

Lane Changing and Speed Interaction on Freeways: An Analytical Microscopic Study

Traffic and Granular Flow 2015
October 28-30, 2015
Nootdorp, Holland

Mehdi Keyvan-Ekbatani
Vincent Grebert
Winnie Daamen
Victor L. Knoop

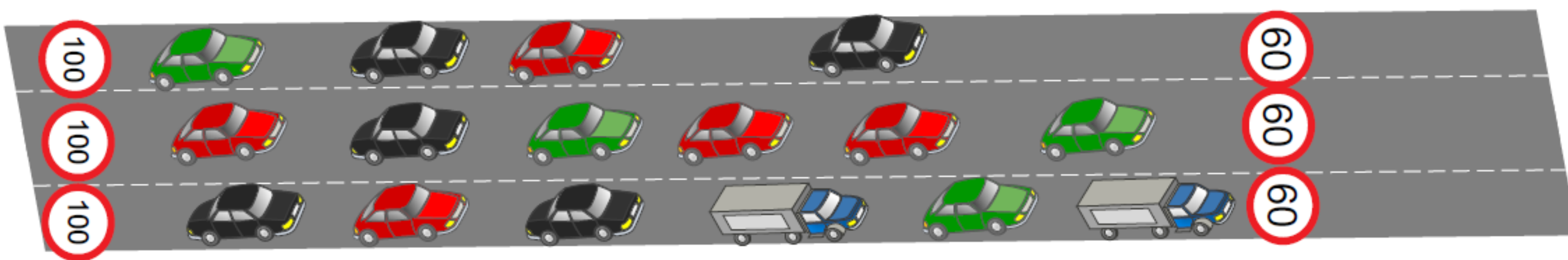


Abstract

It is crucial to understand the impact of lane changing manoeuvres, as initial perturbations, on the capacity, stability, and breakdown of traffic flows. In a recent study, four distinct strategies have been empirically found: (1) Speed Leading; (2) Speed Leading with Overtaking; (3) Lane Leading; (4) Traffic Leading. The principal aim of this paper is to investigate the impact of the forenamed driving strategies on freeway traffic operations. To the best of our knowledge, combining speed choice and lane preference is not currently considered in most driving behavior models. The developed strategy-based lane-change model is implemented in a microscopic simulation environment. A thorough study on the simulation results (i.e. lane flow distribution, lane change rate, speed contour plots) shed some light on the impact of the implemented lane change strategies on the freeway traffic flow characteristics.

