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| **Research article** |  |

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**Artyom Boyarov\*1**

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| 1Student, Whitgift School, United Kingdom  **Correspondence**  \*Artyom Boyarov  Email: [artyom.boyarov@gmail.com](mailto:artyom.boyarov@gmail.com)  **Funding Information**  Project Name  Grant/Award Number: XXXXXXXX | **Abstract**  These instructions give you guidelines for preparing papers for *Engineering Reports.* Use this document as a template if you are using Microsoft *Word* 16.0 or later. Otherwise, use this document as an instruction set. The electronic file of your paper will be formatted further. The abstract is limited to 150–200 words and cannot contain equations, figures, tables, or references. It should concisely state what is done, how it is done, principal results, and their significance. Define all acronyms used in the abstract. Please use the present tense here.  **KEYWORDS**  About four key words or phrases in alphabetical order, separated by commas. |

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# experimental procedures

A kinematic simulation of a two-axled vehicle was developed in the Python programming language with the Matplotlib library providing a graphical frontend. The bicycle kinematic model was used to simulate the car. The simulation was run at a fixed time step of 0.1 seconds. Trajectories for the simulation were made up of straight segments and curved line segments; points on the trajectories were generated using linear interpolations and geometric slerps. Each control algorithm was implemented as a separate function which would return a steering angle on each step based on the current position of the car. Control algorithms were implemented using the available literature as well as the PythonRobotics Github repository [8]. While the simulation was running, values for the steering angle and cross track error (measured as the distance from the front axle to the nearest waypoint) were recorded and then stored in a csv file at the end of the simulation. These values were then processed and analyzed. The code is publicly available; the GitHub page is mentioned in the appendix.

# results

Yes

Make figures and then conclusions

# conclusions

Copy over discussion

Each of the experiments presented a similar pattern of results: the pure pursuit controller would have smooth steering and a low steering angle, and the Stanley controller would have the lowest cross track error. For some experiments the cross track error of the other controllers compared did not differ greatly from the cross track error of the Stanley controller, namely the three-quarter turn on the roundabout course. The combined pure pursuit controller and Stanley controller with lookahead had a lower cross track error than the pure pursuit controller, however both controllers had sudden changes in steering angle as well as a large steering angle.

The simulation was quite accurate as it was not affected by external factors. Also the measurements used were entirely accurate. When the experiments were repeated, the results obtained were very similar. However, the simulation had the speed fixed to 50 km/h, but in an actual scenario the speed of the vehicle will change, especially while turning. A more realistic simulator could have been used for the experiment, such as the CARLA simulator. This simulator features advanced vehicle physics and so the effect of turning on the speed of the vehicle could have been observed.

The results therefore indicate that no single controller offers optimal control of a vehicle. The Stanley controller offers a good cross track error, at the cost of sudden changes in steering, which would be uncomfortable for passengers or goods. The pure pursuit controller had smoother turns, however it had a large cross track error. A controller which can avoid the large change in steering angle while having a low cross track error is a possible next step for development. A possible implementation may be a modified Stanley controller which outputs a value for the rate of change of steering angle, which is clamped within a margin, so that the vehicle does not change the steering angle suddenly.

Apart from looking for an improved kinematic lateral control algorithm, the possible next step may be to look at predictive control algorithms such as model predictive control, which may offer improved performance than the kinematic algorithms, albeit at a higher computational cost. Articulated vehicles may also be investigated. Articulated trucks are very common, and articulated buses are used around the world. Articulated buses offer higher passenger capacity and faster transportation (7).

Overall, the research showed that no control algorithm offered optimal performance. The pure pursuit algorithm had smooth steering, but a high cross track error. The Stanley control algorithm had a lower cross track error but had large changes in steering angle. The combined Stanley and pure pursuit control algorithm and the Stanley with lookahead algorithm had a lower cross track error than the pure pursuit controller, however they had high steering angles and sudden changes in steering angle. This indicates that no kinematic control algorithm discussed provides optimal results, and so an algorithm which addresses the shortcomings of the Stanley and pure pursuit controllers or a predictive algorithm such as model predictive control may produce better results.

