Estimating the Probability of a Timely Traffic-Hazard Warning via Simulation

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Critical Systems Engineering for
Socio-Technical Systems

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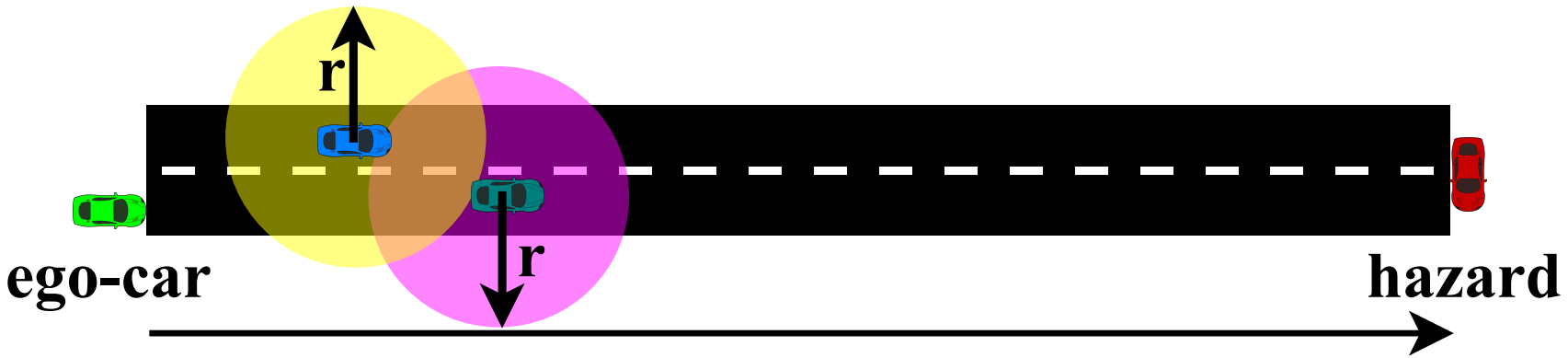
Agenda I

1. Brief Problem Outline
2. Practical Application
3. Conclusion

Underlying question

- How reliable are hazard warning systems?
- A car approaches a hazard.
- A hazard on its path is a safety threat.
- The threat can only be assessed on close range.
- Cars between ego-car and hazard can propagate a warning.



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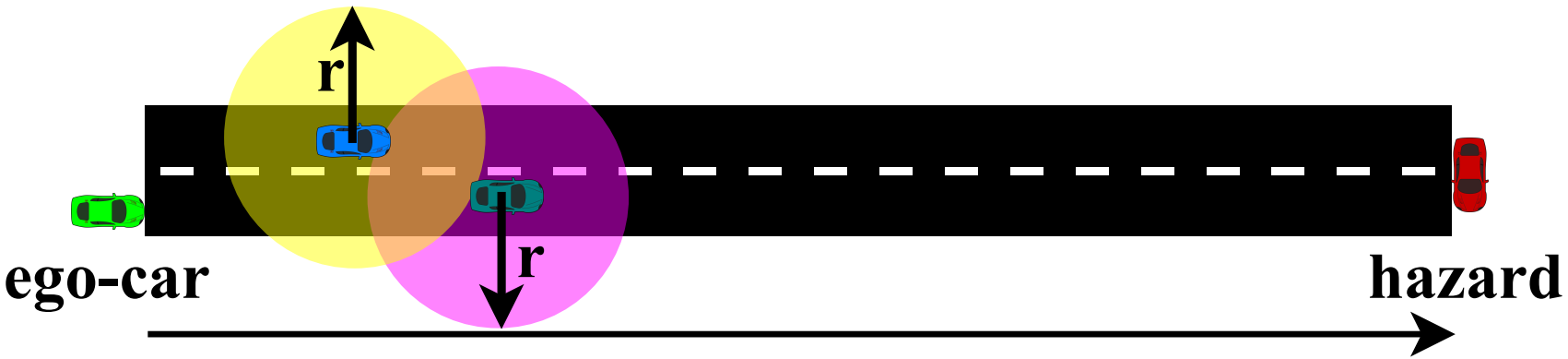

