

Model-Free Reinforcement Learning for Static Point Source Localization in a 3D Simulation.*

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Abstract—The development of effective source localization techniques has broad reaching implications across multiple domains and environments. Whether it be natural resource detection, environmental monitoring and conservation, search and rescue, navigation or endless additional applications it is an interesting and complex problem that can be solved by the implementation of machine learning algorithms. The contribution of this work aims to implement an RL method that balances the trade-off between exploration and exploitation to efficiently locate and navigate toward the “source” in a relatively large static environment

Index Terms—reinforcement learning, q-learning, source localization,

I. INTRODUCTION

The development of effective source localization techniques has broad reaching implications across multiple domains and environments. Whether it be natural resource detection, environmental monitoring and conservation, search and rescue, navigation or endless additional applications it is an interesting and complex problem that can be solved by the implementation of machine learning algorithms.

Demonstrated methods of source localization such as local search and optimization problems guided by chemotaxis are not efficient for large search environments or remote isolated sources due to their affinity for local minima and maxima. The contribution of this work aims to implement an RL method that balances the trade-off between exploration and exploitation to efficiently locate and navigate toward the “source” in a relatively large static environment

II. RELATED WORKS

What papers can we reference?

III. METHODS

A python interface was implemented to simulate an agent and a three-dimensional environment. A uniform concentration gradient

Explain data, pollution? units?

was applied around a source point which the agents goal was to locate. The agent was trained using Direct Utility Estimation

Identify applicable funding agency here. If none, delete this.

Cite this: 21.2.1 Direct utility estimation, Artificial Intelligence A Modern Approach Third Edition, pg 833

IV. EXPERIMENTS AND RESULTS

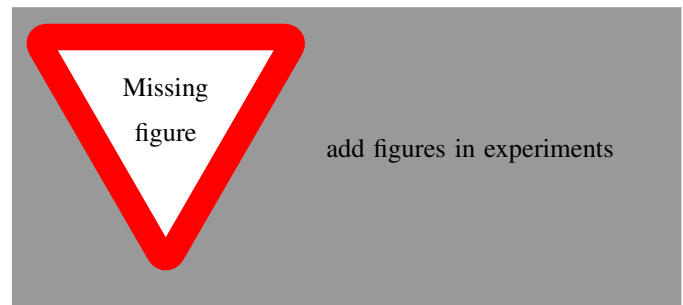


Fig. 1. Example of a figure caption.

V. CONCLUSION

VI. FUTURE WORK

ML Project Paper Due 2021-MAY-06

TODO LIST

What papers can we reference?	1
Explain data, pollution? units?	1
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$$a + b = \gamma \quad (1)$$

Be sure that the symbols in your equation have been defined before or immediately following the equation. Use “(1)”, not “Eq. (1)” or “equation (1)”, except at the beginning of a sentence: “Equation (1) is . . .”

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Please use “soft” (e.g., `\eqref{Eq}`) cross references instead of “hard” references (e.g., (1)). That will make it possible to combine sections, add equations, or change the order of figures or citations without having to go through the file line by line.

Please don’t use the `{eqnarray}` equation environment. Use `{align}` or `{IEEEeqnarray}` instead. The `{eqnarray}` environment leaves unsightly spaces around relation symbols.

Please note that the `{subequations}` environment in \LaTeX will increment the main equation counter even when there are no equation numbers displayed. If you forget that, you might write an article in which the equation numbers skip from (17) to (20), causing the copy editors to wonder if you’ve discovered a new method of counting.

\BibTeX does not work by magic. It doesn’t get the bibliographic data from thin air but from .bib files. If you use \BibTeX to produce a bibliography you must send the .bib files.

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- The word “data” is plural, not singular.
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- In your paper title, if the words “that uses” can accurately replace the word “using”, capitalize the “u”; if not, keep using lower-cased.
- Be aware of the different meanings of the homophones “affect” and “effect”, “complement” and “compliment”, “discreet” and “discrete”, “principal” and “principle”.
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- There is no period after the “et” in the Latin abbreviation “et al.”.
- The abbreviation “i.e.” means “that is”, and the abbreviation “e.g.” means “for example”.

An excellent style manual for science writers is [7].

F. Authors and Affiliations

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TABLE I
TABLE TYPE STYLES

Table Head	Table Column Head		
	Table column subhead	Subhead	Subhead
copy	More table copy ^a		

^aSample of a Table footnote.

Figure Labels: Use 8 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when



Fig. 2. Example of a figure caption.

writing Figure axis labels to avoid confusing the reader. As an example, write the quantity “Magnetization”, or “Magnetization, M”, not just “M”. If including units in the label, present them within parentheses. Do not label axes only with units. In the example, write “Magnetization (A/m)” or “Magnetization {A[m(1)]}”, not just “A/m”. Do not label axes with a ratio of quantities and units. For example, write “Temperature (K)”, not “Temperature/K”.

ACKNOWLEDGMENT

The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression “one of us (R. B. G.) thanks ...”. Instead, try “R. B. G. thanks...”. Put sponsor acknowledgments in the unnumbered footnote on the first page.

REFERENCES

Please number citations consecutively within brackets [1]. The sentence punctuation follows the bracket [2]. Refer simply to the reference number, as in [3]—do not use “Ref. [3]” or “reference [3]” except at the beginning of a sentence: “Reference [3] was the first ...”

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REFERENCES

- [1] G. Eason, B. Noble, and I. N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” *Phil. Trans. Roy. Soc. London*, vol. A247, pp. 529–551, April 1955.
- [2] J. Clerk Maxwell, *A Treatise on Electricity and Magnetism*, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.
- [3] I. S. Jacobs and C. P. Bean, “Fine particles, thin films and exchange anisotropy,” in *Magnetism*, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.
- [4] K. Elissa, “Title of paper if known,” unpublished.
- [5] R. Nicole, “Title of paper with only first word capitalized,” *J. Name Stand. Abbrev.*, in press.

- [6] Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetism Japan, p. 301, 1982].
- [7] M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

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