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Multi-Instrument Recognition, Mix-Parameter Estimation and Timbre Characterization using Deep Neural Networks

master's thesis

submitted to

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Statutory Declaration

I declare that I have authored this thesis independently, that I have not used other than the declared sources/resources, and that I have explicitly marked all material which has been quoted either literally or by content from the used sources.

_____	_____
date	(signature)

Acknowledgements

Here you can tell us, how thankful you are for this amazing template ;)

Abstract (English)

Write some fancy abstract here!

Abstract (German)

Hier könnte eine Kurzfassung sein. OKCOOL :)

Contents

1
Introduction and Usage

The SPSC Thesis/Report/Homework Template provides you with several commands that have proven useful in the creation of a thesis. Nonetheless, they are by no means mandatory. You have to decide which methods and commands you find useful and which you don't. Also, if you have a specific command or best-practice approach you found useful: Tell us! If it fits into this template, we will add it. As always: Feedback, bug reports, feature request, ..., are greatly appreciated!

1.1 Building the template

To make the build process easier, you can use the provided bash script, i.e. `bash build.sh`. It executes all commands needed for the standard template in the correct order:

1. pdflatex

2. biber

3. makeglossaries

4. pdflatex (2×)

Alternatively you can execute these commands manually or using your favourite tex editor. Note, that you need to rebuild `biber` and `makeglossaries` only after you modified the respective files, otherwise `pdflatex` is sufficient.

1.2 Structure of Sections

The template provides several pre-defined commands for parts, chapters, sections, subsections, and subsubsections. These commands contain a mandatory argument for the label, and prevent floats (images and tables) to cross part- chapter and section boundaries. Table 1.1 in Section 1.2 lists these commands. This is a citation [1]. LOOL.

Command	FloatBarrier	Reference As
`\newpart{Title}{label}`	yes	`\fref{part:label}`
`\newchapter{Title}{label}`	yes	`\fref{chp:label}`
`\newsection{Title}{label}`	yes	`\fref{sec:label}`
`\newsubsection{Title}{label}`	no	`\fref{sec:label}`
`\newsubsubsection{Title}{label}`	no	`\fref{sec:label}`

Table 1.1: Commands to start new parts, chapters, sections, ...

1.3 Layout of Files/Directories

Bringing order to the chaos of a thesis is always a problem. Especially the file/directory structure can become somewhat huge and make later changes difficult. The command \pwd (print working directory) can be used to divide the thesis into smaller parts and make absolute paths (from the main file) unnecessary.

By starting a new chapter with \newchapter{Introduction}{intro}, the working directory is set to the subdirectory intro. The command \pwd can then be used in all file paths (e.g., \input or \includegraphics) to make sure all files can be loaded without having to define a path. For example, this file is loaded via \input{\pwd/intro_basics}.

Consider creating one directory per chapter, and one file per section. This will make it easier to identify the correct file, and also to shift chapters and especially sections. External files (figures, code, . . .) can for example be placed in subdirectories for each chapter.

1.4 Floats: Graphics, Tables, and Listings

1.4.1 Figures and Tables

Even relatively complex figures are easy to create, as you can see from this example. Note that you can refer to Figure 1.1, but also to the subfigures: Figure 1.1(a) and Figure 1.1(b).
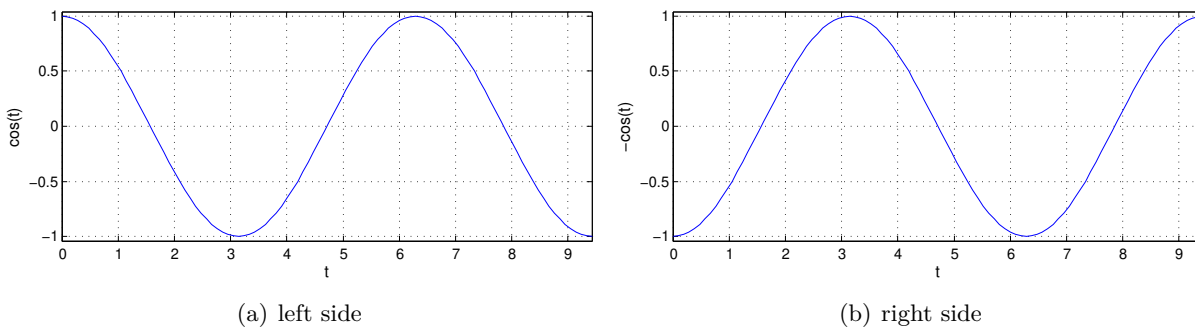

(a) left side   (b) right side

Figure 1.1: Two subplots.

