Traffic flow with bicycle lanes and bike boxes: *A cellular automaton*

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Class Report for
Complex Social Systems: Modeling Agents, Learning, and Games

Agenda:

Introduction

Literature

The Model

The Simulation

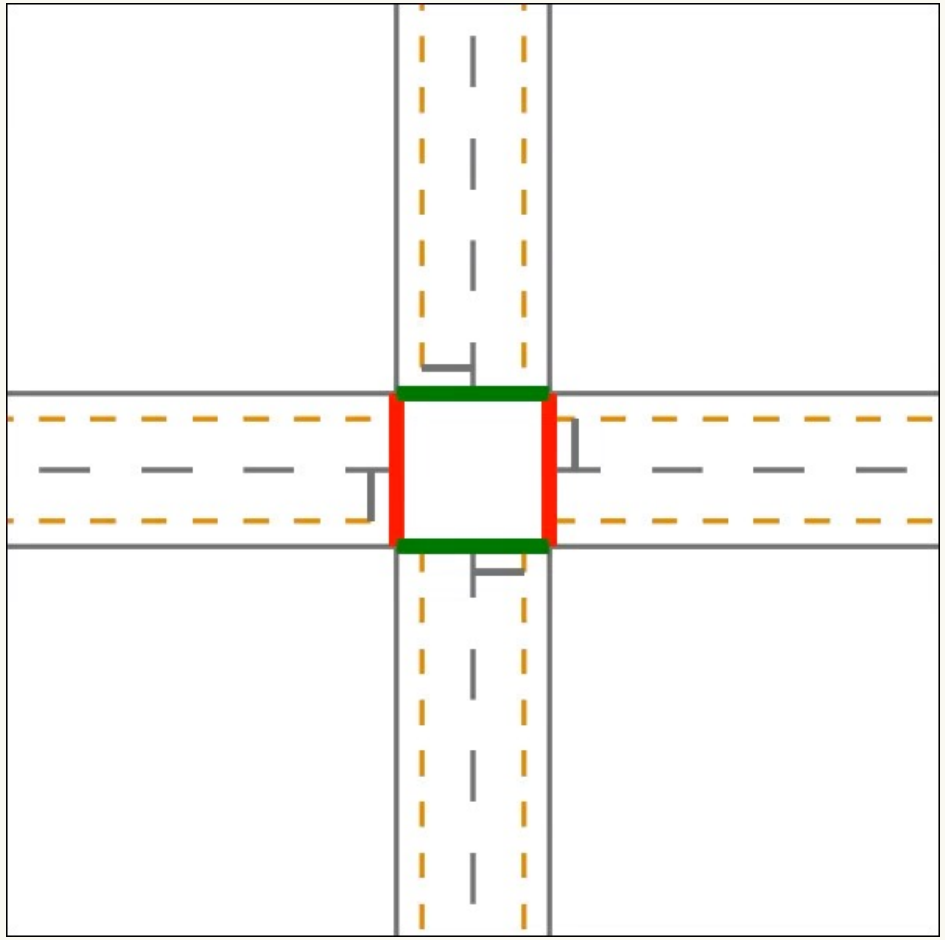
Results and Hypotheses

Challenges

Introduction

Safe cycling through
Transport planning
& Simulation

Bike Boxes or
Advanced Stop Lines



Literature

The Nagel-Schreckenberg Model

1. ***Acceleration:*** *If the velocity v of a vehicle is slower than its max velocity and the gap to the next vehicle is larger than v + 1, its speed is updated to v + 1*
2. ***Slowing down:*** *If the distance to the next vehicle is j and j<v, the vehicle's speed is updated to j − 1*
3. ***Randomization:*** *With given probability p (called the slowdown probability) the vehicle decreases its velocity by 1*
4. ***Vehicle motion:*** *All vehicles are advanced v sites (according to their updated velocity of steps 1-3)*

Kai Nagel and Michael Schreckenberg. "A cellular automaton model for freeway traffic". Journal de Physique I 2 (Dec. 1992), p. 2221. doi: 10.1051/jp1:1992277

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The Nagel-Schreckenberg Model[1]

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2. *Slowing down*
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4. *Vehicle motion*