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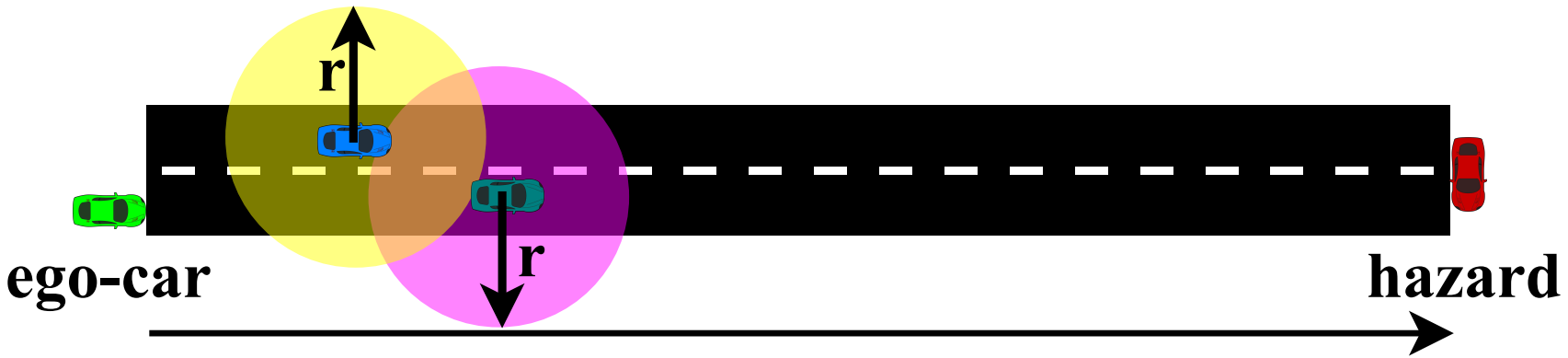

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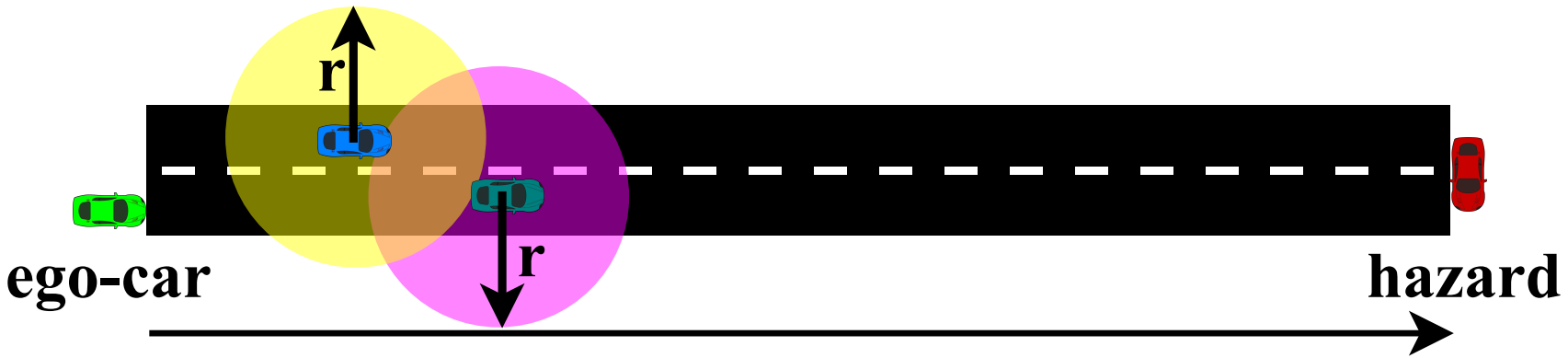

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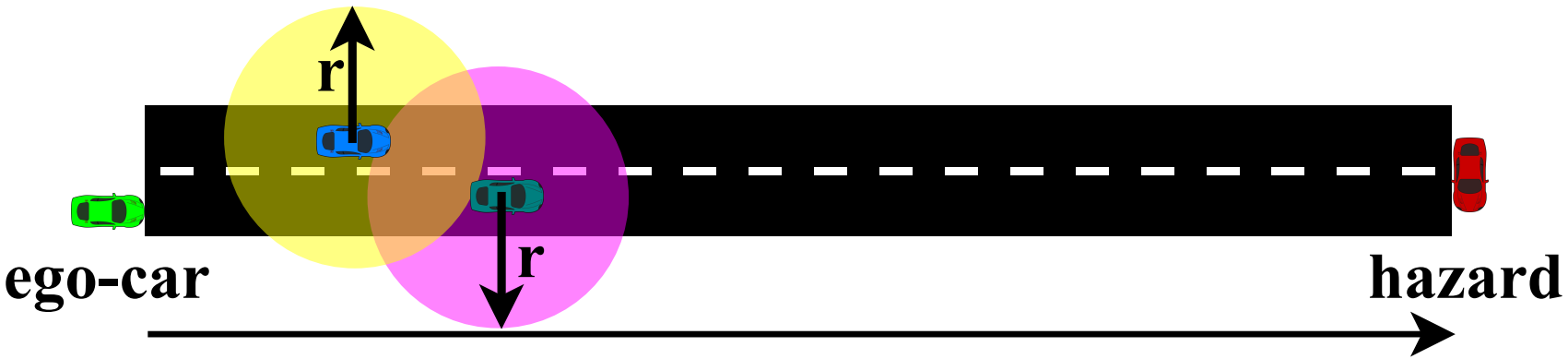

Approach

Simulation:

