Mitigating the impact of selfish routing: An optimal-ratio control scheme (ORCS) inspired by autonomous driving(2018)

1 Network Data

Attribute	Value
Network	Sioux Falls
Links, nodes and OD pairs	76, 24 and 528
TSTT under UE	7480225
TSTT under SO	7194922
Total flow demand	360600

2 Model

Control a proportion of travelers for each OD pair to gain TSTT savings.

$$\min \quad \gamma\|\bar{\mathbf{q}}\|_1 + z_2(\mathbf{x}^*) \tag{8}$$

$$s.t. \quad \mathbf{q}^- \leqslant \bar{\mathbf{q}} \leqslant \mathbf{q}^+ \tag{9}$$

$$T(\mathbf{x}^*)\cdot(\mathbf{x}-\mathbf{x}^*) \geqslant 0 \,, \forall\, \mathbf{x} \in \Omega(\bar{\mathbf{q}}) \tag{10}$$

where γ is control intensity. The objective function includes the total controlled demand(abbreviated as "First term") and total system travel time(Abbreviated as "Second term").

3 Questions

Q1: Solutions in section 5.1.3(ORCS with full control potential) may not be reasonable.

- Control potential $C_{max} = 1$.
- Control coefficient $\gamma = 0.1$.

As shown in Fig. 3a and b, the model converges quickly within 20 iterations and achieves almost 85% of the potential total travel time saving with less than 7.5% vehicles being controlled. Fig. 3c plots link volume-to-capacity (V/C) ratios at UE, SO and under
(First paragraph in page 9)

(a) Total system travel time

(b) Percentage of the controlled demand
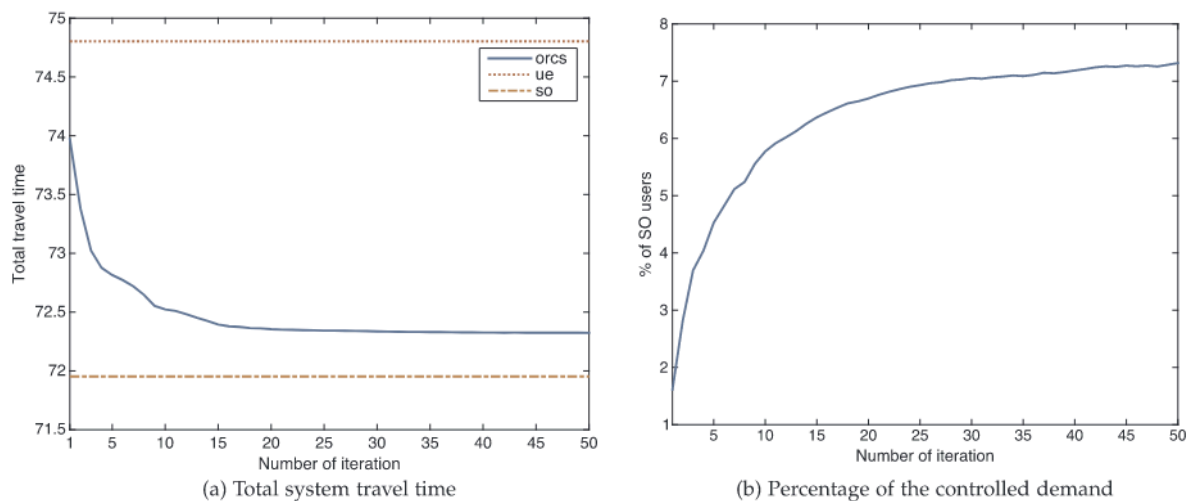
(Fig 3 in page 10)

Results source	First term	Second term	Objective values
The paper	$0.1*360600*0.07 = 2524$	$7480225 - (7480225 - 7194922)*0.85 = 7237718$	$7237718 + 2524 = 7240242$
SO solutions	$0.1*360600 = 36060$	7194922	$7194922 + 36060 = 7230982 < 7240242$
Replication	$0.1*154461 = 15446$	7195742	$7195742 + 15446 = 7211188 < 7230982$

It shows that the objective values can be further decreased.