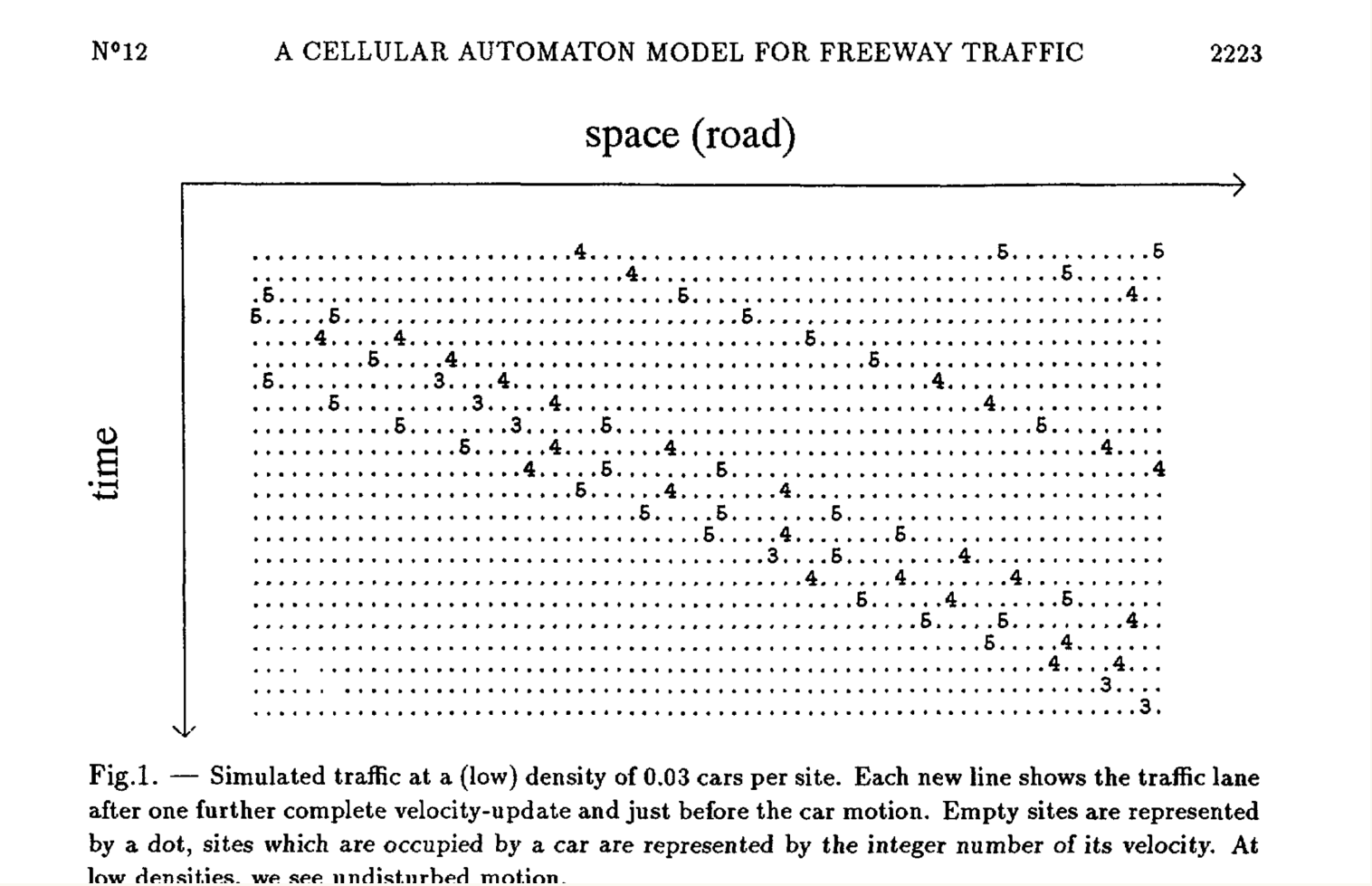

Fig.1. — Simulated traffic at a (low) density of 0.03 cars per site. Each new line shows the traffic lane after one further complete velocity-update and just before the car motion. Empty sites are represented by a dot, sites which are occupied by a car are represented by the integer number of its velocity. At low densities, we see undisturbed motion.

[1]Kai Nagel and Michael Schreckenberg. "A cellular automaton model for freeway traffic". Journal de Physique I 2 (Dec. 1992), p. 2221. doi: 10.1051/jp1:1992277

