

RESEARCH ARTICLE

Nagel–Schreckenberg Model

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Keywords: Traffic Flow, Traffic Dynamics at Intersections, Simulation, Automaton Model

Abstract

This paper presents an investigation into the Nagel-Schreckenberg model, a cellular automaton model used for simulating traffic flow, with a focus on understanding traffic dynamics at intersections. By extending the model to incorporate traffic signals, we explore the effects of different signal patterns and control strategies on overall traffic flow efficiency. The study aims to provide insights into the optimal management of traffic signals at intersections, leading to improved road safety and reduced travel times. Through simulation scenarios and analysis, we evaluate various traffic signal control strategies and assess their impact on key metrics such as vehicle throughput, average travel time, queue lengths, and congestion levels. The findings contribute to our understanding of traffic flow behavior at intersections and offer implications for traffic management and planning. The limitations of the cellular automaton model are discussed, and suggestions for future research in traffic flow modeling and intersection management are provided. This research provides a foundation for developing efficient traffic management techniques and informing sustainable urban mobility planning.

Impact Statement

Some Data journals (DAP, DCE) require an ‘Impact Statement’ section. Comment out this section if it is not required.

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3. Equations

Equations in L^AT_EX can either be inline or on-a-line by itself. For inline equations use the \dots commands. Eg: The equation $H\psi = E\psi$ is written via the command $H\psi = E\psi$.

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Table 1. Tables which are too long to fit, should be written using the “table*” environment as shown here.

Projectile	Element 1			Element 2 ¹		
	Energy	σ_{calc}	σ_{expt}	Energy	σ_{calc}	σ_{expt}
Element 3	990 A	1168	1547 ± 12	780 A	1166	1239 ± 100
Element 4	500 A	961	922 ± 10	900 A	1268	1092 ± 40

Note: This is an example of table footnote this is an example of table footnote this is an example of table footnote this is an example of table footnote this is an example of table footnote

¹This is an example of table footnote

For on-a-line by itself equations (with auto generated equation numbers) one can use the equation or eqnarray environments D .

$$\mathcal{L} = i\psi\gamma^\mu D_\mu\psi - \frac{1}{4}F_{\mu\nu}^a F^{a\mu\nu} - m\psi\psi \quad (3.1)$$

where,

$$\begin{aligned} D_\mu &= \partial_\mu - ig \frac{\lambda^a}{2} A_\mu^a \\ F_{\mu\nu}^a &= \partial_\mu A_\nu^a - \partial_\nu A_\mu^a + g f^{abc} A_\mu^b A_\nu^c \end{aligned} \quad (3.2)$$

Notice the use of `\nonumber` in the align environment at the end of each line, except the last, so as not to produce equation numbers on lines where no equation numbers are required. The `\label{}` command should only be used at the last line of an align environment where `\nonumber` is not used.

$$Y_\infty = \left(\frac{m}{\text{GeV}} \right)^{-3} \left[1 + \frac{3 \ln(m/\text{GeV})}{15} + \frac{\ln(c_2/5)}{15} \right] \quad (3.3)$$

The class file also supports the use of `\mathbb{b}`, `\mathscr` and `\mathcal` commands. As such `\mathbb{b}{R}`, `\mathscr{R}` and `\mathcal{R}` produces \mathbb{R} , \mathscr{R} and \mathcal{R} respectively.

4. Figures

As per the \LaTeX standards eps images in latex and pdf/jpg/png images in pdflatex should be used. This is one of the major differences between latex and pdflatex. The images should be single page documents. The command for inserting images for latex and pdflatex can be generalized. The package that should be used is the graphicx package.

5. Tables

Tables can be inserted via the normal table and tabular environment. To put footnotes inside tables one has to use the additional “fntable” environment enclosing the tabular environment. The footnote appears just below the table itself.

