IKO42360 Technical Report: Monte Carlo Localization (MCL)*

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***Abstract*— You may or may not write an abstract. It is essentially a summary comprising of not more than 250 words.**

I. INTRODUCTION

This report guidance presents elaborated instructions. You may find this as a complement to the original instruction file. This report guidance is not strict in the sense that you may *not only* add some point *but also* remove some point, yet you still obtain an optimal grade (if those addition and removal are reasonably justified). Feel free to ask TAs for any doubt.

- give some context or background
- state the problem
- state the objective
- give an overview about the method
- why choose a particular method
- give an overview about the experiment results
- outline the content

II. THE ROBOT SIMULATION

- robot's specification?
- assumptions?

A. Action Simulation

- assumptions?
- probability distribution?
- notice different characteristics of the floor surface
- code listing

B. Perception Simulation

- assumptions?
- probability distribution?
- code listing

III. ACTION MODELS

- the theory: either odometry or velocity motion models
- assumptions, e.g. gaussian errors
- code listing
- experiment on motion model
- how do different characteristics of the floor surface influence the model?
- reproduce fig. 5.4, 5.9, 5.10 from [1]

*Team TA, compiled on 28/05/2014 at 6:15am

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IV. PERCEPTION MODELS

- the theory: either beam model for range finders or feature-based measurement models
- assumptions, e.g. gaussian errors
- code listing
- tuning the intrinsic parameters
- experiment on perception model
- what if some obstacles are treated as unexpected objects, implying that they are not contained in the map?
- reproduce fig. 6.4, 6.5 from [1]

V. KLD-SAMPLING MCL

A. The standard MCL

- the theory
- code listing

B. The KLD-sampling MCL

You may try other variants of MCL. If you do so, do not forget to change the title of this subsection and the section.

- the theory
- code listing

VI. EXPERIMENTS AND RESULTS

A. Setup

- what kind of map? assumptions?
- code listing for map constructions
- draw/illustrate the map!
- control commands? hardcoded? wall following?
- experiment design or procedure; the start state?
- evaluation metrics: errors, convergence time
- scope: localization problem type?
- is a live simulation available? excellent if one exists
- for each experiment (local, global and kidnapped-robot), reproduce fig. 8.3, 8.4, 8.7, 8.11, 8.13, 8.16, 8.17, 8.18, 8.19 from [1]. For some figures, replace "cell size" with "number of particles"

B. Local Localization

- result, comparison: standard vs. variant
- analysis

C. Global Localization

- result, comparison: standard vs. variant
- analysis

D. Kidnapped-robot Problem

- result, comparison: standard vs. variant
- analysis

VII. RELATED WORK

Discuss or review in-depth *one* related work. Each team is initially assigned different paper. This can be changed to any paper of your choice; preferably it is published in major robotics conferences, such as ICRA, IROS, RSS. For you, we have collected: [2], [3], [4], [5], [6], [7]

- what is the problem they solved?
- how does the proposed solution/method work?
- how good is their solution? any comparisons?
- what is the limitation of their current implementation?
- what future work or open problems do they mention?
- your opinions about the work

VIII. CONCLUSIONS

- re-state the problem, goal briefly
- explain some interesting points about the action or perception model
- highlight the (proposed) method: the MCL variant
- convey the results, mention the advantages of using the (proposed) method and current limitations
- some lessons-learned, some open problems

APPENDIX: PLANNING UNDER MDP

Your work on Problem 2 is explained here.

- re-state the problem, the goal briefly
- formulate the $MDP = (S, A, P_{sa}, R, \gamma)$
- code listing, for the core modules
- plot the values of V^* on the grid map
- plot the optimal policy π^* on the grid map, reproduce fig. 14.2 from [1]
- analysis

APPENDIX: FEEDBACK TO THE CLASS

We love improvements. We value your feedback to the lecturer, the TAs, the lecture, the homework, etc. Feel free to write almost anything about the class, for example, something that you do not want your juniors suffer from. We thank you for all the hard work you put in this class. Good luck :)

REFERENCES

[1] S. Thrun, W. Burgard, and D. Fox, *Probabilistic Robotics*. MIT Press, 2005.

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