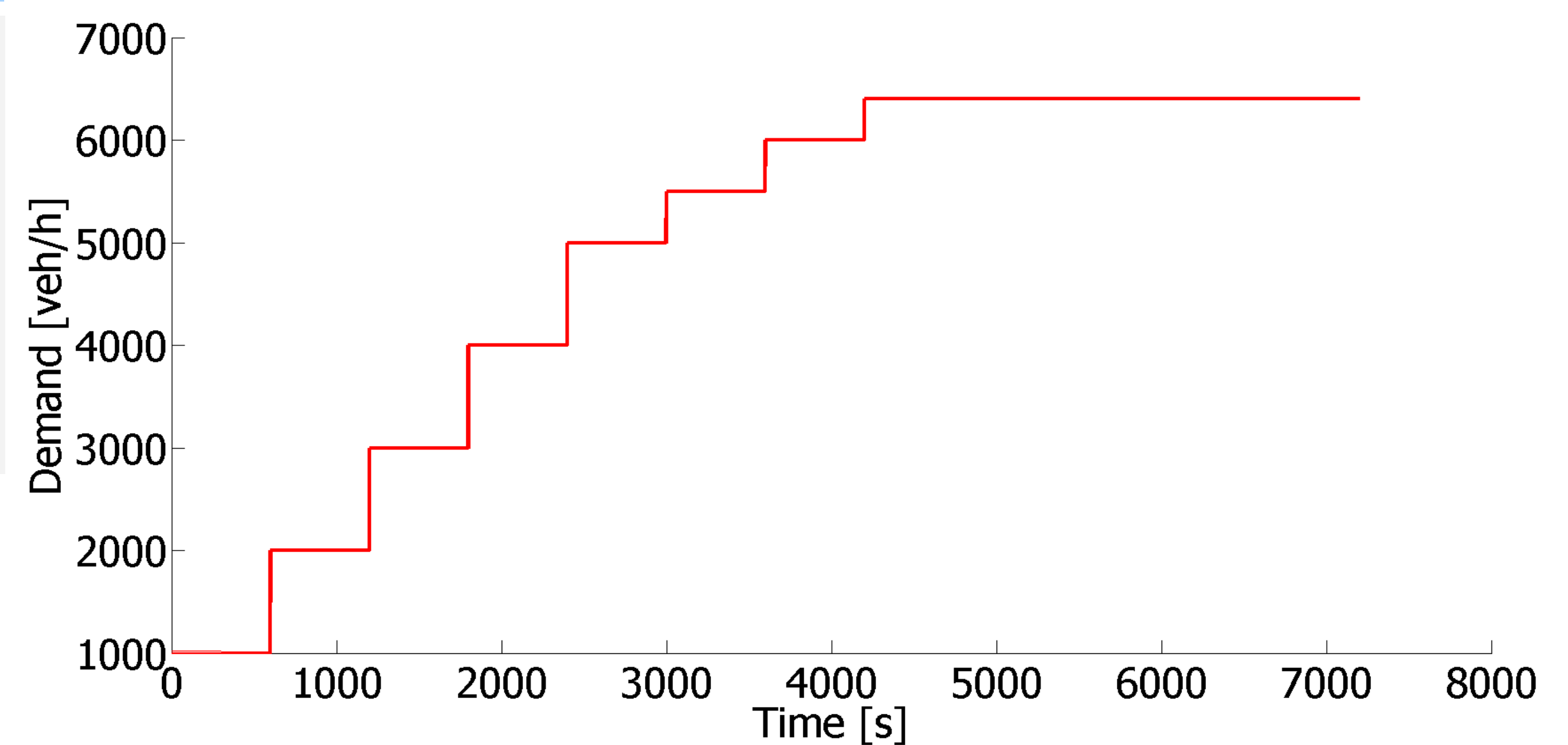
Simulation Setup

- A three-lane freeway stretch (7km) modelled in the microscopic simulation environment MOTUS, in the last 2km, a speed limit is imposed.
- 4 simulation scenarios are defined; (1)-(3), 100% of cars with the (1)-(3) strategies and scenario 4, 50% with strategies 1 and 4 each.