- specify **fixed** parameters: distance to hazard, velocity of ego car, communication range of cars
- specify **dynamic** parameters: velocity of other cars, number of other cars
- goal: determine how **reliability** depends on (dynamic) parameters
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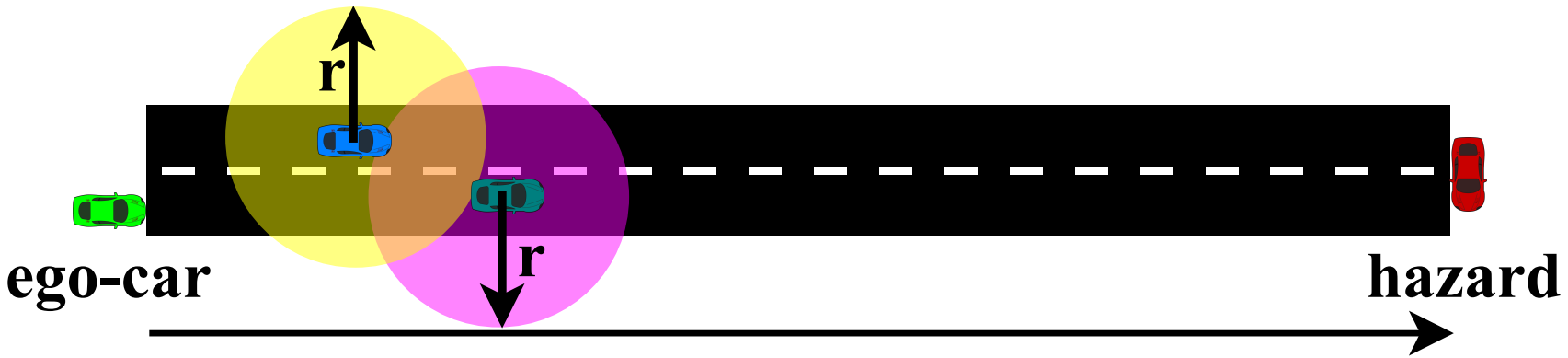

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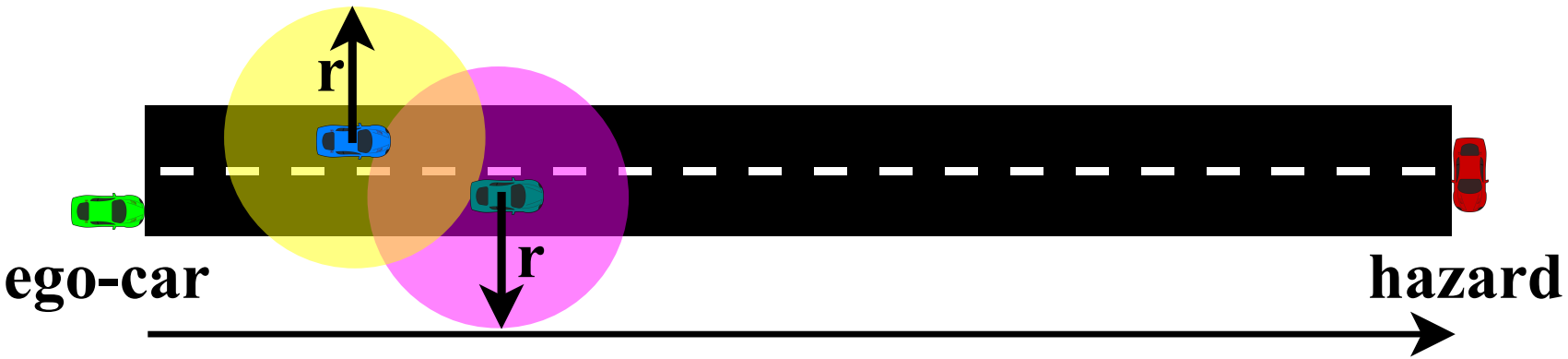

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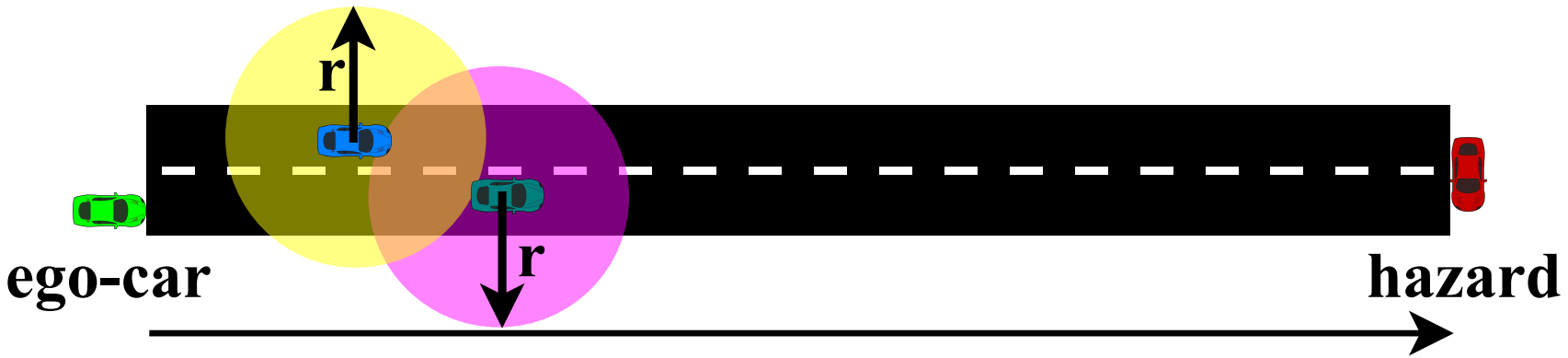

