

A very very long title

- with a subtitle

En himla bra svensk titel

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Abstract

The abstract resides in file `Abstract.tex`. Here you should write a short summary of your work.

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Acknowledgments

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1 Introduction

In this thesis project, the problem of searching for targets in unknown environments is addressed. This chapter presents the motivation behind the project, the research questions that are addressed, and the delimitations.

1.1 Motivation

Searching for targets (objects of interest, goals) in unknown environments is a well-studied problem that appears in many areas from robotics [], computer vision []. Applications

In this project, an instance of this problem is considered where a pan-tilt-zoom camera is fixed in place, and used to scan an environment for target objects. Automating this task is of interest for multiple reasons

While

This is where the studied problem is described from a general point of view and put in a context which makes it clear that it is interesting and well worth studying. The aim is to make the reader interested in the work and create an urge to continue reading.

1.2 Aim

The aim of this thesis is to implement an autonomous agent that intelligently searches its environment for targets. Ideally, the agent should learn common characteristics of environments and utilize this knowledge to search for targets in new environments more effectively.


1.3 Research questions

This thesis will address the following questions:

1. How can the visual search problem be solved by a learning agent?
2. How can a simulator that tests the ability of an agent to solve the presented problem be implemented?
3. How does the learning agent compare to common non-learning methods?

1.4 Delimitations

This thesis will be focused on the behavioural aspects of the presented problem. To train and test agents, a simplified environment will be used. This will test the desired characteristics of the agent as presented above, but will not simulate realistic environments.



2 Theory

2.1 Visual Search

2.2 Reinforcement Learning

Reinforcement learning (RL) is a subfield of machine learning concerned intelligent agents that learn to achieve some goal through interaction with their environment. An agent conditioned to improve its behaviour through reward and punishment. In this section, some key concepts will be introduced.

Markov Decision Process

The problem of learning from interaction to achieve a goal is usually framed as a (finite) Markov Decision Process (MDP). An *agent* learns by interacting with an *environment*. At each discrete time step, the agent selects an action and perceives an observation of the state of its environment as well as a reward signal. An MDP is formally defined as a quadruple $\langle S, A, R, P, \rho_0 \rangle$, where

- S is the state space,
- A is the action space,
- X
- $R : S \times A \times S \rightarrow \mathbb{R}$ is the reward function,

Taxonomy of Algorithms

- Model-free vs. model-based
-

Policy Optimization

Generalization

A decorative element consisting of several thin, vertical black lines of varying heights, positioned to the left of the chapter number.

3

Method

In this chapter, the method is described in a way which shows how the work was actually carried out. The description must be precise and well thought through. Consider the scientific term replicability. Replicability means that someone reading a scientific report should be able to follow the method description and then carry out the same study and check whether the results obtained are similar. Achieving replicability is not always relevant, but precision and clarity is.

Sometimes the work is separated into different parts, e.g. pre-study, implementation and evaluation. In such cases it is recommended that the method chapter is structured accordingly with suitable named sub-headings.



4 Results

This chapter presents the results. Note that the results are presented factually, striving for objectivity as far as possible. The results shall not be analyzed, discussed or evaluated. This is left for the discussion chapter.

In case the method chapter has been divided into subheadings such as pre-study, implementation and evaluation, the result chapter should have the same sub-headings. This gives a clear structure and makes the chapter easier to write.

In case results are presented from a process (e.g. an implementation process), the main decisions made during the process must be clearly presented and justified. Normally, alternative attempts, etc, have already been described in the theory chapter, making it possible to refer to it as part of the justification.



5 Discussion

This chapter contains the following sub-headings.

5.1 Results

Are there anything in the results that stand out and need be analyzed and commented on? How do the results relate to the material covered in the theory chapter? What does the theory imply about the meaning of the results? For example, what does it mean that a certain system got a certain numeric value in a usability evaluation; how good or bad is it? Is there something in the results that is unexpected based on the literature review, or is everything as one would theoretically expect?

5.2 Method

This is where the applied method is discussed and criticized. Taking a self-critical stance to the method used is an important part of the scientific approach.

A study is rarely perfect. There are almost always things one could have done differently if the study could be repeated or with extra resources. Go through the most important limitations with your method and discuss potential consequences for the results. Connect back to the method theory presented in the theory chapter. Refer explicitly to relevant sources.

The discussion shall also demonstrate an awareness of methodological concepts such as replicability, reliability, and validity. The concept of replicability has already been discussed in the Method chapter (3). Reliability is a term for whether one can expect to get the same results if a study is repeated with the same method. A study with a high degree of reliability has a large probability of leading to similar results if repeated. The concept of validity is, somewhat simplified, concerned with whether a performed measurement actually measures what one thinks is being measured. A study with a high degree of validity thus has a high level of credibility. A discussion of these concepts must be transferred to the actual context of the study.

The method discussion shall also contain a paragraph of source criticism. This is where the authors' point of view on the use and selection of sources is described.

In certain contexts it may be the case that the most relevant information for the study is not to be found in scientific literature but rather with individual software developers and open

source projects. It must then be clearly stated that efforts have been made to gain access to this information, e.g. by direct communication with developers and/or through discussion forums, etc. Efforts must also be made to indicate the lack of relevant research literature. The precise manner of such investigations must be clearly specified in a method section. The paragraph on source criticism must critically discuss these approaches.

Usually however, there are always relevant related research. If not about the actual research questions, there is certainly important information about the domain under study.

5.3 The work in a wider context

There must be a section discussing ethical and societal aspects related to the work. This is important for the authors to demonstrate a professional maturity and also for achieving the education goals. If the work, for some reason, completely lacks a connection to ethical or societal aspects this must be explicitly stated and justified in the section Delimitations in the introduction chapter.

In the discussion chapter, one must explicitly refer to sources relevant to the discussion.



6 Conclusion

This chapter contains a summarization of the purpose and the research questions. To what extent has the aim been achieved, and what are the answers to the research questions?

The consequences for the target audience (and possibly for researchers and practitioners) must also be described. There should be a section on future work where ideas for continued work are described. If the conclusion chapter contains such a section, the ideas described therein must be concrete and well thought through.