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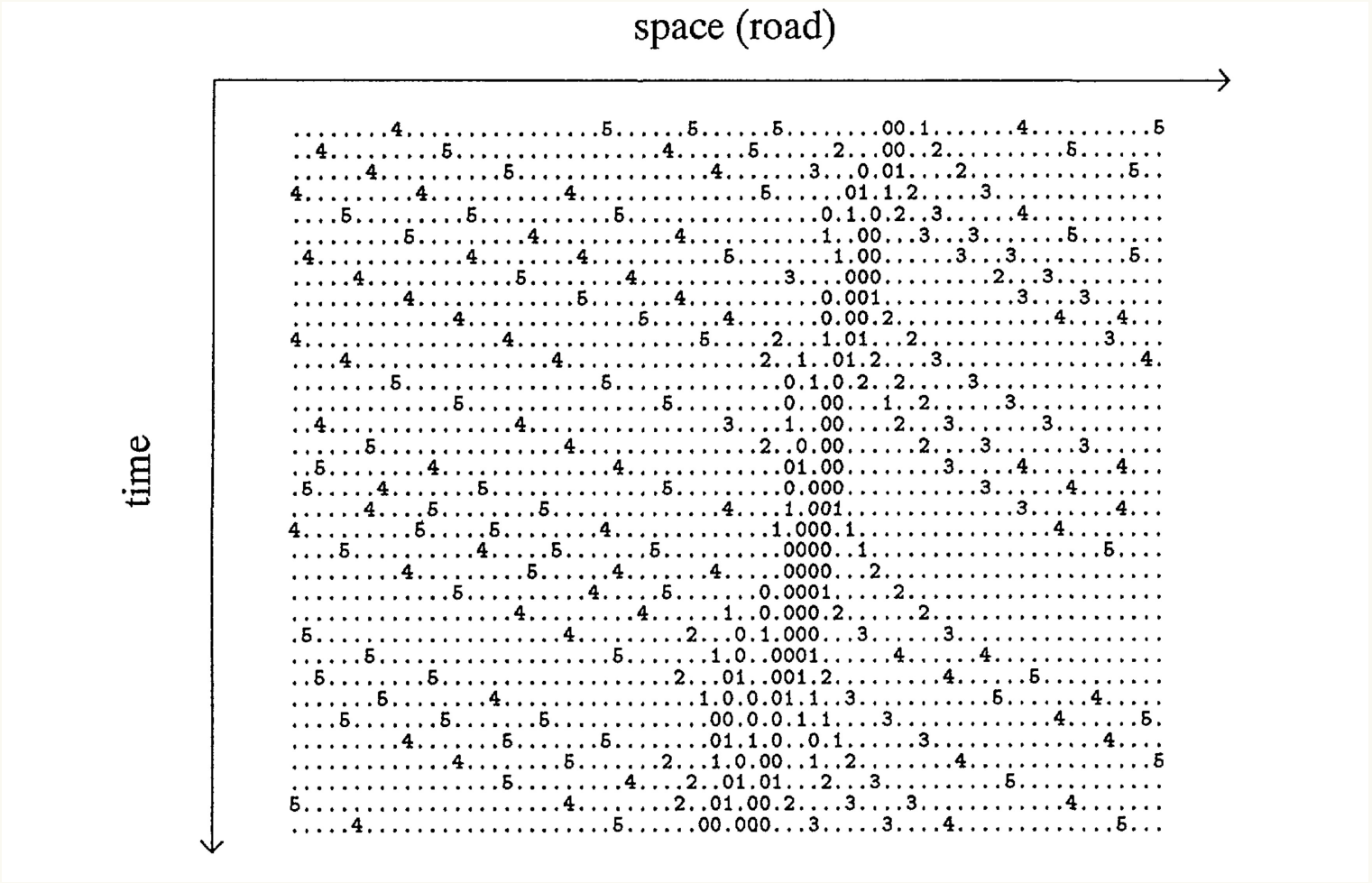

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Literature

Adaptions to the original Model:

- *Agents moving on a lattice (2 dimensional model)*[1]
- *Heterogeneous vehicles*[2]
- *Road with Bicycle Lane and interactions*[3]