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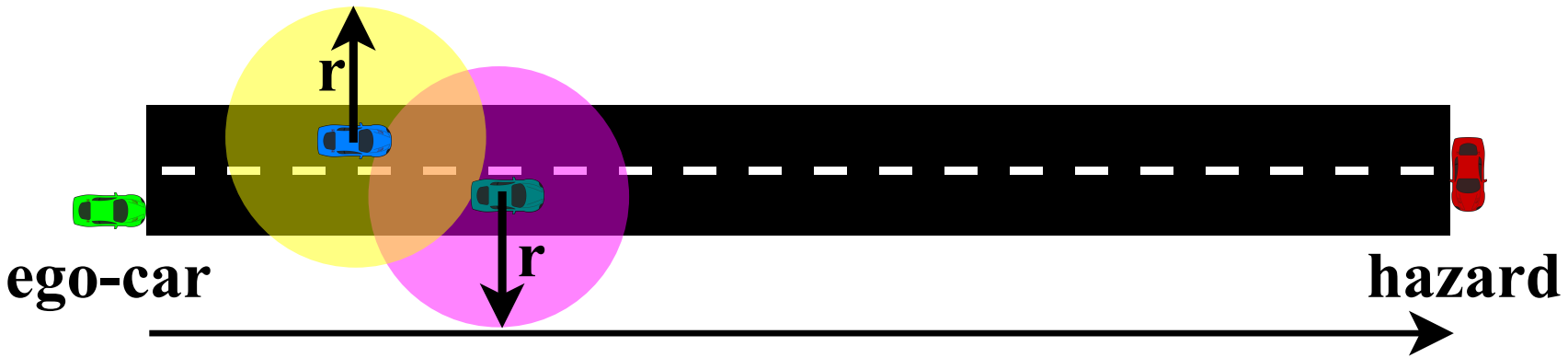

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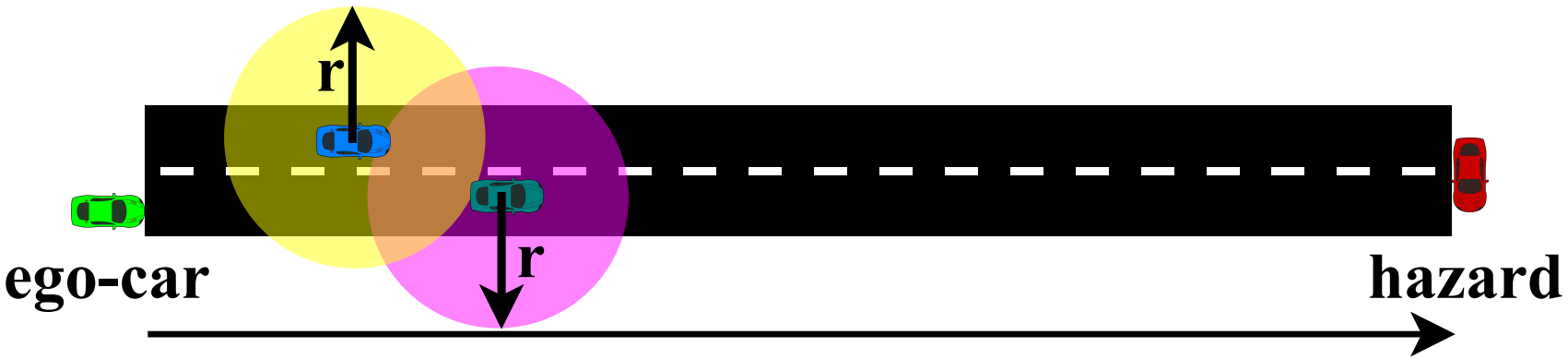

