**SAMoD: Shared Autonomous Mobility-on-Demand using Decentralized Reinforcement Learning**

Maxime GUÉRIAU, Ivana DUSPARIC
School of Computer Science and Statistics, Trinity College Dublin, The University of Dublin
maxime.gueriau@scss.tcd.ie; ivana.dusparic@scss.tcd.ie

1. Context and objectives: Mobility-on-Demand (MoD) with Shared Autonomous Vehicles (SAVs)

- Advantages of SAVs for MoD:
  - fully flexible fleet size
  - robots (almost) never need to take a break
  - can be summoned everywhere
  - can be very efficient if ride sharing enabled [5, 6]

- Challenges for SAVs:
  - dynamic adaptation to demand (and/or anticipation)
  - limit empty mileage [7]
  - optimize SAV-rider assignment (especially with ride sharing)

2. Related work versus decentralized and learning

<table>
<thead>
<tr>
<th>Centralized</th>
<th>Decentralized</th>
<th>Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Several SAV companies</td>
<td>✗</td>
<td>✔</td>
</tr>
<tr>
<td>Dynamic fleet size</td>
<td>✗</td>
<td>✔</td>
</tr>
<tr>
<td>Optimized assignment</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Dynamic ride-sharing</td>
<td>✗</td>
<td>✔</td>
</tr>
<tr>
<td>Rebalancing</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Used data</td>
<td>✗</td>
<td>✗</td>
</tr>
</tbody>
</table>

3. SAMoD agents

- Perception: Requests and vehicles in current zone Built historical data per zone
- Decision making: Reinforcement learning (Q-learning)
- Reward: to have passengers
- Actions: Pick-up (including ride sharing)
  - Rebalance to zone
  - Do nothing

4. SAMoD system architecture

5. Simulation set-up

- Requests (NYC taxi data):
  - 50 consecutive Tuesdays
  - One request:
    - time the user requested the trip
    - number of passengers
    - pick-up location
    - drop-off location
    - pick-up zone (id)
    - drop-off zone (id)

- Evaluation:
  - System:
    - served requests
    - timet-out requests (10 min)
  - Riders:
    - waiting time $t_w$
    - detour time $t_d$
    - travel time $t_T$
  - Vehicles:
    - vehicle miles travelled VMT
    - average, empty, engaged, shared, occupied

6. Results (7-10am peak hour period)

**References**


Acknowledgment

"Surpass: how shared autonomous cars will transform cities" is an on-going project funded by the Irish Research Council (IRC) under the New Horizons Grant Scheme.