

Impact of Varying Collision Avoidance Strategies on Human Stress Level in Human-Robot Interaction

Master Thesis

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“Das ist die Widmung / This is the dedication (optional)”

Acknowledgement

Das ist die Danksagung / This is the acknowledgement (optional)

Abstract

Das ist die Kurzfassung (siehe Abschnitt 1.3) / This is the abstact (see section 1.3).

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Introduction

The thesis should focus on the documentation of your own contribution and scientific results, in which an analysis, interpretation and evaluation of the applied methodology and the results are of key importance.

In general, scientific publications start with a study and review of related literature. You should revisit the literature study throughout your thesis before engaging on a new investigation or issue. In addition to the TU Dortmund library, research literature on the internet from the following sites.

<http://scholar.google.de/>

<http://www.sciencedirect.com/>

<http://citeseer.comp.nus.edu.sg/cs>

<http://ieeexplore.ieee.org/search/advsearch.jsp>

<http://www.springerlink.com/>

Evaluate the quality and relevance of publications in relation to the topic of your thesis. The purpose of the literature study is to obtain an overview, sound knowledge and awareness on established related approaches, methodologies and solutions. Your thesis should only contain references that are relevant to the thesis assignment. The analysis of the literature and the practical requirements of the thesis provide guidance to formulate a concise and specific problem formulation. The thesis should start with a scientific problem formulation

The problem formulation consists of just one or two sentences and should clarify the research problem, you aim to address and to why and where it is relevant. The problem formulation is constitutes the core of your thesis and provides the beacon if you lose track during your investigations and writing of thesis.

In developing the solution of the tasks and the presentation of the results utilize the methods and knowledge that you acquired during your studies in related courses. Take care that the gathered data is described as objectively as possible and that your findings are supported by sufficient examinations and evidence. The presentation should allow others to comprehend and reproduce your results. The thesis should conclude with a discussion and interpretation of relevant findings. The scope of a bachelor thesis is about 30 pages, the scope of a master thesis about 60 pages. A more detailed guideline on how to structure and write a thesis and how to cite references and sources properly is provided Rossing and Praetsch (2005).

1.1 Motivation

1.2 Aim of the Thesis

The title page provides information about the topic of the thesis, the chair, date of submission and the name of the author in the corresponding entries of the template.

1.3 Literature Review

The summary (abstract) of about half a page should provide a brief outline on the motivation, problem and content of the thesis. The scope and the main result should become clear. It has to be clear what the work is about and what the main results are.

The table of contents represents the logical structure of the thesis. It helps to clarify the organization and framework of the thesis. The level of detail should be chosen appropriately and should normally not contain more than two levels (section, subsection) of granularity per chapter.

The nomenclature includes the specification of all symbols, variables, abbreviations and their explanations throughout the thesis. The `nomencl` package automatically generates the entries of the symbols and facilitates managing the nomenclature.

<http://www.ctan.org/tex-archive/macros/latex/contrib/nomencl/>. The tex files are scanned by `makenomenclature` after `nomencl` is invoked. The result is a file `struktur.nlo` containing the entries. The entries are processed with `makeindex.exe` and then included with `printnomenclature` into the main latex file. For an example, see section ??.

How to set up the nomenclature compiler

TeXstudio

Options → *Configure TeXstudio ...* → *Commands* → line *Makeindex*:

```
makeindex.exe %.nlo -s nomencl.ist -o %.nls
```

Test configuration: F11 or *Tools* → *Index*.

If successful, recreate PDF. *Makeindex* must be reinvoked each time the nomenclature changes.

See *nomenclature.tex* for examples of how to generate the nomenclature.

Bugs

If the spacings in the nomenclature are incorrect and thus the descriptions of the symbols are not displayed, it helps to set the indent manually. To do this, in the file *nomenclature.tex* extend the line with the command `\printnomenclature` to `\printnomenclature[<Einzug>]`. `<Einzug>` is the indentation size of the description. A collection of 4 cm. is similar to the default in this sample nomenclature (By default, the indent size is `\nomlabelwidth`. For more information, see the *nomencl* Pakets).

