



Eidgenössische Technische Hochschule Zürich  
Swiss Federal Institute of Technology Zurich



Massachusetts  
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# Driftless VIO

## Master Thesis

Computer Vision and Geometry Group  
Swiss Federal Institute of Technology Zurich

Sensing, Perception, Autonomy, and Robot Kinetics  
Massachusetts Institute of Technology

## Supervision

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February 2, 2018



# Preface

Blah blah ...



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# Abstract

Blah blah ...





# Chapter 1

## Introduction

This template is meant to be used for semester, bachelor, and master theses written at the Institute for Dynamic Systems and Control (IDSC), ETH Zurich. The template includes several examples of equations, figures, tables, etc. in order to act as a *very* short introduction to T<sub>E</sub>X and L<sup>A</sup>T<sub>E</sub>X. Yet, the template is also provided to ensure that all written work at IDSC shares identical formatting.

### 1.1 The Preamble

The preamble of the L<sup>A</sup>T<sub>E</sub>X template defines the font size, page layout, language, report type, title, and author(s) of the report. The preamble of the current template is shown below. It should be more or less clear how you need to modify the preamble to fit your needs; if not, consult your supervisor.

```
\documentclass[10pt,twoside,a4paper,fleqn]{report}

\usepackage[german,st]{ethidsc}                % IDSC style
                                              % {german}/english: language
                                              % {st}/bt/mt: thesis type

% Page header (don't change)
\setlength{\parindent}{0em}                    % Disable parindent
\rhead[\noupเปอร์case{\rightmark}]{\thepage} % Special headings
\lhead[\thepage]{\noupเปอร์case{\leftmark}} % Special headings
\cfoot{}                                         % Special headings

% Title page (please fill in)
\title{\LaTeX\ Thesis Template v.1.4}          % Report title

\studentA{Hans Muster}
\ethidA{97-906-739}
\semesterA{5}
\emailA{muster@student.ethz.ch}

% \studentB{Second Student}
% \ethidB{12-345-678}
% \semesterB{9}
% \emailB{second@student.ethz.ch}

\supervision{First Supervisor\\ Prof. Dr. Second Supervisor}
\date{March 2011}
```

```
\identification{IDSC-XX-YY-ZZ}           % Project identifier
```

```
\infopage  
\declaration
```

The style `ethidsc.sty` enforces certain changes to the original `report` class, e.g., the title page. The style accepts two options. The first option lets you choose the language of your report, i.e., the language of the title page, headings, info-page, etc. Valid options are: **german** (default) and **english**. The second option defines the type of report which will be printed on the title and info page. Valid options are: **st** (default), **bt**, and **mt** for semester, bachelor and master thesis, respectively. For instance, if you will be writing a master thesis in English, use

```
\usepackage[english,mt]{ethidsc}
```

The command `\infopage` prints an information page at the end of the document which you must sign before handing in the report.

## Chapter 2

# Working with L<sup>A</sup>T<sub>E</sub>X

This chapter explains how to typeset some of the most common elements contained in a technical report using L<sup>A</sup>T<sub>E</sub>X.

### 2.1 Headings

Your report can be structured using several different types of headings. Use the commands `\chapter{.}`, `\section{.}`, `\subsection{.}`, and `\subsubsection{.}`. Use the asterisk symbol `*` to suppress numbering of a certain heading if necessary, for example, `\section*{.}`.

### 2.2 References and Footnotes

References to literature are included using the command `\cite{.}`. For example `[?, ?]`. Your references must be entered in the file `bibliography.bib`. Making changes or adding new references in the bibliography file can be done manually or by using specialized software such as *JabRef* which is free of charge.

Cross-referencing within the text is easily done using `\label{.}` and `\ref{.}`. For example, this paragraph is part of chapter 2; more specifically section 2.2 on page 3. You will need to compile your document twice in order for the cross-referencing to be updated.

Footnotes<sup>1</sup> are added using the command `\footnote{.}`, but try to avoid the used of footnotes altogether.

### 2.3 Lists

Three types of list-environments are commonly used: `itemize`, `enumerate`, and `description`. The following example uses `itemize` to create a list without numbering

- point one; and
- point two

created using

```
\begin{itemize}
  \item point one; and
  \item point two
\end{itemize}
```

The following example uses `enumerate` to create a list with numbering

---

<sup>1</sup>The use of footnotes is generally not recommended.

1. point one; and
2. point two

created using

```
\begin{enumerate}
  \item point one; and
  \item point two
\end{enumerate}
```

The following example uses `description` to create a list with custom text as bullet-points

**P1** point one; and

**P2** point two

created using

```
\begin{description}
  \item[P1] point one; and
  \item[P2] point two
\end{description}
```

## 2.4 Tables

Table 2.1 shows an example of a simple table-layout. Try to avoid vertical lines on tables. The Internet contains countless resources on how to create special elements and structures in tables such as cells spanning multiple rows, rotated text, sideways tables, justification of cell elements, etc.