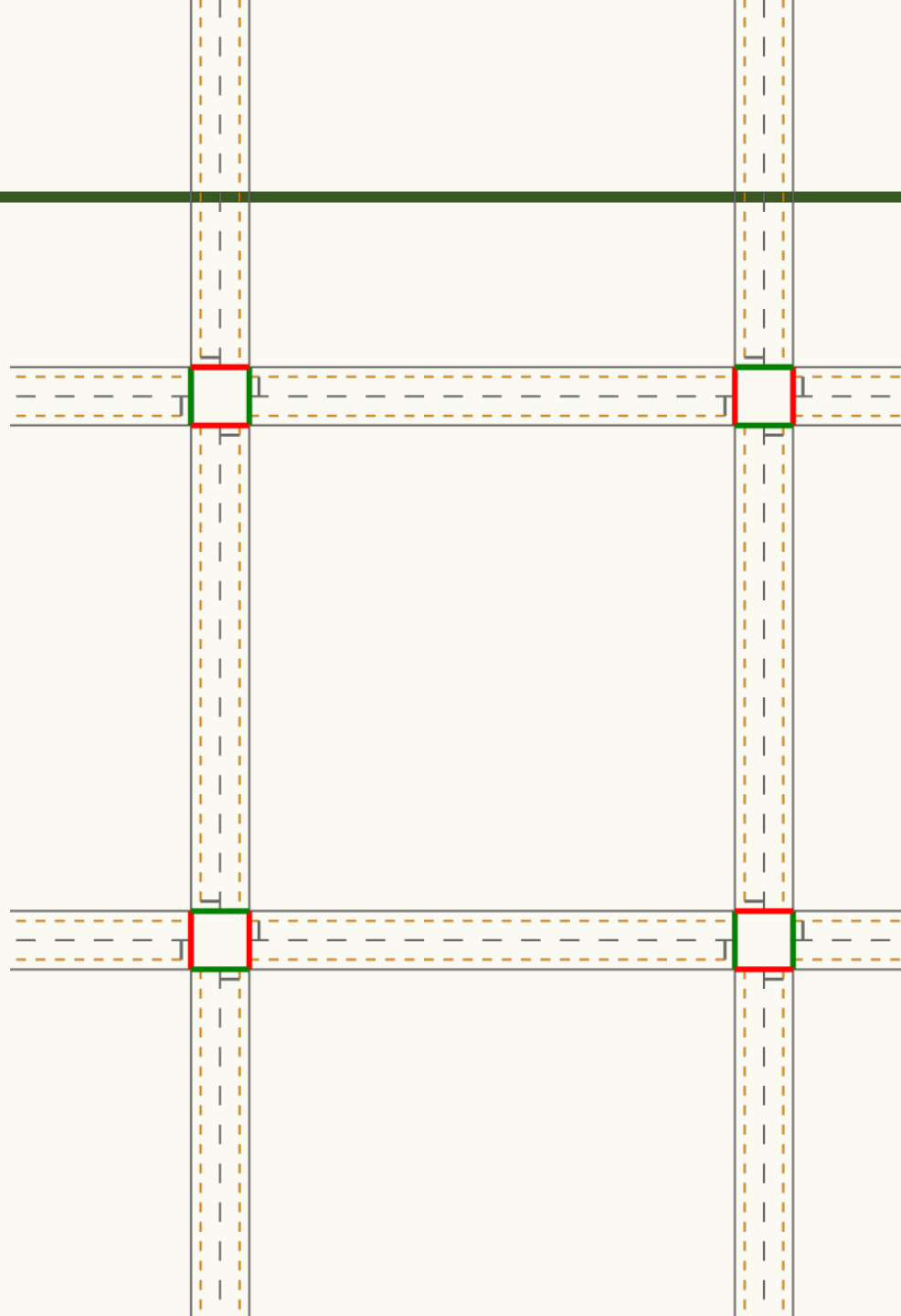
[1]Debashish Chowdhury and Andreas Schadschneider. "Self-organization of traffic jams in cities: Effects of stochastic dynamics and signal periods". Phys. Rev. E 59 (2 Feb. 1999), R1311–R1314. doi: 10.1103/PhysRevE.59.R1311

[2]Dirk Helbing and Michael Schreckenberg. "Cellular automata simulating experimental properties of traffic flow". Phys. Rev. E 59 (3 Mar. 1999), R2505–R2508. doi: 10.1103/PhysRevE.59.R2505.

[3]Jelena Vasic and Heather J. Ruskin. "Cellular automata simulation of traffic including cars and bicycles". Physica A: Statistical Mechanics and its Applications 391.8 (2012), pp. 2720–2729. issn: 0378-4371. doi: https://doi.org/10.1016/j.physa.2011.12.018.

The Model

- *Lattice of 270 × 270 cells*
- *Open boundary conditions*
- *Vehicles moving in 1 direction only*
- *Intersections with traffic lights*
- *Heterogeneous vehicles:*
  - *CARS:*
    *2*2 cells, max speed 5 cells/time step*
  - *BIKES:*
    *1*1 cell, max speed 3 cells/time step*
- *1 time step: 1 second, 1 cell: 3,5 m*
- *Visualisation with tuning parameters*



The Simulation

Shared Roads

- *Cars & Bikes share road with no protected bicycle space*
- *No overtaking*

Bicycle Lanes & Bike Boxes

- *Bike Lane and Bike box implemented*
- *Increase safety*
- *Prioritize bikes*

Goal: compare in terms of
- average maximum velocity
- traffic flow

For cars and bikes respectively

The Simulation

The Simulation in the Web interface

Results and Hypotheses

Make statements about and quantify the improvement of traffic flow and prioritizing bicycles in traffic

Expectation:

- Improved flow for bicycles with bike lanes and bike boxes
- Bike Boxes prioritize bicycles at intersections

Challenges

- Generation of new agents:
  Dynamic number of agents

- Length of streets:
  If the first road in the simulation is full, no new agents

- Statistics:
  Generating statistics for dynamic number of agents

Challenges

- Traffic lights:
  Not adaptive, e.g. green wave for bikes
- Look ahead for collisions
- Rules for bike boxes

Thank you for your
attention
&
Ride safely