**Purpose**

To develop a traffic prediction method that represents well both the spatial and temporal dynamics of the traffic and is computationally efficient.

**Introduction**

- **Traffic Prediction**: forecasting of future traffic state based on historical traffic data
- **Traffic Data**: usually measured by magnetic induction loop detectors
  - Traffic speed
  - Traffic flow
- **Spatio-Temporal Characteristic** of Traffic Data
  - Sequence of traffic data on a road segment: a time series
  - Each time series on each road segment has a spatial relationship with each other
- **Deep Neural Networks for Traffic Prediction**
  - Convolutional neural networks (CNNs)
  - Effective in understanding spatial features
  - Recurrent neural networks (RNNs)
  - Traffic prediction as a time series forecasting
  - Traffic data as spatio-temporal images
    - CNN or capsule network (CapsNet)\(^1\) to capture spatio-temporal relationship

**Contribution**

- **Model Architecture**
  - A structural RNN (SRNN) approach for traffic prediction that incorporates the topological information of the road network.
    - The SRNN proposed in \(^2\) has been usually applied to driver maneuver anticipation, human motion forecasting, human activity anticipation, and human trajectory prediction.
    - The prediction performance and computational efficiency are validated with real data from the SETA EU project.

**Methods**

- **Problem Definition**
  - Given a sequence of traffic speed data \( \{ x^i_t \} \) at time steps \( t = T - I + 1, ..., T \), we predict the future traffic speed \( x^i_{T+1} \) on each road segment \( i = 1, ..., V \).
  - \( T \): current time step
  - \( I \): the length of data sequence

- **Spatio-Temporal Graph Representation**

- **Architecture of the SRNN** in perspective of node \( v \) drawn with the unrolled spatio-temporal graph.
  - Uses 3 sets of RNNs: node RNN, spatial edge RNN, temporal edge RNN.
  - Feature vector of spatial edge RNN: current traffic speed values of adjacent road segments.
  - Feature vector of temporal edge RNN: current and previous traffic speed values of each road segment.
  - Feature vector of node RNN: current traffic speed value concatenated with the results of the above edge RNNs.

**Validation with Real Data**

- **Validation with Real Data**
  - Two different sets of road segments used in the experiment. Each set contains 50 road segments marked in red.
  - Speed prediction performance (unit: km/h).

  |          | CapsNet | SRNN |
  |----------|---------|------|
  | Task 1   | MAE     | RMSE | MAE   | RMSE   |
  |          |         |      |       |        |
  | Task 2   | 5.720   | 9.133| 5.632 | 8.906  |
  |          | 5.741   | 9.172| 5.588 | 8.975  |

**References**

1) Y. Kim, P. Wang, Y. Zhu, and L. Mihaylova, “A Capsule Network for Traffic Speed Prediction in Complex Road Networks”, Proc. from the IEEE SDF Workshop, 2018.

2) A. Jain, A. R. Zamir, S. Savarese, and A. Saxena, “Structural-RNN: Deep Learning on Spatio-temporal Graphs”, Proc. from the ICVPR, 2016.