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2. How does the velocity interval of other cars influence the results?
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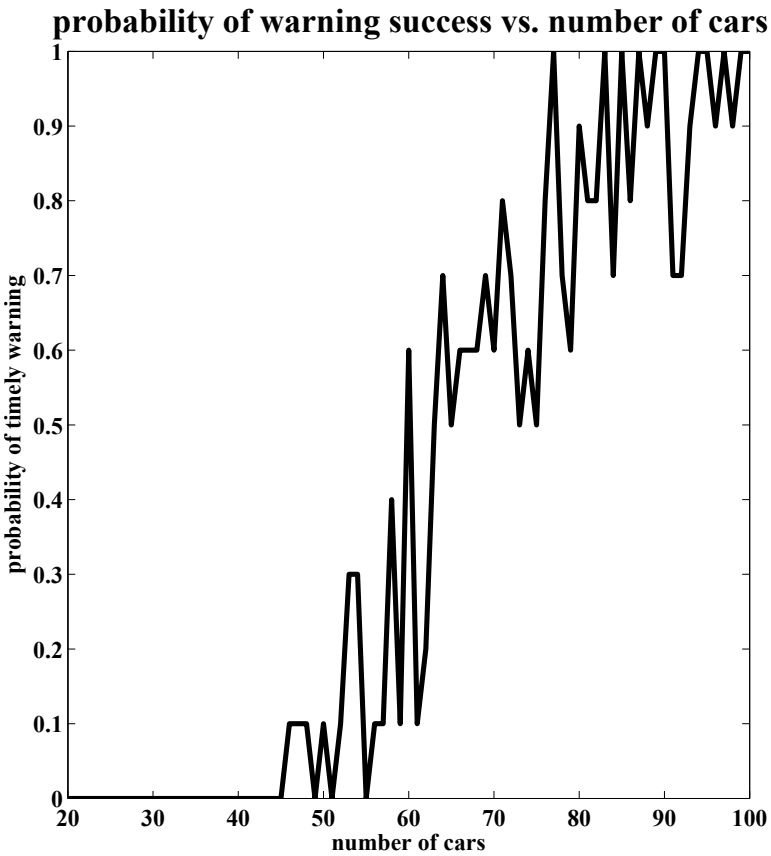

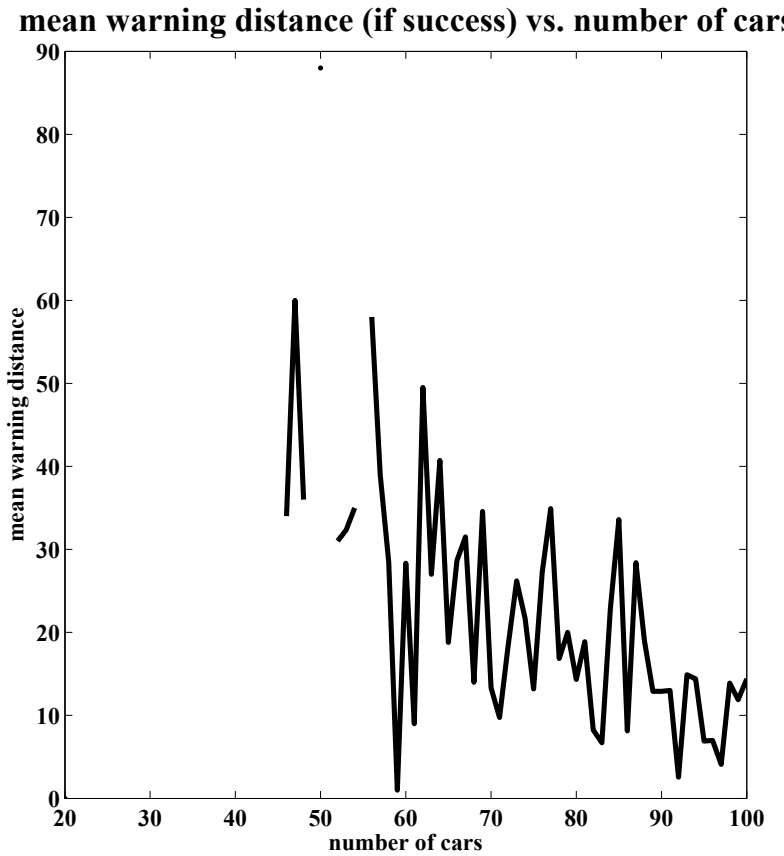

Figure: 10 trials

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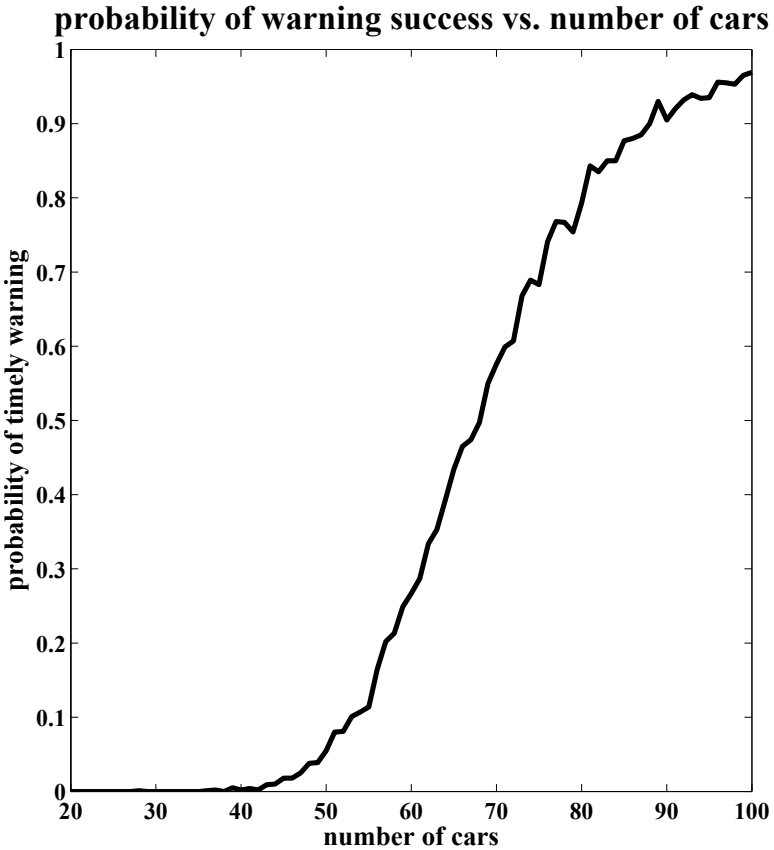