It is difficult to provide specific guidelines about thesis content and structure. Nevertheless, most scientific publications in engineering and natural sciences share a common structure of presentation. The proposed thesis organization may not apply in all cases, but is often a good starting point to structure your thesis. If in doubt, discuss the structure of your thesis with your supervisor. As an example, the content of the written paper may be structured as follows:

- introduction
- theoretical foundations
- your approach and investigations
- experimental/simulation results and analysis
- summary and outlook

2

Theoretical foundation/Biosignals

2.1 Stress Framework

2.1.1 Photoplethysmogram-PPG

2.1.2 Electrodermal Activity-EDA

2.1.3 Motion Capture

L^AT_EX packages and compilers have the advantage that they can be installed completely independently of the latex editor. They are summarized in so-called latex distributions. Recommended distributions on Windows are MikTeX (<http://miktex.org/>) and on OS X MacTeX <https://tug.org/mactex/>.

The choice of latex editor is usually based on individual needs and tastes. A recommended, cross-platform editor is TeXstudio <http://texstudio.sourceforge.net/>. This offers, among other things, the possibility to display desired positions of the PDF preview directly in the source text. Another popular editor is TeXnicCenter (<http://www.texniccenter.org/>). Finally, the author chooses between the Latex- (PS/Dvi) and the pdf_latex compiler. The respective selection are made in the settings of the editor.

Pdflatex:

- More advanced than latex
- Supports the following image file types: PDF (Vector), PNG, JPG.
- Supports EPS images with the package "epstopdf" (already included).
- Not compatible with old packages that only work with PostScript files.

Latex (PS/Dvi):

- Works with "psfrag" and other PS based packages.
- Supports EPS images only without further conversion.
- Longer compile time

2.2 Robot Collision Avoidance

2.3 Machine Learning Methods

Insert a table next to a figure taking into account the associated directories (tables, figures):

Configuration	Parameter set
1	$\{p_1, p_2, p_5\}$
2	$\{p_1, p_4, p_5\}$
3	$\{p_2, p_3, p_4\}$



Table 2.1: Definition range of parameters for optimization.

Figure 2.1: Sample diagram

The *Subcaption* package (labeling of tables and figures with a), b), ...) should only be chosen if the associated tables/figures really belong together contextually.



(a) TU Dortmund Logo



(b) RST Logo

Figure 2.2: Collection of all logos

For long descriptive texts, the *Subfigure-Caption* can be left blank. A description with reference to the letters a), ..., then takes place in the general description.

Table 2.2 lists all parameters used. Table 2.2a ...

Table 2.2: Main numbering

(a) Table on the left		(b) Table on the right	
Configuration	Parameter set	Configuration	Parameter set
1	$\{p_1, p_2, p_5\}$	1	$\{p_1, p_2, p_5\}$
2	$\{p_1, p_4, p_5\}$	2	$\{p_1, p_4, p_5\}$
3	$\{p_2, p_3, p_4\}$	3	$\{p_2, p_3, p_4\}$

Tikz is an extensive L^AT_EX package to create images using program instructions. Several LaTeX examples are available at the following link:

<http://www.texample.net/tikz/examples/>

A particularly useful tool to create figures is the integration with the Matlab plugin "matlab2tikz":

<http://www.mathworks.com/matlabcentral/fileexchange/22022-matlab2tikz>

converts images created in Matlab to a tikz image. One advantage is the easy way to adjust afterwards any attributes of the image or the drawing: line color, width, type, grid, legends, markers, u.a.

The basic procedure starts with creating the Tikz code:

1. Create Matlab drawing and bring it to the foreground (it is better to close all other pictures). Attributes of the drawing can also be adjusted here (grid, line color, width, log scaling, ...).
2. After adding "matlab2tikz" in the Matlab paths, the image can be converted:
`matlab2tikz('myfile.tikz');`
3. The file *myfile.tikz* now contains the Tikz-Code.

In principle, Tikz-Code can be processed directly in the Latex document within the *tikzpicture* environment. However, this variant scales poorly with the capacities of the latex compiler. Especially with multiple graphs from Matlab, which can sometimes contain many data points, the compiler might crash with memory errors. It is therefore advisable to compile each Tikz image as a separate Latex instance and then include it as a PDF. To simplify this, we make use of the *standalone* package. Including the Tikz code in the *standalone* environment is done as follows:

1. The *standalone* environment is built like a standalone latex document. It starts with a *documentclass* and wraps the *tikzpicture* environment inside a *document* environment. The preamble loads appropriate packages (e.g. tikz, pgfplots, fonts, math, ...) and defines needed styles.
2. If the *standalone* class is chosen as the class, the resulting PDF of the standalone latex document is already cropped to the dimensions of the content/image. Furthermore, the class should have the same font size as the later main document.
3. The standalone latex document can either be compiled by itself, or via `\includestandalone[...]{...}` command in another (main) document. The image should already have the correct dimensions for the target document when it is created so that the *scale=1.0* option can be set. With the option *mode=buildnew* the outsourced image will only be compiled if it has changed. This speeds up the compilation process of the main document considerably in case of many images.
4. The PDFs of the outsourced images that are created in individual instances are located in the same folder as the Tikz code and can also be used for other purposes (presentation, ...).