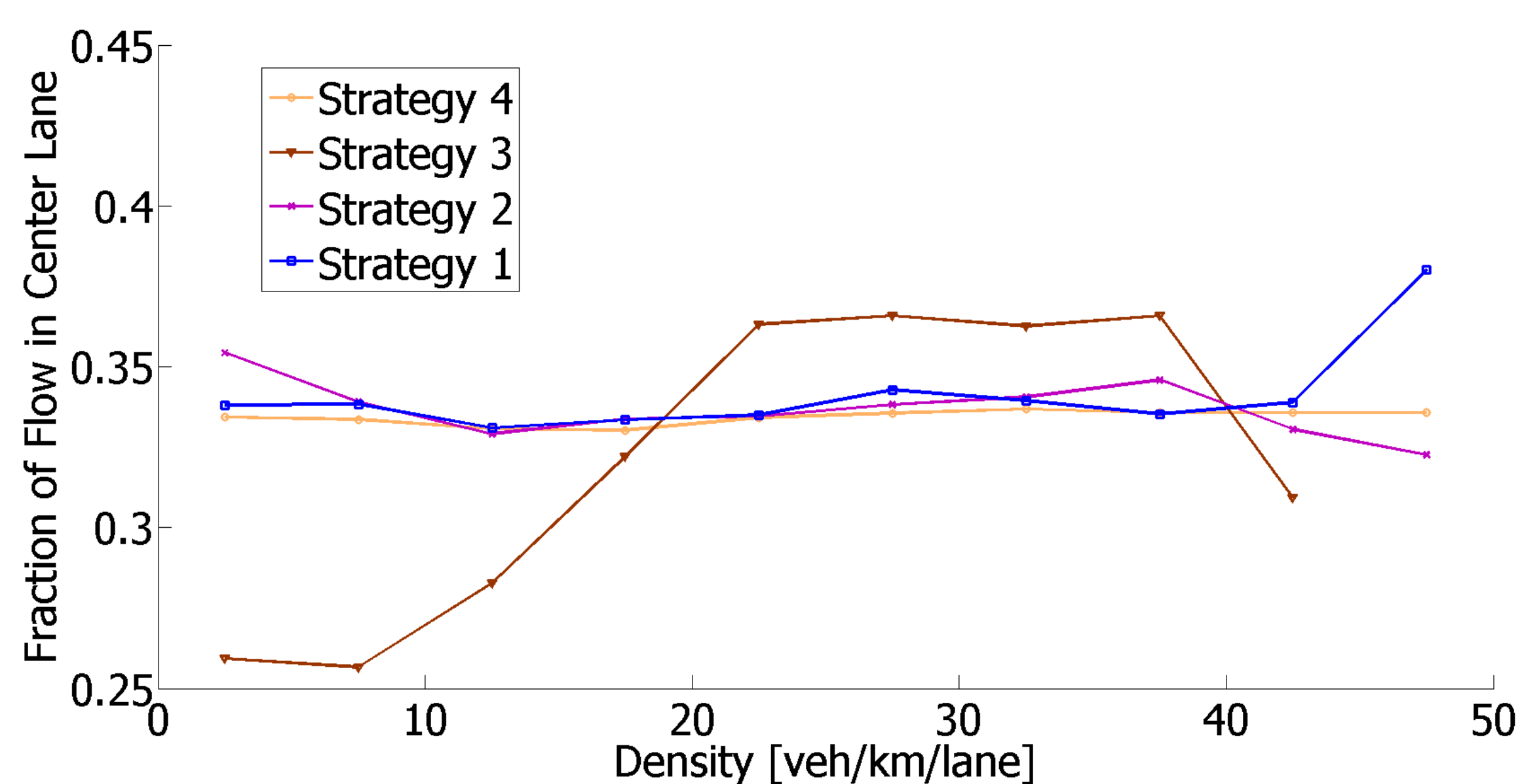


Strategies Description

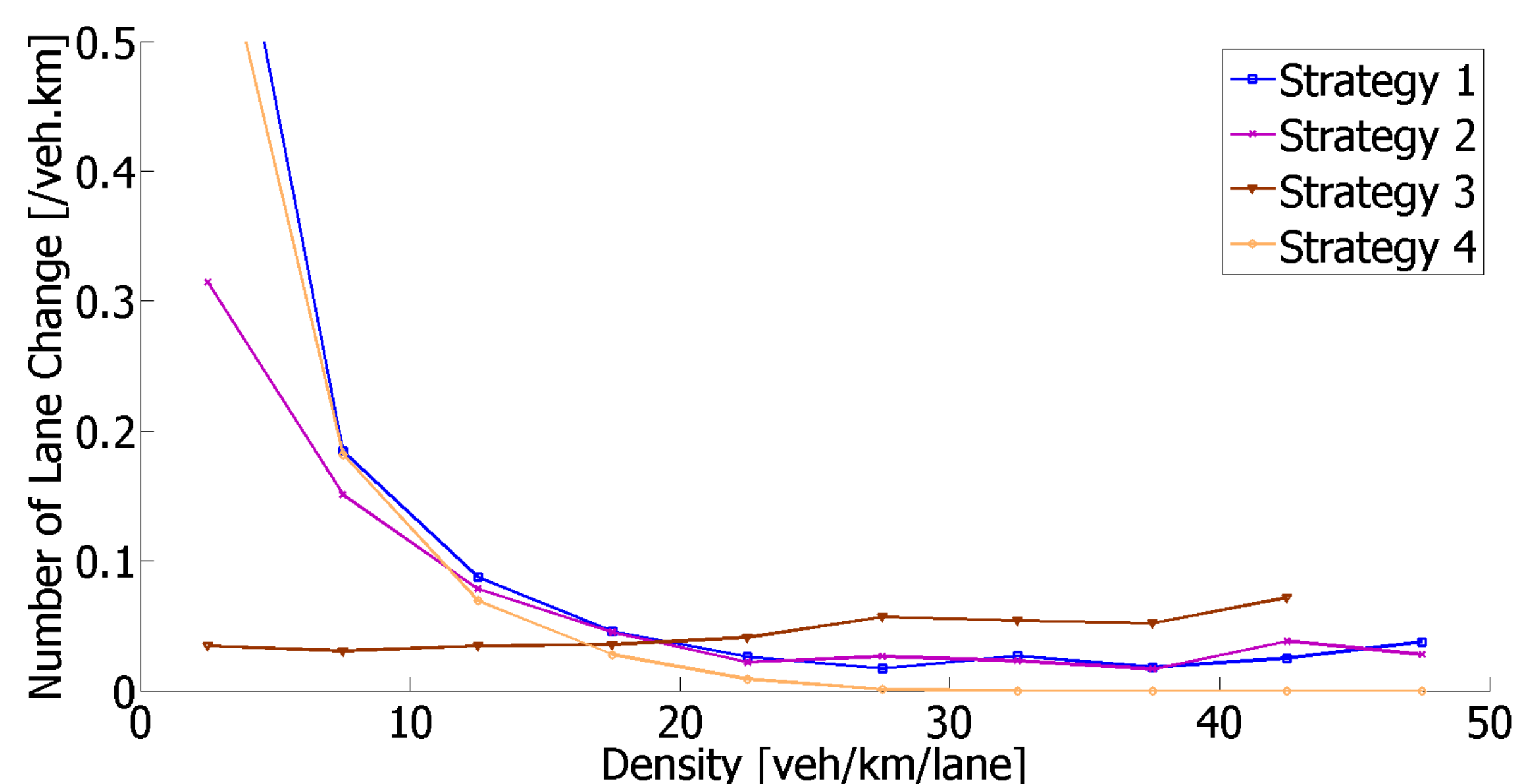
- 1) **Speed Leading:** drivers adapt lanes such that they can drive their with desired speed.
- 2) **Speed Leading with Overtaking:** similar to the previous one, only, the drivers increase speed when they are in the left lane.
- 3) **Lane Leading:** drivers choose a lane and adapt their speed to the speed of the vehicles on that lane.
- 4) **Traffic Leading:** drivers try to have a behaviour in line with the traffic stream. Speed choice and desired lane changes cannot be separated from a behavioral point of view.