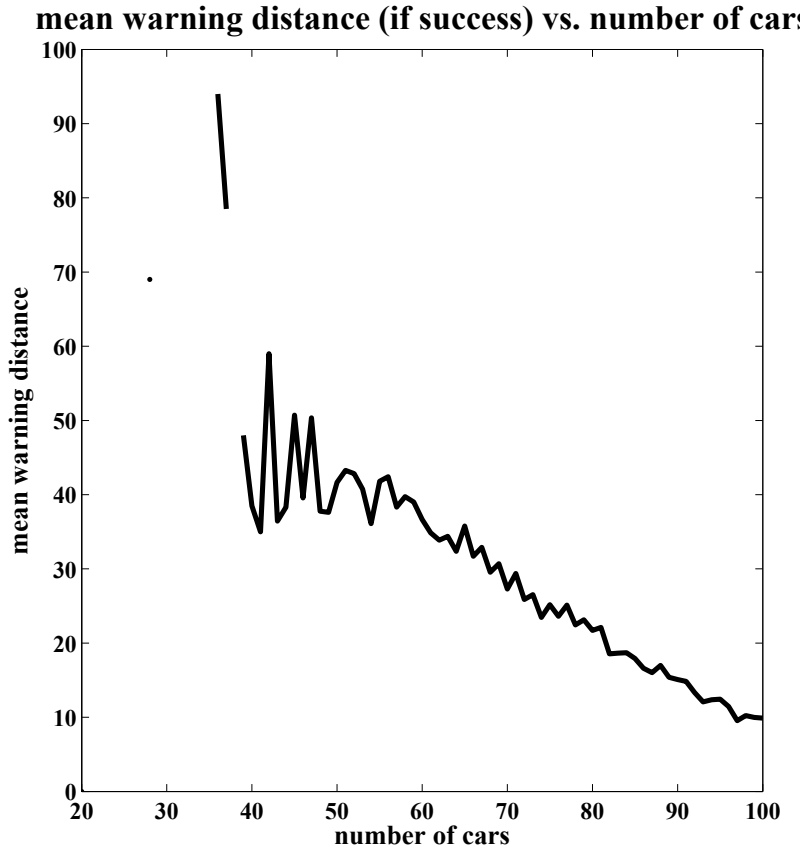

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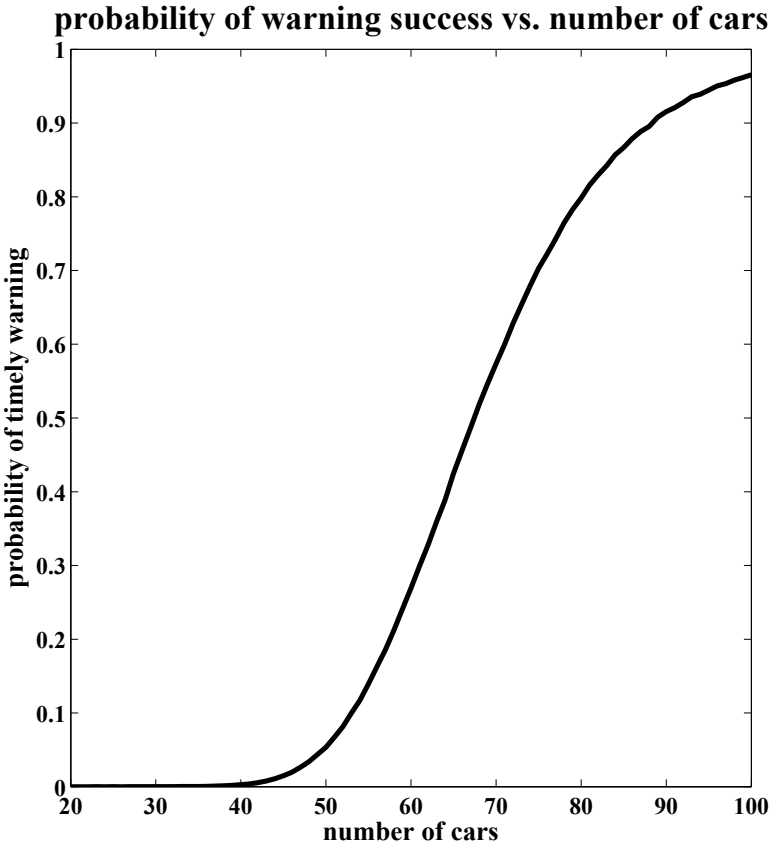


