformed all state-of-the-art traffic forecasting methods in a transfer learning setting
Conclusion and Future Work

• TL-DCRNN outperformed all state-of-the-art traffic forecasting methods
• Allow practitioners to apply data-driven methods trained on datasets collected elsewhere
• Enabling a wide range of transportation system operations operate efficiently in reduced infrastructure and data acquisition cost
• Deployment strategies for traffic management systems across the country
• Extend this approach beyond highway implementations