A Coarse-to-Fine Approach for Motion Pattern Discovery

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LBS
Promising Applications

Logistics Monitoring

Transport Scheduling

Movement Prediction
Coarse-to-fine Approach

**Coarse Clustering**
A Median-based GMM

**Refined Separation**
Fisher optimal division method
Coarse Clustering

I
\[ P(v_i) = \sum_{k=1}^{K} \pi_k N(v_i | \mu_k, \sigma_k) \]

II
\[ \sum_{i=1}^{L} \log \left\{ \sum_{k=1}^{K} \pi_k N(v_i | \mu_k, \sigma_k) \right\} \]

III
\[ \gamma(k|v_i) = \frac{\pi_k N(v_i | \mu_k, \sigma_k)}{\sum_{j=1}^{K} \pi_j N(v_i | \mu_j, \sigma_j)} \]

VI
\[ \Gamma(k|v_i) = \frac{\gamma'(k|v_i)}{\sum_{k-1}^{K} \gamma'(k|v_i)} \]
Refined Separation

\[ D_k(i' - n, i' + n) = \sum_{t=i' - n}^{i' + n} (v_t - \overline{v}) \]

\[ c = \arg \min_{i'} \sum_{k=1}^{K} D_k(i' - n, i' + n) \]
Data Collection System

Android Phone → GPS Satellite → GPS Signal → Wireless communicate → Sina App Engine (SAE) → Server → Database
The Real GPS Data
Clustering Result

K-means

FCM

GMM

The proposed algorithm
### Accuracy by Different Methods

#### Table 1 Accuray on the LDPA data set

<table>
<thead>
<tr>
<th>Method</th>
<th>K-means</th>
<th>FCM</th>
<th>GMM</th>
<th>Proposed Algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>78.04%</td>
<td>78.64%</td>
<td>79.75%</td>
<td>88.15%</td>
</tr>
</tbody>
</table>

#### Table 2 Accuracy on the real GPS data

<table>
<thead>
<tr>
<th>Method</th>
<th>K-means</th>
<th>FCM</th>
<th>GMM</th>
<th>Proposed Algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>79.65%</td>
<td>79.73%</td>
<td>83.38%</td>
<td>93.74%</td>
</tr>
</tbody>
</table>
π_k for different motion patterns

Driving → Biking

Walking → Biking

Walking → Driving → Biking

Walking → Biking → Walking
The parameter selection

The effect of $m$ on the accuracy

The effect of $n$ on the accuracy

\[
\gamma'(k|\nu_i) = \text{Median}_{j=i-m}^{i+m} \gamma(k|\nu_j) \quad D_k(i' - n, i' + n) = \sum_{t=i'-n}^{i'+n} (\nu_t - \overline{\nu})
\]
Conclusion

A Median-based GMM

Fisher Optimal Division Method

Coarse To Fine

K Adaptive

More Accurate
Thank You!