Writing (papers)

Research and Innovation Tools and Activities

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When?

When to publish?

As soon as possible:

- When you have a **novel** idea, method or result...
- you can **claim** some advantage over previous results...
- ... and you have **enough evidence** to support your claims.

Remember *Publish or Perish Part I: Why, When, Where, How much?*

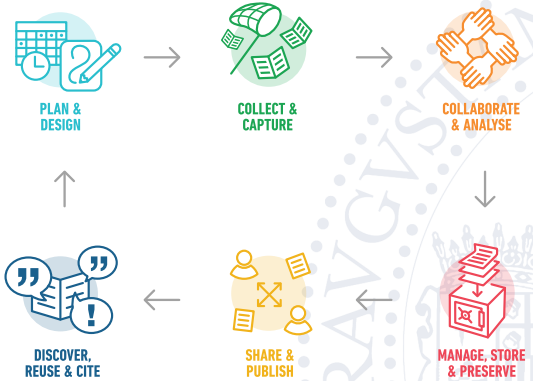
When are you ready?

You were born ready. Start writing.

Learn about writing papers by:

- Reading papers.
- Writing (blogs, love letters, papers with co-authors)

When to START writing?



When to START writing?

Writing should happen **in parallel** to the research lifecycle. It is not a stage of research but part of the whole process.

How to start writing?

- It is much **easier** to **rewrite** than to write from scratch.
- You eventually **need** to write from **scratch**.
- You can start with section / subsection **headings** to give sense of structure.
- Just **dump** your text, even if you consider it a draft. You will rewrite it later.

Rewriting exercise [Freeman 1994]

Real example (from William T. Freeman's). Original text:

> The underlying assumption of this work is that the estimate of a given node will only depend on nodes within a patch: this is a locality assumption imposed at the patch-level. This assumption can be justified in case of skin images since a pixel in one corner of the image is likely to have small effect on a different pixel far away from itself. Therefore, we can crop the image into smaller windows, as shown in Figure 5, and compute the inverse J matrix of the cropped window. Since the cropped window is much smaller than the input image, the inversion of J matrix is computationally cheaper. Since we are inferring on blocks of image patches (i.e. ignoring pixels outside of the cropped window), the interpolated image will have blocky artifacts. Therefore, only part of xMAP is used to interpolate the image, as shown in Figure 5.

Rewriting exercise [Freeman 1994]

> The underlying assumption of this work is that the estimate of a given node will only depend on nodes within a patch: this is a locality assumption imposed at the patch-level. This assumption can be justified in case of skin images since a pixel in one corner of the image is likely to have small effect on a different pixel far away from itself.

> We assume local influence–that nodes only depend on other nodes within a patch. This condition often holds for skin images, which have few long edges or structures.

Rewriting exercise [Freeman 1994]

✗

> Therefore, we can crop the image into smaller windows, as shown in Figure 5, and compute the inverse J matrix of the cropped window. Since the cropped window is much smaller than the input image, the inversion of J matrix is computationally cheaper.

✓

> We crop the image into small windows, as shown in Fig. 5, and compute the inverse J matrix of each small window. This is much faster than computing the inverse J matrix for the input image.

Rewriting exercise [Freeman 1994]

> Since we are inferring on blocks of image patches (i.e. ignoring pixels outside of the cropped window), the interpolated image will have blocky artifacts. Therefore, only part of xMAP is used to interpolate the image, as shown in Figure 5.

> To avoid artifacts from the block processing, only the center region of xMAP is used in the final image, as shown in Fig. 5.

Rewriting exercise [Freeman 1994]

Rewritten text:

We assume local influence–that nodes only depend on other nodes within a patch. This condition often holds for skin images, which have few long edges or structures. We crop the image into small windows, as shown in Fig. 5, and compute the inverse J matrix of each small window. This is much faster than computing the inverse J matrix for the input image. To avoid artifacts from the block processing, only the center region of xMAP is used in the final image, as shown in Fig. 5.