See the source code of the figure 2.3 as an example of a standalone image environment. This template is built in such a way that both, the packages from the *shared_packages.tex* file, and the commands from the *commands.tex* file can be included into the *standalone* environment via `\input`. In *shared_packages.tex* the files *colordef.tex* and *tikzdef.tex* are also directly included for custom colors and tikz styles. This way, packages, commands, colors, and styles do not have to be copied into each *standalone* environment, but can be customized in a centralized way.

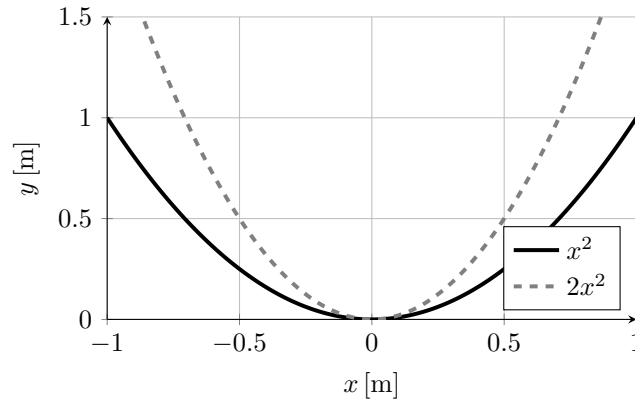


Figure 2.3: Square function

If `matlab2tikz` is used, the Tikz environment first uses the scientific representation of numbers, i.e. depending on the decimal magnitude. The default can be overwritten with the following commands, or a selection of them, can be inserted into the *axis* environment:

- `scaled y ticks = false,`
- `scaled x ticks = false,`
- `y tick label style=/pgf/number format/.cd, fixed, int detect, fixed zerofill, precision=3,`
- `x tick label style=/pgf/number format/.cd, fixed, int detect, fixed zerofill, precision=3`

The first two commands allow you to group the powers of ten so that a common power of ten is appears on both axes. The lower two commands defines the desired precision.

Tikz can generate block diagrams (see above linked examples). A myriad of examples come up in a Google search.

