STAR: A Concise Deep Learning Framework for Citywide Human Mobility Prediction

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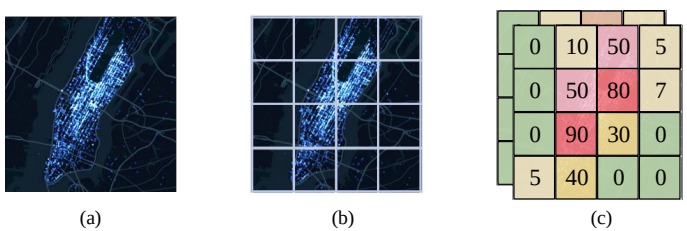
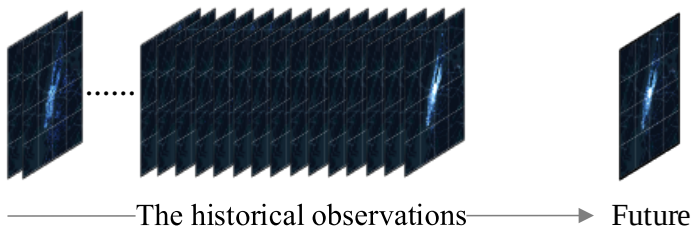
Preliminary

- **Definition**[1]: Human mobility is defined as the total number of humans passing through an area during a certain period.
- **Problem**[2]: Given the historical observations $\{X_t | t = 0, ..., n-1\}$ to predict X_n in the future.



(a)



(b)

[1] Zhidan Liu et al. In: *IEEE Network* (2018).

[2] Junbo Zhang, Yu Zheng, and Dekang Qi. In: *AAAI*. 2017.

Motivation

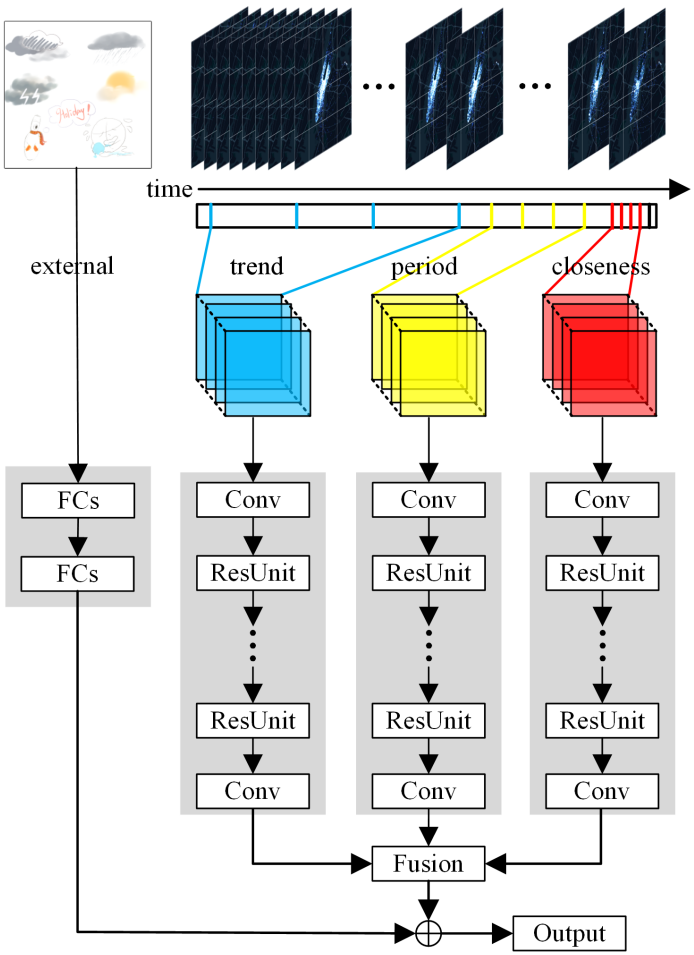


Figure: ST-ResNet

New idea

- Fusion themselves in convolution operation:

$$T^{l}_{i,j,k} = \sum_{c} \sum_{m} \sum_{n} T^{l-1}_{c,j+m,k+n} K_{i,c,m,n} \quad (1)$$

New discovery

- Temporal shifting pattern[a] e.g., The peak hours on weekdays are usually in the afternoon, but could vary from 5:00pm to 6:00pm

[a] Huaxiu Yao et al. In: *AAAI*. 2019.