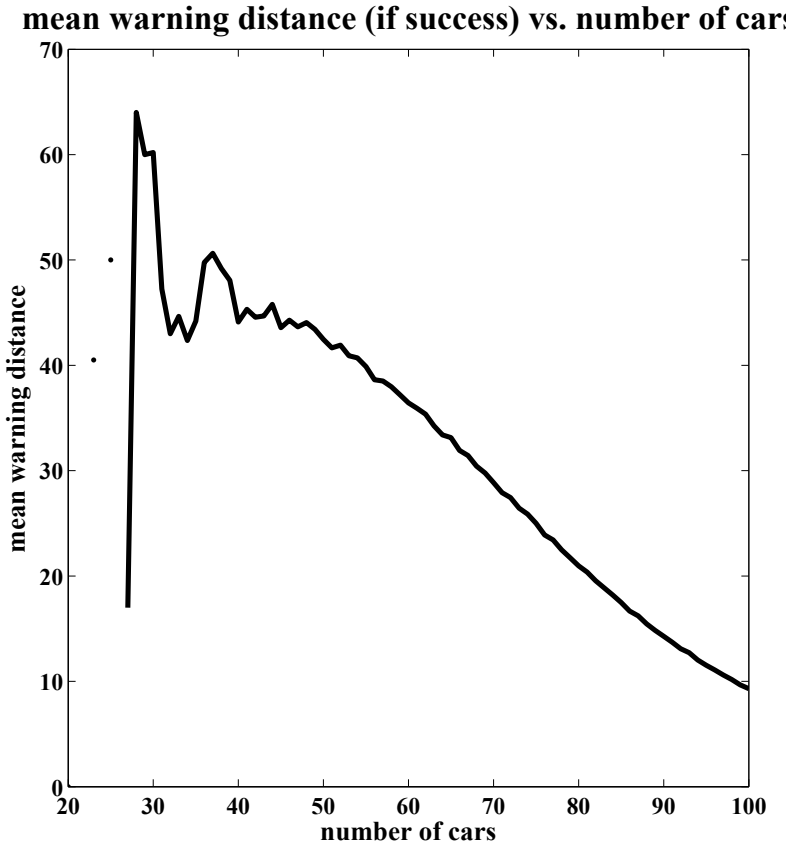
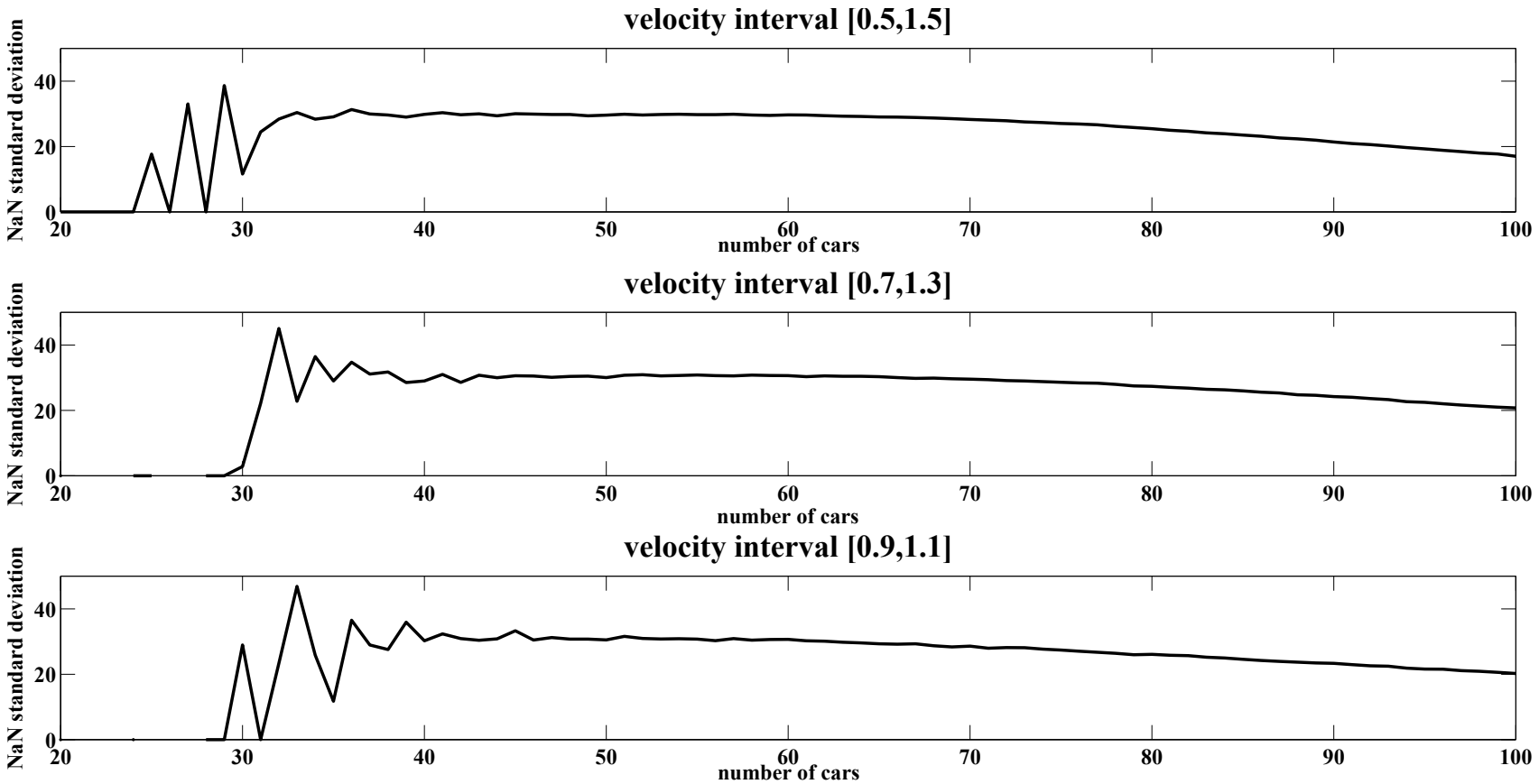
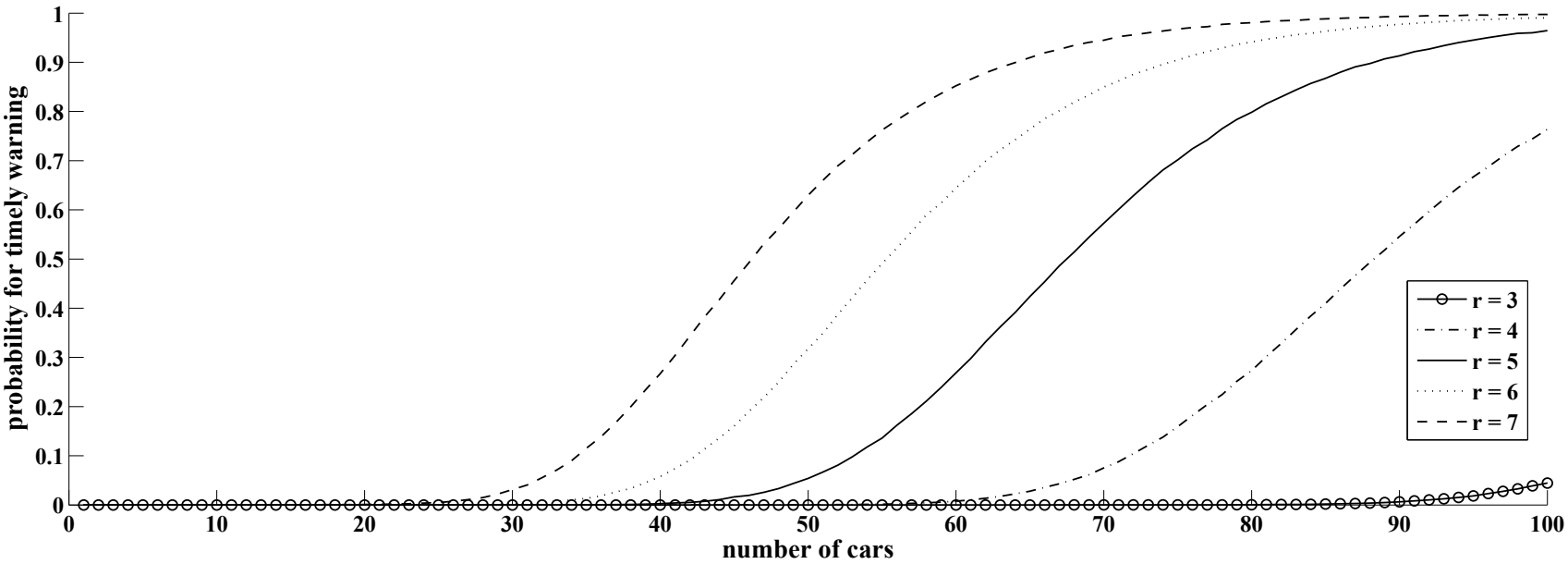


Figure: 100.000 trials

Setting 2: The velocity interval



Setting 3: The communication range



Lessons learned

- Number of simulations should not be fixed.
- The velocity interval has **minor** influence on results.
- The radio range has **major** influence on results.
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Future work

- Employ Hoeffding to determine number of simulations.
- Switch to SUMO & OMNET++ for better traffic simulation.
- Determine security weak spots caused by unequal distributions (e.g. traffic backlog).
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Questions?