6. Cross referencing

Environments such as figure, table, equation, align can have a label declared via the `\label{#label}` command. For figures and table environments one should use the `\label{}` command inside or just below the `\caption{}` command. One can then use the `\ref{#label}` command to cross-reference

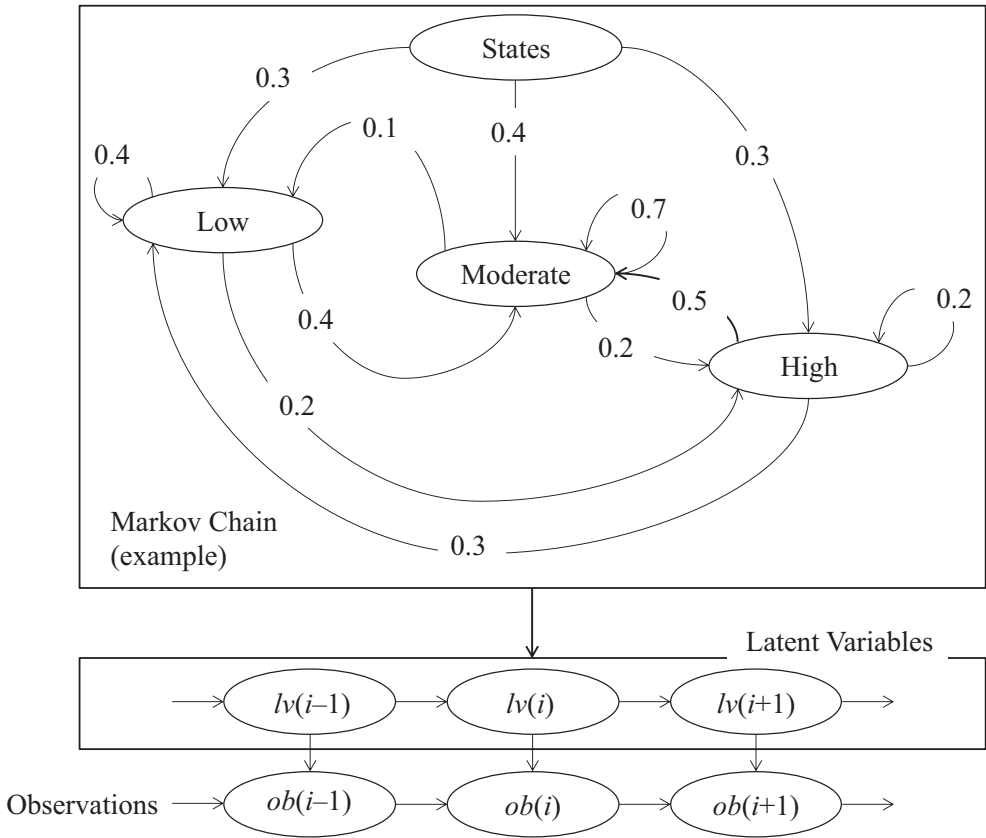


Figure 1. This is a widefig. This is an example of long caption this is an example of long caption this is an example of long caption this is an example of long caption.

them. As an example, consider the label declared for Figure 1 which is `\label{fig1}`. To cross-reference it, use the command `Figure \ref{fig1}`, for which it comes up as “Figure 1”. The reference citations should be used as per the “natbib” packages. Some sample citations: [1, 2, 3, 4, 5].

7. Lists

List in \LaTeX can be of three types: enumerate, itemize and description. In each environment, new entry is added via the `\item` command. Enumerate creates numbered lists, itemize creates bulleted lists and description creates description lists.

1. First item in the number list.
2. Second item in the number list.
3. Third item in the number list.

List in \LaTeX can be of three types: enumerate, itemize and description. In each environment, new entry is added via the `\item` command.

- First item in the bullet list.
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- Third item in the bullet list.

A. Appendix. Title for Appendix Section

Appendix text here.

B. Conclusion

Some Conclusions here.

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Competing Interests. A statement about any financial, professional, contractual or personal relationships or situations that could be perceived to impact the presentation of the work — or ‘None’ if none exist

Data Availability Statement. A statement about how to access data, code and other materials allowing users to understand, verify and replicate findings — e.g. Replication data and code can be found in Harvard Dataverse: \url{https://doi.org/link}.

Ethical Standards. The research meets all ethical guidelines, including adherence to the legal requirements of the study country.

Author Contributions. Please provide an author contributions statement using the CRediT taxonomy roles as a guide \url{https://www.casrai.org/credit.html}. Conceptualization: A.A; A.B. Methodology: A.A; A.B. Data curation: A.C. Data visualisation: A.C. Writing original draft: A.A; A.B. All authors approved the final submitted draft.

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