Efficient Time-Dependent Vehicle Routing for Large-scale Delivery Points

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Introduction

- Vehicle Routing Problem
- Time-dependent road network

Motivation

- Better routing schedule to save cost (time / distance)
  + Use time-dependence information to generate
  + More accurate routing algorithm: Local search based Approach
- Better efficiency to support large-scale delivery points
  + Pruning techniques
  + Algorithm parallelization

System Architecture

- Oracle Network Data Model (NDM) integration
- Populate the LA road network and TD patterns into Oracle database
- Use JAVA API for network analysis (Shortest path, TSP)
- Develop VRP Algorithms upon their NDM Model

Running Examples

- Large-scale Time-Dependent Vehicle Routing
  + Find near optimal routing schedule given specific delivery points and departure time
  + Support large-scale delivery points.

Accuracy Comparison (Deviation, lower is better)

<table>
<thead>
<tr>
<th>Method</th>
<th>Node # = 100</th>
<th>Node # = 500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweep</td>
<td>27.5%</td>
<td>27.6%</td>
</tr>
<tr>
<td>Clarke-Wright</td>
<td>14.2%</td>
<td>20.1%</td>
</tr>
<tr>
<td>TD Local Search+</td>
<td>0.16%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

Efficiency Comparison (Running time, lower is better)

<table>
<thead>
<tr>
<th>Method</th>
<th>Node # = 100 (ms)</th>
<th>Node # = 500 (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweep</td>
<td>6.2</td>
<td>15.2</td>
</tr>
<tr>
<td>Clarke-Wright</td>
<td>6.2</td>
<td>80.69</td>
</tr>
<tr>
<td>TD Local Search</td>
<td>23089</td>
<td>3345398</td>
</tr>
<tr>
<td>TD Local Search+</td>
<td>6535</td>
<td>1053210</td>
</tr>
</tbody>
</table>

+ TD local search+ is much more accurate.
+ Sweep and Clarke-Wright are more efficient.

Conclusion and Future Work

- Designed an efficiency large-scale vehicle routing system
- Improve the efficiency of Timed-dependent local search algorithm
- Design better heuristic to integrate real-time traffic update