Map-Based Temporally Consistent Geolocalization through Learning Motion Trajectories

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• **Goal** – Model Motion Trajectory on Graph for Consistent Geolocalization

**Input:** Motion Trajectory (direction + distance)

**Prediction:** Inconsistent to consistent edge location
• Sequential Motion Trajectories with RNN

\[ P_{\text{loc}} = P(s_t | \varphi, \beta_{1:t}, M) \]

output edge \hspace{1cm} turning \hspace{1cm} distance \hspace{1cm} map

\[ h_s = f_\alpha(x_s, h_{s-1}) \quad \forall s = 1, \ldots, t \]
\[ y_t = f_\beta(h_t) \]

\[ P(Y = i | y) = \text{softmax}(y) = \frac{e^y}{\sum_{j=0}^{k} e^y} \]
• Temporal Consistent Strategy on Graph

Strategy 1 (Like Prim Algorithm, Local)

Strategy 2 (Like Kruskal Algorithm, Global)
• **Experiment – Synthetic Dataset**

✓ Simple path generation by depth-first algorithm

Map graph for KITTI dataset

<table>
<thead>
<tr>
<th>Data</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topological Map</td>
<td>40 nodes, 61 edges</td>
</tr>
<tr>
<td>Trajectory Length</td>
<td>10 nodes</td>
</tr>
<tr>
<td>All Trajectories</td>
<td>17537</td>
</tr>
<tr>
<td>All Classes</td>
<td>61</td>
</tr>
<tr>
<td>Input Feature Space</td>
<td>20</td>
</tr>
<tr>
<td>Training Trajectories</td>
<td>17536</td>
</tr>
<tr>
<td>Training Output Classes</td>
<td>61</td>
</tr>
</tbody>
</table>
• Experiment – Real Dataset

✓ Stereo Visual Odometry

raw trajectory  
processed trajectory
• Experiment – Training

(a) Training loss.

(b) Accuracy.
• Experiment – Consistent Geolocalization
• Conclusion

✓ Learning *motion* trajectory with RNN

✓ Temporally *consistent* localization with two strategies
Thank you!

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