The IORS Mechanism

FARE ESTIMATION:
- for each request \( r_i \) from passenger \( i \) at time \( t \), the mechanism first checks if a vehicle is available.
- if so, the mechanism compares the cost per unit demand before and after adding the request into the coalitions, then selects the maximum fare as the quote.
- if not, the mechanism rejects the request.

PICKUP ASSIGNMENT:
- the mechanism selects the \( n_i \) requests that produces the lowest cost per unit demand for pickup.

PAYMENT CALCULATION:
- the mechanism calculates the final payment immediately after the fulfillment of each trip.

Ridesharing in AMoD Systems

AMoD SYSTEMS:
- Fleets of driverless cars
- Information processing center
- Passengers
- Infrastructure (e.g., road networks)

OBJECTIVE:
- To promote ridesharing

CHALLENGES:
- Truthful demand needed
- Passengers may not cooperate
  (due to self-interestedness, privacy)

SOLUTION:
- Mechanism design

Problems of Existing Mechanisms for Ridesharing

- Direct valuation revelation
- Additional constraints to satisfy desirable properties
  (e.g., strategyproofness, budget balance)
- Neglecting non-monetary factors (e.g., waiting time)
- Do not work in online settings

Our Contributions

We introduced the first posted-price, online mechanism, called the Integrated Online Ridesharing (IORS) mechanism to promote ridesharing in AMoD systems.

We showed that IORS mechanism is ex-post incentive compatible, and demonstrated the competitiveness of IORS compared with two benchmarks via simulation.

The IORS Mechanism

An Example

Problem:
- At \( t=0 \), \( AV1(0,0) \) picks up \( P1 \) and follows line \( y=0 \), estimated cost per unit demand \( 0/10 = 1 \)
- \( AV2 \) picks up \( P2 \) and goes down along \( x=5 \), cost \( =12/10 = 1.2 \).

Resolution:
- At \( t=2 \), \( AV2(5,1) \) picks up \( P2 \) and goes down along \( x=5 \), cost \( =12/10 = 1.2 \).

Results

PROPERTIES:
- Posted-Price
- Online
- Ex-post incentive compatible
- Others: individual rational, budget balance

NUMERICAL RESULTS:
- Outperforms the bottom-up mechanism
- Close to the optimal solution with less computational time

Key References