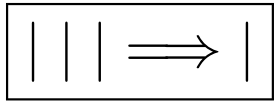
Methodology

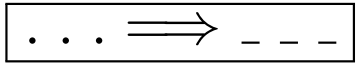
Narrow the network (for efficiency)

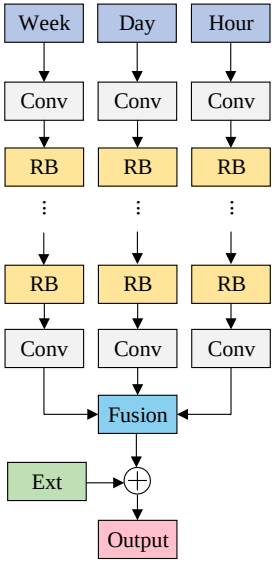
- retaining one of the networks in ST-ResNet

Increase the input information (for accuracy)

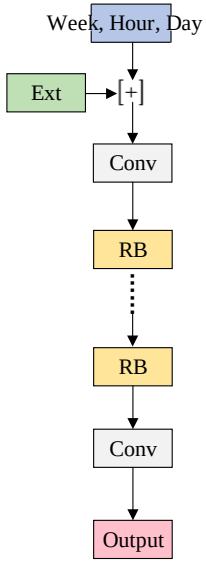
- increasing the closeness dependents in each period







(a) ST-ResNet



(b) STAR

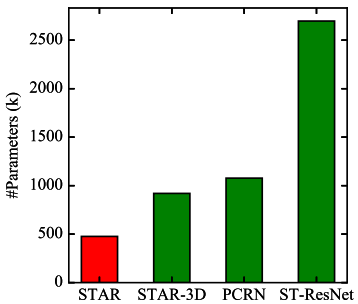
$\mathcal{Q} \leftarrow \emptyset$
for $i \in [1, l_c]$ **do**
  $\mathcal{Q} \leftarrow X_{t-i}$
for $i \in [1, l_p]$ **do**
  for $r \in [0, l_r]$ **do**
    $\mathcal{Q} \leftarrow X_{t-i\times p-r}$
for $i \in [1, l_q]$ **do**
  for $r \in [0, l_r]$ **do**
    $\mathcal{Q} \leftarrow X_{t-i\times q-r}$
return $\mathcal{Q}$

Algorithm 1: Select Keyframes

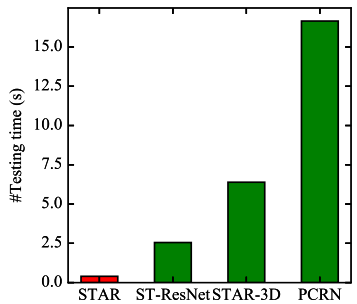
Experiment

Dataset: TaxiBJ[3]

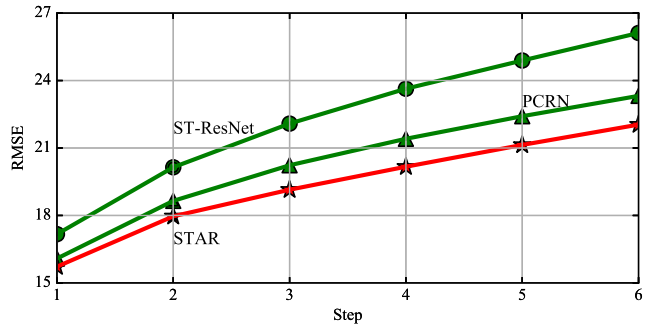
Evaluating: RMSE



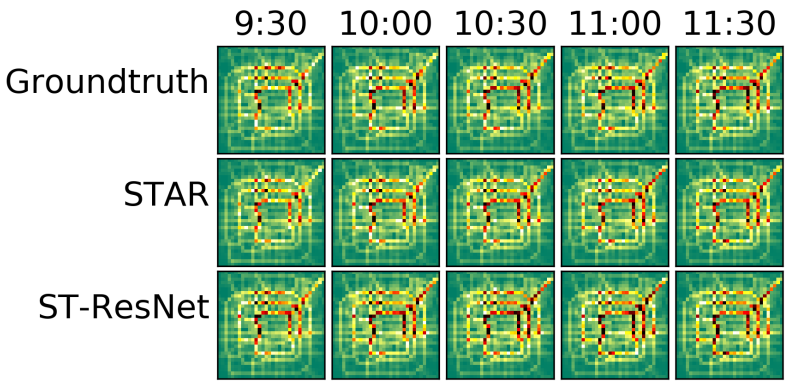
(c) #parameter



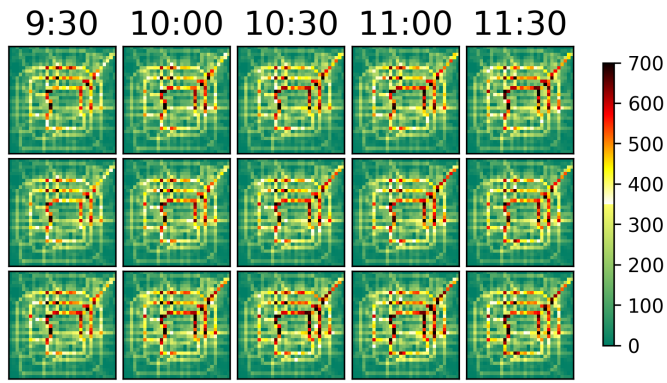
(d) #time



(e) mulit-step



(f) inflow



(g) outflow

[3] Junbo Zhang, Yu Zheng, and Dekang Qi. In: *AAAI*. 2017.

Thank You