To create such two-column figures, the following simplified command can be used:

```
\twofigs{\pwd/plots/example1}{left side}{-ex1}{\pwd/plots/example2}{right side}{-ex2}{Two subplots.}{intro:floats:usage:figure-std}
```

Reference it using:

```
\fref{fig:intro:floats:usage:figure-std}
```

See Table 1.2 on the next page for more standardized commands. Captions and labels are mandatory for all these commands.

Command	Description
\fig{file}{caption}{label}	Standard figure, full textwidth.
\figc{param}{file}{caption}{label}	Standard figure with controllable parameters for includegraphics.
\twofig{file_l}{caption_l}{file_r}{caption_r}{caption}{label}	Two figures, side by side.
\twofigs{file_l}{caption_l}{add.label_l}{filename_r}{caption_r}{add.label_l}{caption}{label}	Two figures, side by side, with labels for each subfigure.
\twofigc{param_l}{file_l}{caption_l}{param_l}{filename_r}{caption_r}{caption}{label}	Two figures, side by side, with controllable parameters for includegraphics.

\figf, \figcf, \twofigf, \twofigsf, \twofigcf	Like the above, but with framed figures.

Table 1.2: Standardized commands for figures.

1.4.2 Listings

A code listing can be included from an external file using:

```
\filelisting{styMatlab}{\pwd/plots/matlab.m}{Some matlab code example.}{code-example}
```

which looks like this:

```matlab
1  % init
2  clear; close all; clc;
3  addpath('~/spr/matlab'); globalinit('silent');
4
5  % example plots
6  %    example1
7  figure; plot(linspace(0,3*pi,100), cos(linspace(0,3*pi,100)));
8  grid on; xlim([0,3*pi]); ylim(xyzlimits([-1,1])); setlabels('', 't', 'cos(t)');
9  savefigure(gcf, 'example1', 'eps', struct('papersize',[14.5,7]));
10 %    example2
11 figure; plot(linspace(0,3*pi,100), -cos(linspace(0,3*pi,100)));
12 grid on; xlim([0,3*pi]); ylim(xyzlimits([-1,1])); setlabels('', 't', '-cos(t)');
13 savefigure(gcf, 'example2', 'eps', struct('papersize',[14.5,7]));
```

Listing 1.1: Some matlab code example.

To include only certain lines of an external file you can supply option parameters to the listing command like this:

```
\filelisting[firstline=3, lastline=6]{styMatlab}{\pwd/plots/matlab.m}{Subset printed.}{param-example}
```

A reference to Listing 1.1 can be created using

```
\Fref{lst:code-example}
```

You can also write code inline using:

```
\begin{lstlisting}[style=styMatlab,caption={Some fancy matlab inline code},label={lst:matlabInline}]
clf;
plot(sin(0:1:5));
\end{lstlisting}
```

1.5 Miscellaneous

The template also provides several commands that make life easier. The "reminder" commands, for example, can be used to <mark style="background-color:red">mark something that should be revised</mark>, but also as a placeholder for leftout parts of a <mark style="background-color:red">(...)</mark>, if there is some open question <mark style="background-color:red">???</mark>, or you have to look up some reference <mark style="background-color:red">[?]</mark>. They can easily be found in the source code: Just search for `\rem`. A second group of commands is used to create nice value-unit pairs, such as f=$3\,$kHz, $2\,‰$, or $12.3 \pm 0.4\,$kg.

Some other examples of SI unit usage:

- `\SI{1.7e2}{\pico\joule\per\kilo\gram\squared}` will be $1.7 \times 10^2\,{}^{\text{pJ}}\!/\!{}_{\text{kg}^2}$

- `\SI{2.8}{\meter\tothe{5}}` to the example: $2.8\,\text{m}^5$

- `\SI{2 x 3 x 4}{\milli\meter}` volume example: $2\,\text{mm} \times 3\,\text{mm} \times 4\,\text{mm}$

- `\num{12345678}` will be 12 345 678 in german and 12.345.678 in english without changing this source file

- `\ang{13;14;15}` angle example: $13°14'15''$

- `\SIrange{1}{10}{\m}` Range example: $1\,\text{m}$ to $10\,\text{m}$

Oh, by the way: This section is

<mark style="background-color:yellow">... under construction ...</mark>

1.6 Citation

For citing a new reference, e.g. a book [1] or URL [2], you have to add an entry to `./bib/bibliography.bib`.