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D:\sci_software\miniconda\envs\myenv\python.exe D:\library\Programs\ORCS\ORCS.py
Iteration 1: cur_gap3 = 129700.00, TSTT = 7269329.41, controlled ratio = 0.35968, total controlled demand = 129700.00
Iteration 2: cur_gap3 = 19400.00, TSTT = 7207530.28, controlled ratio = 0.41348, total controlled demand = 149100.00
Iteration 3: cur_gap3 = 3261.41, TSTT = 7205796.70, controlled ratio = 0.42252, total controlled demand = 152361.41
Iteration 4: cur_gap3 = 2100.00, TSTT = 7195742.31, controlled ratio = 0.42835, total controlled demand = 154461.41
Iteration 5: cur_gap3 = 0.00, TSTT = 7195742.31, controlled ratio = 0.42835, total controlled demand = 154461.41
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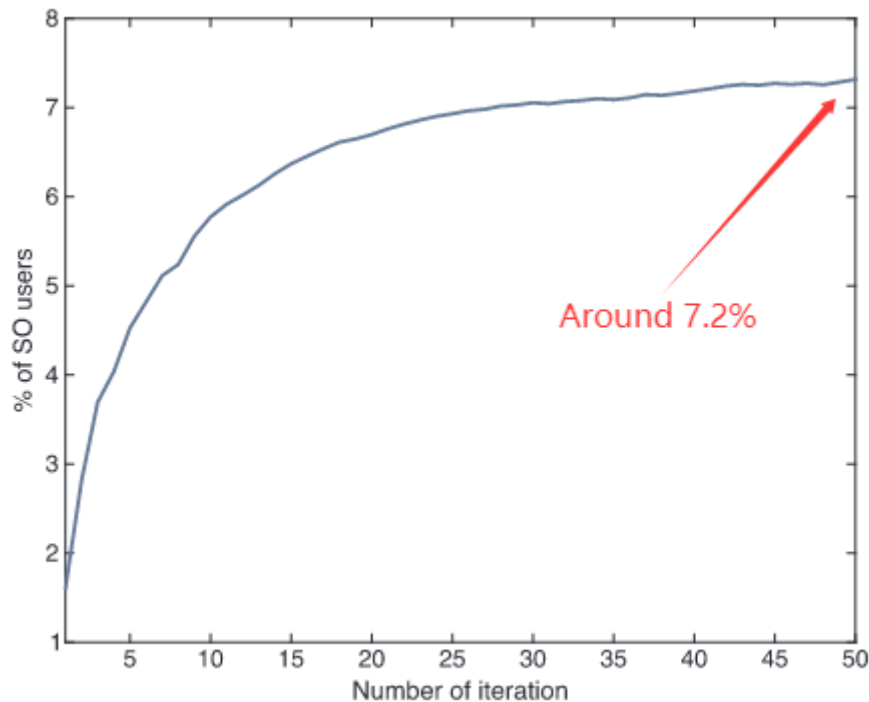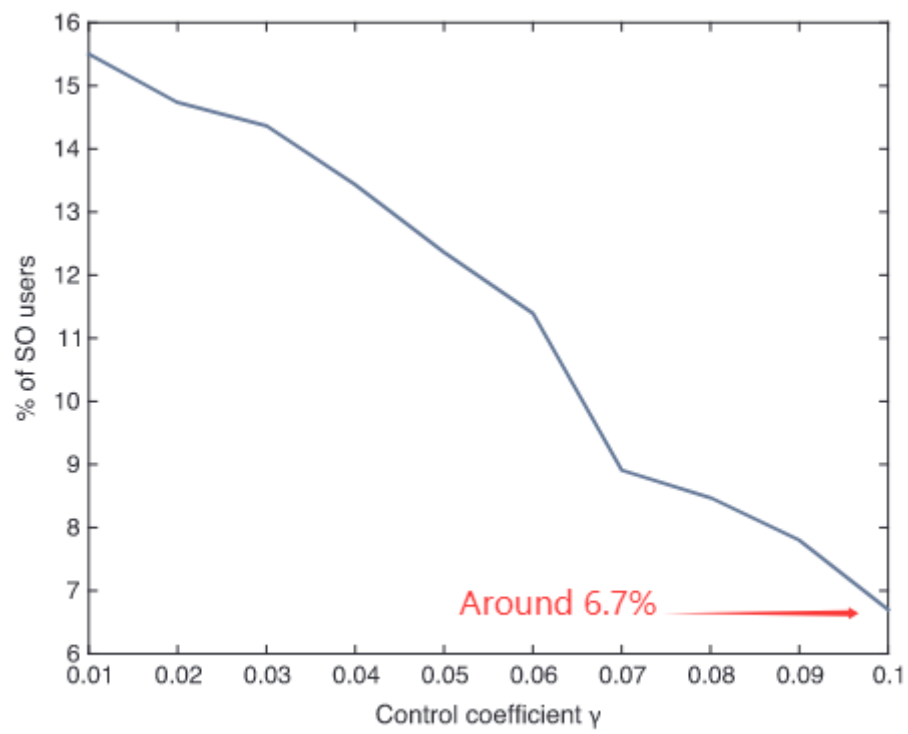(Replicated data)
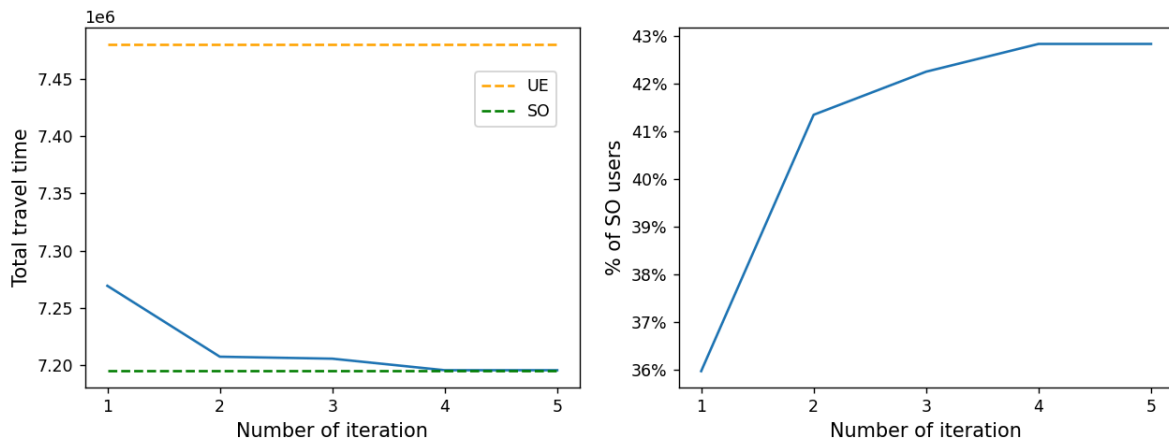
(Replicated data)

Q2: Inconsistency in context:

In Fig 3, when $\gamma = 0.1$, the percent of SO users is more than 7%. However, in Fig 4, when $\gamma = 0.1$, it is lower than 7%.

(b) Percentage of the controlled demand

(Fig 3b in page 10, where percent of SO users is around 7.2%)

Around 6.7%

(b) Percentage of the controlled demand

(Fig 4b in page 11, where percent of SO users is around 6.7%)