Decoding Neural Dynamics of Visual Perceptual Segmentation

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Abstract

What is this thesis about?   This thesis will present a comprehensive study on the role of visual perceptual segmentation related to gaze prediction and its dynamics. It aims to explore how segmentation affects visual perception and lay the foundation for future research on neural dynamics in visual processing in the context of perceptual segmentation. We will investigate the interplay between segmentation and visual perception through a series of experiments and analyses, ultimately contributing to a deeper understanding of the underlying neural mechanisms.

Why is this thesis important?   The importance of this thesis lies in its potential to advance our understanding of visual perception and segmentation. By examining the neural dynamics associated with these processes, we can gain insights into how the brain interprets and organizes visual information.

This research has implications for various fields, including cognitive neuroscience, psychology, and artificial intelligence, where understanding visual perception is crucial for developing better models and applications.

Most importantly this research lays solid foundations for a running hypothesis that visual perceptual segmentation is a key factor in gaze prediction and neural dynamics, and its findings will be part of a larger body of work that aims to unravel the complexities of visual processing in the human brain.

What will be the structure of the thesis   We will begin with an introduction to the topic, outlining the significance of visual perceptual segmentation and its relevance to gaze prediction. The thesis will then delve into the methodology used in our research, including experimental design, data collection, and analysis techniques.

Results   Thanks to the works done in this thesis, we will present a new State of the Art (SoTA) model for gaze prediction that outperforms existing methods. This

model will be based on the findings of our research, demonstrating the significance of visual perceptual segmentation in gaze prediction tasks.

"Essentially, all models are wrong, but some are useful."

George Box

Acknowledgments

Some acknowledgments to family, friends, supervisors, etc.

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Chapter 1

Introduction

"A design of any kind shows its real value when taking beyond its original limits."

Tom Jennings

Some few conventions (and an example of nested item list):

- In a `.tex` file, text lines can have variable length.

- Put a newline after every fullstop, see an example in section 1.1; paragraphs are separated by empty lines in the `tex` file, so a newline at the end of a sentence does not affect the structure of the paragraph.

- This is a tradeoff for using versioning tools:

  - Lines too long (full paragraphs) would introduce diffs that are too large.
  - Fixed maximum line widths (e.g., 80 columns) lead to editors to reorganize the paragraph to fit the width, causing again diffs that are too large.

You can use the percentage symbol (%)[1] to avoid a space between item list and this paragraph, so that the first line of this paragraph is not indented.

Enumerated list:

1. Item 1.

2. Item 2.

3. Item 3.

---

[1] And notice how to insert a symbol of percentage!

Column 1	Column 2
text 1	Some long text in the table. Some long text in the table. Some long text in the table. Some long text in the table. Some long text in the table.Some long text in the table.
text 2	some other text. some other text. some other text. some other text. some other text. some other text.

Table 1.1: This is the caption of the table.

4. Item 4.

Sometimes, when you have a list of items for which you don't want to use bullet points or enumerations, you can use paragraphs with titles. See the following text.

This is the first paragraph.   This is the long text of the first paragraph. This is the long text of the first paragraph.

This is the second paragraph.   This is the long text of the second paragraph. This is the long text of the second paragraph. This is the long text of the second paragraph. This is the long text of the second paragraph.

This is the third paragraph.   This is the long text of the third paragraph. This is the long text of the third paragraph. This is the long text of the third paragraph. This is the long text of the third paragraph. This is the long text of the third paragraph. This is the long text of the third paragraph.

Finally, table 1.1 provides an example of table. You can add as many columns and rows as you wish. Please refer to `https://www.ctan.org/pkg/tabulary` for the documentation of the package. In particular, see how to change the size and the alignment of the columns, if you need it.

1.1   General recommendations

An example of line breaking follows[2]. Do you see it? This is a new line in the `.tex` file but it is the same paragraph in the `pdf`.

---

[2]And this is another example of footnote; don't forget the full stop at the end of the footnote.
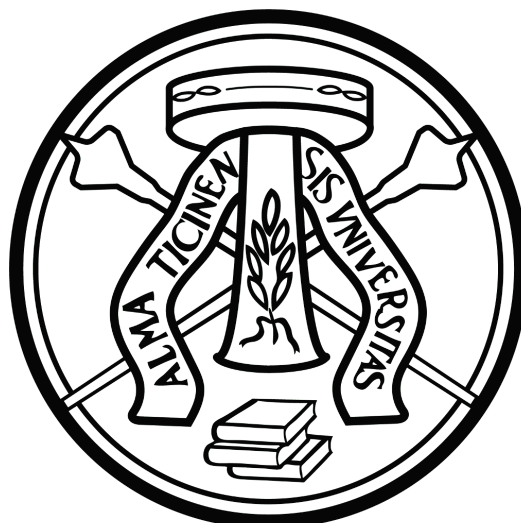
Figure 1.1: Example of figure; this is the caption that goes below the figure.