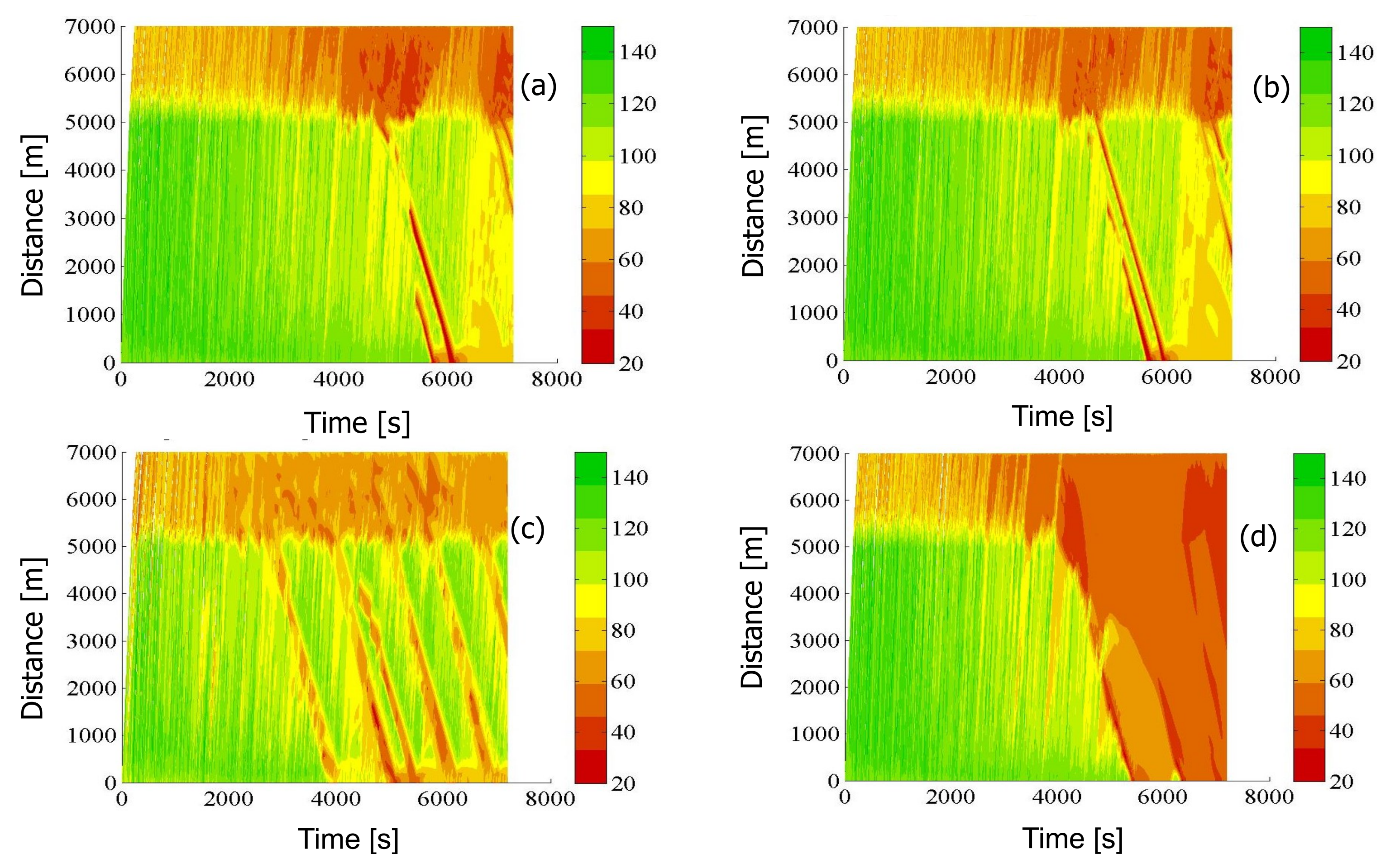
Simulation Results



Lane flow distribution of the four strategies on middle lane



Lane change rate of the four strategies



(a)-(d) Speed contour plots for strategies 1, 2, 3 and 4 respectively

Conclusions

- The flow distribution on the middle lane under different strategies is quite different.
- Number of lane changes decreases in high densities (scenarios 1,2 and 4). Lane change rate with strategy 3 is low.
- Under different strategies, various instabilities occur (stop-and-go).