Table 2.1: Driving cycle data of ECE-15, EUDC, and NEDC.

Description	Unit	ECE	EUDC	NEDC
Duration	s	780	400	1180
Distance	km	4.052	6.955	11.007
Average velocity	km/h	18.7	62.6	33.6
Idle speed	%	36	10	27

This table was created using

```
\begin{table}[ht]
\begin{center}
\caption{Driving cycle data of ECE-15, EUDC, and NEDC.}\vspace{1ex}
\label{tab:table}
\begin{tabular}{llccc}\hline
Description & Unit & ECE & EUDC & NEDC \\ \hline
Duration & s & 780 & 400 & 1180 \\
Distance & km & 4.052 & 6.955 & 11.007 \\
Average velocity & km/h & 18.7 & 62.6 & 33.6 \\
Idle speed & \% & 36 & 10 & 27 \\ \hline
\end{tabular}
\end{center}
\end{table}
```

Table 2.2 shows a more advanced version of Tab. 2.1 using the `booktabs` package. Inspect the source code of this document to see how this was done.

Table 2.2: Driving cycle data of ECE-15, EUDC, and NEDC.

Description	Unit	Driving cycle		
		ECE	EUDC	NEDC
Duration	s	780	400	1180
Distance	km	4.052	6.955	11.007
Average velocity	km/h	18.7	62.6	33.6
Idle speed	%	36	10	27

## 2.5 Working with Units

The package `\usepackage{units}` enables two useful commands, namely `\unit[.]{.}` and `\unitfrac[.]{.}{.}`. Use these commands to display units in a concise way, for example

$$\delta t = 1 \text{ s} \tag{2.1}$$

$$v = 5 \text{ m/s}. \tag{2.2}$$

This example was done using

```
\begin{align}
\delta t &= \unit[1]{s} \\
v &= \unitfrac[5]{m}{s}.
\end{align}
```

## 2.6 Including Graphics

It is recommended that you only use encapsulated post-script graphics `.eps` in your report. If you mix `.eps` with other formats such as `.png`, `.jpeg` or `.gif`, you will most likely not be able to compile your report without errors. Note that figures created in MATLAB are easily saved in `.eps` format.

The inclusion of a figure can be done in the following way:

```
\begin{figure}[ht]
\centering
\includegraphics[width=0.75\textwidth]{img/k_surf.eps}
\caption{Example of a figure.}
\label{img:k_surf}
\end{figure}
```

Two figures are displayed next to each other using

```
\begin{figure}[ht]
\begin{minipage}[t]{0.48\textwidth}
\includegraphics[width = \textwidth]{img/cycle_we.eps}
\end{minipage}
\hfill
\begin{minipage}[t]{0.48\textwidth}
\includegraphics[width = \textwidth]{img/cycle_ml.eps}
\end{minipage}
\caption{Two figures next to each other.}
\label{img:cycle}
\end{figure}
```

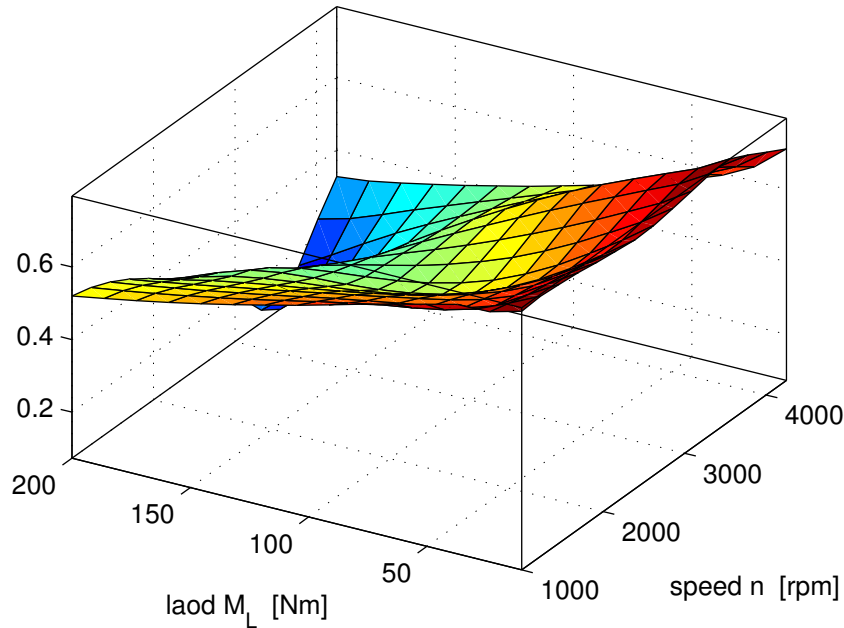


Figure 2.1: Example of a figure.