Figure 1.1 reports an example of template to include a figure. Just copy this template around and set the filename (without extension!), the size, and write the caption.

Use something like

```
width=0.5\textwidth
```

to set the size of the figure as a percentage of the text width (in this case it is 50%). You can also specify an absolute width with `width=4cm`, but usually a relative size is fine. Sometimes (very rarely, in my experience) you may want to set the size on the basis of the height of the figure, i.e., `height=4cm`.

The label **must go inside the caption**, otherwise sometimes LaTeX does not handle the references correctly.

Every figure, table, listing or equation must be referenced and properly described in the text. **Never use statements such as "previous chapter", "next section" or "figure below"**: these elements may be moved during the editing of the text, thus if you use these statements then you may have to update the sentences every time you move something around. This document uses the package `cleveref`, so use the command `\cref` (e.g., this is a reference to section 1.1) for a smart referencing (use `\Cref` for uppercase). It takes care of putting the right label and spacing before the number, and it will reference the item independently from its position in the text.

To use equations and to refer to them, use the `equation` environment like in this way:

Listing 1.1: Example of listing.

```python
def filter_difference(lines):
    filter_header_lines = filter(lambda line: not line.startswith(
        '---') and not line.startswith('+++'), lines)
    filter_difference = filter(lambda line: line.startswith(
        '-') or line.startswith('+'), filter_header_lines)
    return filter_difference
```

$$A = \pi r^2 \tag{1.1}$$

And proper reference to eq. (1.1).

If you don't need to refer to an equation, you can skipt the numbering:

$$2 + 2 = 4$$

In case of inline math, this is how it is done: $P = 2 \cdot \pi \cdot R$.

Listing 1.1 provides an example of listing for source code.

1.1.1   Formatting text

Beside equations and math text, there are some other formattings that are worth mentioning:

- for everything related to software, such as file names, functions, variables, etc., use `texttt`, e.g., `hello.txt` or `var_name`.

- to put some text within quotes, use `enquote`, e.g., "like this"; `enquote` is better than other solutions because it is more robust and handles internationalization correctly.

1.1.2   Citations

For citations from the bibliography use `\cite`. Here an example: [1].

Citations go **inside** the corresponding sentence. Note the position of the citation w.r.t. the full stop:

- "The algorithm has poor efficiency. [1]" **WRONG**

- "The algorithm has poor efficiency [1]." **CORRECT**

You have to populate the bibliography file `biblio.bib`. You can put as many items as you want in the file. Only the items that are cited in the thesis with `\cite` will be included in the bibliography, as in the example above.

The items to populate the `.bib` file are in BibTeX format. This is a popular format. If you look for some paper or book, it is likely that somewhere the bib format already exists. Try to search on the Internet for the title of the paper plus *bibliography* or *bib*.

1.1.3 Use of acronyms

Acronyms are very popular in scientific and technical documents. We use the `acronym` package.

All the acronyms are defined in `cap_acronyms.inc.tex`.

Use the acronyms with "**UNIPV!** (**UNIPV!**)", "**Robolab!** (**Robolab!**)", "**LED!** (**LED!**)". The package is smart enough to write the long version the first time, and then to use the short version, like so: "**UNIPV!**" and "**Robolab!**".

Sometimes you need to use the full version again, do it with **UNIPV!** (**UNIPV!**). If you need the long version only, use **UNIPV!**.

Plurals can be handled with **LED!**s.

1.2 Objectives of the thesis

Put here the objectives of the thesis.

1.3 Organization of the document

The thesis is organized as follows:

- chapter 2 explains this . . .

- chapter 3 explains that . . .

- chapter 4 presents this . . .

- chapter 5 presents that . . .

- finally the conclusions in chapter 6.

1.4 Partnership

Any possible additional information regarding the thesis.

Chapter 2

State of the art

"The wireless telegraph is not difficult to understand.
The ordinary telegraph is like a very long cat. You
pull the tail in New York, and it meows in Los
Angeles. The wireless is the same, only without the
cat."

Albert Einstein

This chapter provides an overview of the state of the art.

Chapter 3

Tools and Frameworks

"I believe that inside every tool is a hammer."

Adam Savage

This chapter describes the tools and frameworks used in the thesis.

Chapter 4

Implementation

"Sometimes, the elegant implementation is just a
function. Not a method. Not a class. Not a
framework. Just a function."

John Carmack

This chapter shows the details of the implementation of the work.

Chapter 5

Results

"Somewhere, something incredible is waiting to be known."

Carl Sagan

This chapter shows the results obtained in the thesis.

Chapter 6

Conclusions

"Computer Science is no more about computers than
astronomy is about telescopes."

E. W. Dijkstra

This chapter summarizes the conclusions of the work.

Bibliography

[1] Tullio Facchinetti. How to write a thesis in latex, 2021. `http://robot.unip` `v.it/toolleeo`, Last Access 2021.06.21.