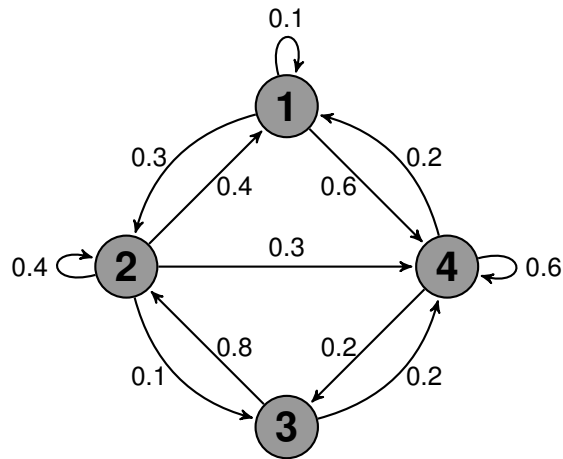


Figure 2.4: Gezeichnet mit Tikz

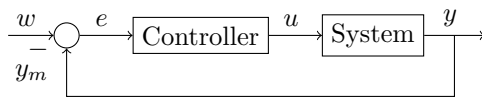


Figure 2.5: Block diagram with Tikz

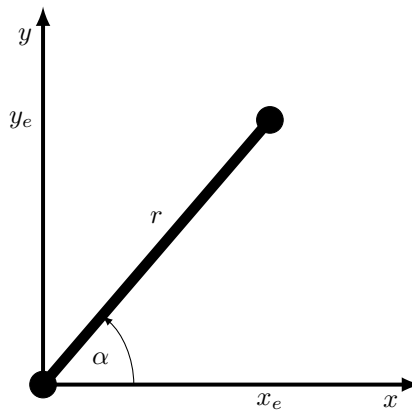


Figure 2.6: Simple drawing with tikz

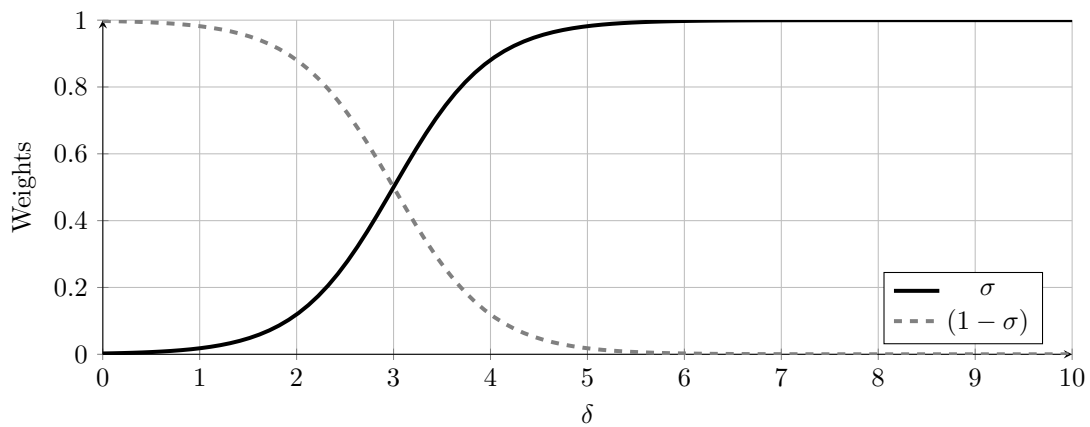


Figure 2.7: Plot with Tikz (without detour via Matlab)

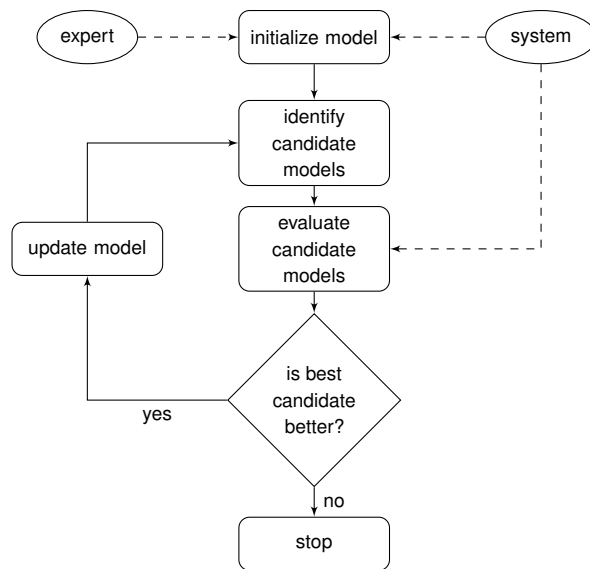


Figure 2.8: Flowchart with Tikz

3

Methodology

3.1 Data Acquisition

3.2 Pre-Processing

3.3 Feature Extraction

3.4 Classification /Stress Detection/

Latex

- <http://miktex.org/>
Windows Latex Distribution
- <https://tug.org/mactex/>
Os X Latex Distribution
- <http://texstudio.sourceforge.net/>
TeXstudio Development environment (recommended)
- <http://www.texniccenter.org/>
TeXnicCenter Development environment
- <http://de.wikipedia.org/wiki/Hilfe:TeX>
Collection of mathematical commands
- <http://www.ctan.org/>
Documentation of all packages
- <http://en.wikibooks.org/wiki/LaTeX/HILFE>
HILFE
- <http://www.texify.com/>
Try Latex Code by Copy/Paste (Formulas)

Graphics

- <http://www.inkscape.org/>
Vector graphics
- <http://www.imagemagick.org/>
converted from *.* to eps

Matlab

- <http://www.mathworks.com/matlabcentral/fileexchange/22022-matlab2tikz>
exported figure to tikz
- <http://www.mathworks.com/matlabcentral/fileexchange/21286-matlabfrag>
exported figure to eps + tags
- <http://www.mathworks.com/matlabcentral/fileexchange/23604-fixlines>
replaces " Matlab " lines with " reasonable " lines
- <http://www.mathworks.com/matlabcentral/fileexchange/23629-exportfig>
exported figure to eps, pdf, etc. (with fixlines, without tagging)

4

Experiment

4.1 Design of Experiments

4.2 Procedure/Protocol

5

Result

6

Discussion and Conclusion

Bibliography

Rossing, W. E. and J. Praetsch (2005): *Wissenschaftliche Arbeiten. Leitfaden für Haus- und Seminararbeiten, Bachelor- und Masterthesis, Diplom- und Masterarbeiten, Dissertationen.* PRINT-TEC Druck + Verlag.

7

Appendix

Das ist der Anhang (siehe Abschnitt ??) / This is the appendix (see section ??)