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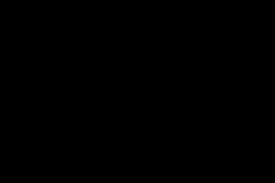


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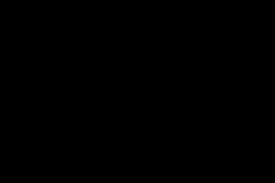


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Authors should list all funding sources, including details of funding bodies with grant numbers, in the Acknowledgments section.

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I would like to thank Professor Howie Choset of Carnegie Mellon University for reading through my manuscript. I would also like to thank Ilya Makarov for reading through my manuscript and helping me refactor it. I would like to thank my parents for their assistance during my study and research and for funding a course for me on autonomous vehicles, which encouraged me to undertake this research project.

**DATA AVAILABILITY STATEMENT**

Authors are required to provide a data availability statement to describe the **availability** or the **absence** of shared data. When data have been shared, authors are required to include in their data availability statement a link to the repository they have used, and to cite the data they have shared. Whenever possible the scripts and other artefacts used to generate the analyses presented in the paper should also be publicly archived. If sharing data compromises ethical standards or legal requirements, then authors are not expected to share it.

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The data that support the findings of this study are openly available in the Github repository *heemogoblin/trajectory-following-simulation* at [github.com/heemogoblin/trajectory-following-simulation](https://github.com/heemogoblin/trajectory-following-simulation).

* The data that support the findings of this study are available in [repository name] at [URL/DOI], reference number [reference number]. These data were derived from the following resources available in the public domain: [list resources and URLs]
* The data that support the findings will be available in [repository name] at [URL / DOI link] following an embargo from the date of publication to allow for commercialization of research findings.
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**CONFLICT OF INTEREST**

The author declares no potential conflict of interest.

**REFERENCES**

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| [1] | B. Gastel and R. A. Day, How to Write and Publisher a Scientific Paper, New York, USA: Cambridge University Press, 2017. |
| [2] | W. J. Strunk and E. B. White, The Elements of Style, IV Edition, Massachusetts, USA: Longman Publishers, 2000. |
| [3] | J.-l. Doumont, Trees, maps, and theorems. Effective communication for rational minds, Brussels, Belgium: Principiae, 2009. |
| [4] | Y. Lv, Y. Duan, W. Kang, Z. Li and F.-Y. Wang, “Traffic Flow Prediction With Big Data: A Deep Learning Approach,” *IEEE Transactions on Intelligent Transportation Systems,* vol. 16, no. 2, pp. 865-873, 2015. DOI: https://doi.org/10.1109/TITS.2014.2345663. |
| [5] | H. Tang, C. Hammack, S. C. Ogden, Z. Wen, X. Qian, Y. Li, B. Yao, J. Shin, F. Zhang, E. M. Lee, K. M. Christian, R. A. Didier, P. Jin, H. Song and G.-l. Ming, “Zika Virus Infects Human Cortical Neural Progenitors and Attenuates Their Growth,” *Cell Stem Cell,* vol. 18, no. 5, pp. 587-590, 2016. DOI: https://doi.org/10.1016/j.stem.2016.02.016. |
| [6] | C. Guo, J. Ran, A. Vasileff and S.-Z. Qiao, “Rational design of electrocatalysts and photo(electro) catalysts for nitrogen reduction to ammonia (NH3) under ambient conditions,” *Energy & Environmental Science,* vol. 11, no. 1, pp. 45-56, 2018. DOI: https://doi.org/10.1039/C7EE02220D. |
| [7] | S. Ren, K. He, R. Girshick and J. Sun, “Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks,” *IEEE Transactions on Pattern Analysis and Machine Intelligence,* vol. 39, no. 6, pp. 1137-1149, 2017. DOI: https://doi.org/10.1109/TPAMI.2016.2577031. |
| [8] | A. Glowacz, “Fault diagnosis of single-phase induction motor based on acoustic signals,” *Mechanical Systems and Signal Processing,* vol. 117, pp. 65-80, 2019. DOI: https://doi.org/10.1016/j.ymssp.2018.07.044. |
| [9] | “Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals,” International Committee of Medical Journal Editors, December 2018. [Online]. Available: http://www.icmje.org/about-icmje/faqs/icmje-recommendations/. [Accessed 01 Jul 2019]. |

**SUPPORTING INFORMATION**

The code for the simulation used to perform the research is available at [github.com/heemogoblin/trajectory-following-simulation](https://github.com/heemogoblin/trajectory-following-simulation).