The positioning parameter `h` (here) forces your figure to be placed in the current position relative to your text. You may add `t` (top), `b` (bottom), and/or `p` (page) to allow for more flexible positioning within your document. For instance, `[tb]` forces your figure to be placed either on the top or bottom of a page.

## 2.7 Equations

The most common way to include equations is using the `equation` environment.

$$p_{\text{meOf}}(T_e, \omega_e) = k_1(T_e) \cdot (k_2 + k_3 S^2 \omega_e^2) \cdot \Pi_{\text{max}} \cdot \sqrt{\frac{k_4}{B}}. \quad (2.3)$$

It is recommended to use `\mathrm{.}` for subscripts comprising more than two letters since it reduces the width of the subscript significantly and improves readability. The corresponding code is

```
\begin{equation}\label{eq:p_meOf}
p_{\mathrm{meOf}}(T_e, \omega_e) \ = \ k_1(T_e) \ \cdot \ (k_2+k_3 \ S^2
\omega_e^2) \ \cdot \ \Pi_{\mathrm{max}} \ \cdot \ \sqrt{\frac{k_4}{B}} \ , \ .
\end{equation}
```

Equations, such as Eq. (2.3), may be referenced using `\eqref{.}`. In-line mathematical content is created using `$. $`, for example  $a^2 + b^2 = c^2$ . It is practically possible to typeset any equation in L<sup>A</sup>T<sub>E</sub>X. Equation (2.4) shows an example of a more advance structure.

$$x_n^k(i) = \begin{cases} y(i) & \text{if } x_{n-1}^k(i) \leq \mathbf{x} \\ z(i) & \text{otherwise} \end{cases}, \text{ for } i = \{1, \dots, N\}. \quad (2.4)$$

## 2.8 Including Code in your Document

Include samples from your Matlab code using the `lstlistings` environment, for example

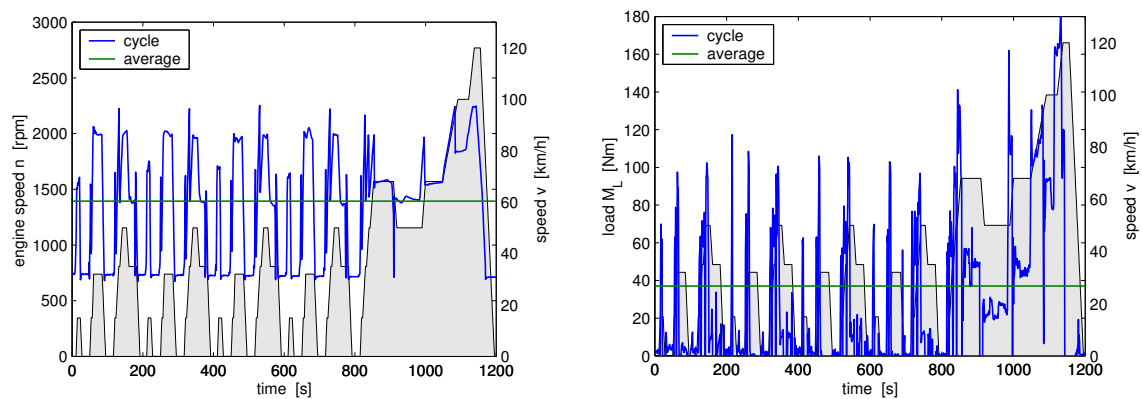


Figure 2.2: Two figures next to each other.

---

```
% Evaluate y = 2x
for i = 1:length(x)

    y(i) = 2*x(i);

end
```

---

This example was created using

```
\lstset{language=Matlab,numbers=none}
\begin{lstlisting}[frame=lines]
% Evaluate y = 2x
for i = 1:length(x)

    y(i) = 2*x(i);

end
\end{lstlisting}
```

where `\usepackage{mcode}` must be included in the preamble of your document. If you want to include the entire content of a file `mycode.m` in your document, simply input the path to `mycode.m` instead of pasting the entire content into your T<sub>E</sub>X-file

```
\lstset{language=Matlab,numbers=left}
\lstinputlisting{path/to/mycode.m}
```

Including the path to your m-file also ensures that the code in your report is always up-to-date. The `\lstset{language=Matlab}` command ensures that MATLAB syntax definitions are used, but many other languages are recognised as well such as **F**ortran and **C**++.





# Appendix A

## Something

Blah, blah ...



## Appendix B

# Again Something

Blah, blah ...



# Bibliography





Eidgenössische Technische Hochschule Zürich  
Swiss Federal Institute of Technology Zurich

Computer Vision and Geometry Group  
Prof. Dr. M. Pollefeys

**Title of work:**

Driftless VIO

**Thesis type and date:**

Master Thesis, February 2, 2018

**Supervision:**

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**Student:**

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Legi-Nr.: 12-822-136

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Zurich, 2. 2. 2018: \_\_\_\_\_