1.7 Acronyms

Generally, every acronym should be written in full at its first occurence including the short term which is used onwards. To make life easier, you can define acronyms using `\newacronym` in the `acronyms.tex` file and use it with `\gls{label}` (singular) or `\glspl{label}` (plural). So first you define the printed circuit board (PCB) and then only the acronym is used, i.e. PCB or PCBs.

1.8 Good to know

- `There will be~no linebreak between no and be.`

- `\hspace{10mm} and \vspace{10mm} can be used to create arbitrary amounts of space.`

- `\hfill will use the rest of the horizontal space in a line.`

- `- will create a hyphen (Bindestrich)`

- `-- will create a dash (Gedankenstrich)`

- `$-$ will create a minus (Mathematisches Minus)`

- `\url{https://example.org/main.php?param=1&param2=1}` (verlinkt)

- `\path{C:\Windows\system32\}` (verlinkt)

Syllabification (Silbentrennung):

- `Syl"-labification would tell Latex another breaking point after the l`. Note that the hyphen will not be printed.

- `Syl""labification would tell Latex another breaking point after the l`. This time it will be broken without a hyphen. This makes sense for words which already include a hyphen.

- `\mbox{midnightlunch}` forbids latex to break the word completely.

Enumerations can be done using one of these environments:

enumerate using numbers

itemize using bullets

description looks like this list

Referencing prefix list supported by `\fref`:

chp chapter

sec section

fig figure

tab table

eq equation

lst listing

enum enumeration

Enquoting "stuff" should be done with `\enquote{stuff}`, because it "translates" the quotes into the style commonly used in the desired language.

2
Fancy and Advanced

2.1 Bringing Style Into Your Thesis

> *"They misunderestimated me."*
> *– Guess Who*

The template does not provide too many "stylish" commands. One of them created the quote above, the others are intended to mark a part of the text using the margins. You can, for example

   . . . state that this is dangerous.

   . . . tell the reader to "better pay attention".

   . . . mark some central results.

   . . . also admit that you're just clueless.

2.2 Higher Mathematics

Naturally, there are also several commands that should make life easier when dealing with equations. One of the central ideas is to be able to change the general style of something, for example vector/matrix highlighting ($\boldsymbol{\phi}$ vs. ϕ), just by modifying the template command.

Here are a few examples. Note that equations (2.1) and (2.2), but also (2.3) and (2.4) do not necessarily make sense...

$$\text{var}\{a+b\} \overset{!}{=} \text{var}\{a\} + \text{var}\{b\} + 2\text{cov}\{a,b\} \tag{2.1}$$

$$\begin{aligned}
\boldsymbol{H} &:= e^{\text{E}\{\boldsymbol{h}^T\boldsymbol{h}\}} - \ln\!\left(\boldsymbol{h}^T\boldsymbol{h}\right) + \log\!\left(\boldsymbol{h}^T\boldsymbol{h}\right) - \frac{\text{ld}\!\left(\boldsymbol{h}^T\boldsymbol{h}\right)}{\log_3(\boldsymbol{h}^T\boldsymbol{h})} \\
&= \begin{bmatrix} h1 & h2 & \dots \\ 0 & h1 & \dots \\ \vdots & \vdots & \ddots \end{bmatrix}
\end{aligned} \tag{2.2}$$

$$\text{E}\{ab^*cd^*\} = \text{E}\{ab^*\}\cdot\text{E}\{cd^*\} + \text{E}\{ad^*\}\cdot\text{E}\{cb^*\} \tag{2.3}$$

$$\text{E}\{ab^*\}\cdot\text{E}\{cd^*\} \neq \text{E}\{ad^*\}\cdot\text{E}\{cb^*\} - \text{E}\{ab^*cd^*\} \tag{2.4}$$

References

[1] P. Mowlaee, J. Kulmer, J. Stahl, and F. Mayer, *Single Channel Phase-Aware Signal Processing in Speech Communication: Theory and Practice*. John Wiley & Sons, Ltd, 2016.

[2] D. Malli. (Jul. 6, 2012). To be used for online resources, [Online]. Available: `https://malli.co.at` (visited on 04/13/2018).

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Acronyms

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