Multiagent Coordination In On-demand Transport with Connected Autonomous Vehicles
A decentralized resource allocation approach

Deploying autonomous vehicle fleets, with limited communication ranges, in order to provide ODT service requires a careful choice and evaluation of solution methods for resource allocation problems.

Our Multiagent Approach

▶ Generic Modeling (AV-OLRA) – Autonomous Vehicles Online Localized Resource Allocation: A generic model to ODT’s dynamic resource allocation problem in connected autonomous vehicle fleets, taking into account the limited connectivity and communication constraints

▶ Behavior Abstraction (AV Agent) – Each Autonomous vehicle is an agent whose behavior consists of 3 sub-behaviors: (Acting, Communicating and Planning)

▶ Solution Abstraction (CM) – A coordination mechanism defines the characteristics of a solution methods and requirements to implement the corresponding planning sub-behavior

▶ Evaluation Testbed (AV-SIM) – A multiagent simulator based on “Plateforme Territoire” with a set of evaluation criteria (QoB, QoS, Communication load, Connectivity)

▶ A new solution method (ORNInA) – A Decentralized, Auction-based, coordination approach with run-time optimization

Experimental evaluation with AV-SIM on real-world data (NYC-TLC trip records)

▶ The problem is split into sub-problems (per CS), the global solution is an aggregation of the sub-solutions.

▶ Consequences of increasing the number of vehicles (enlarging the fleet size):
  - More requests are served (better QoS) with more operational cost (a decrease in QoS after some threshold)
  - A trade-off (QoS vs. QoS)
  - More connectivity between vehicles (larger connected set sizes)
  - More coordination messages and communicational cost

▶ The centralized (Dispatching) is optimal for (fleet size / QoS), the greedy method (Selfish) is the worst, while decentralized coordination methods (MOM-2, DSA, ORNInA) are good alternatives in the middle

References

- Plateforme Territoire: https://territoire.amae.fr/

Contact : alaa.daoud@emse.fr , flavien.balbo@emse.fr , paolo.gianessi@emse.fr , gauthier.picard@onera.fr