Content

Content

Treat the reader as you would a guest in your house [Durand]:

- Would you like something to drink?
- Something to eat?
- Perhaps now, after eating, you'd like to rest?

Content

Treat the reader as you would a guest in your house:

- Would you like a easy-to-follow motivation?
- Maybe now hard maths that keep your interest up?
- Perhaps now, you would like some high level summary with the results?

Manage expectations

Sell your work, but **do not lie**:

- All claims should be supported with experiments, proofs, citations from previous work...
- Unfulfilled promises are the kiss of death.
- State assumptions / limitations up front

Context and contribution

- Position your work in the research playfield.
- The reader should know why reading the paper / section / paragraph.

Understanding complex ideas

If a reader/reviewer misunderstands your ideas, **it is your fault**.

Motivation

Motivate everything:

- Introduce every section with high level overview and motivation.
- Justify choices
- The introduction should do this for the whole paper.

A reader that does not understand **why** will not care about **how**.

Redundancy

The text **can** be redundant at different levels of detail.

1. Say what you are about to say (motivate).
2. Say it.
3. Summarize what you have said.

Redundancy

The text **can** be redundant at different levels of detail.

1. Plain English (intuition).
2. Technical details (algorithms, maths...).

Intuitively, variance is the average error over the data, and is computed as the average squared error $\sigma^2 = \sum_i \frac{1}{N}(y_i - f(x_i))^2$.

Glossary

Although it will not get into the paper, you can keep a comprehensive **glossary of important terms**.

- By writing formal definitions for them, you will be forced to be precise and consistent when using them.
- This will help remove ambiguities, specially when working with co-authors.

Structure

Paper structure

Spatial

1. Title
2. Abstract
3. Introduction
4. Related work
5. Contribution
6. Results
7. Conclusions

Paper structure

Spatial

1. Title
2. Abstract
3. Introduction
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6. Results
7. Conclusions

Temporal

1. Contribution
2. Related work
3. Results
4. Conclusions
5. Introduction
6. Abstract
7. Title
8. *Rewrite until deadline*

Paper structure

Spatial

1. Title
2. Abstract
3. Introduction
4. Related work
5. Contribution
6. Results
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Temporal

1. Contribution
2. Related work
3. Results
4. Conclusions
5. Introduction
6. Abstract
7. Title
8. *Rewrite until deadline*

Reading

1. Title
2. Abstract
3. Conclusions
4. *Random sampling*
5. *Maybe read the rest*

Title

- Summarize the paper in 2-10 words
- As short as possible, and no shorter
- Balance fancy / catchy vs. informative.
- Remember: manage expectations.

Introduction and abstract

Goal: Convince the reader to download (abstract) and read (introduction) the paper.

- Clearly state contributions and novelty.
- Anticipate **implications** of such contributions.
- Be forthcoming with **limitations and assumptions**.

Introduction and abstract

Include a teaser (if the venue's rules allow you so)

Intrinsic Images by Clustering

Elena Garces[1], Adolfo Munoz[1], Jorge Lopez-Moreno[1,2] and Diego Gutierrez[1]

[1]Universidad de Zaragoza, Spain, [2]REVES / INRIA Sophia-Antipolis, France

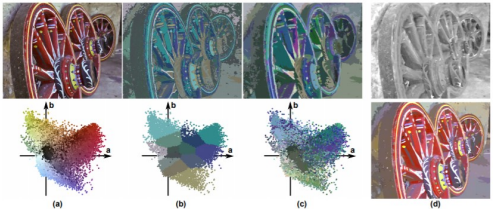


Figure 1: *Our algorithm decomposes an input image into its intrinsic images without user interaction.* ***(a)*** *Input image and scatter plot of pixel data in the (a,b) plane (Lab color space).* ***(b)*** *k-means segmentation according to (a,b) pixel coordinates.* ***(c)*** *Final clustering yielded by our method, taking into account spatial information (both (b) and (c) are depicted in false color).* ***(d)*** *The resulting shading and reflectance intrinsic images. The whole image is shown in Figure 5.*

Abstract

Introduction and abstract

Abstract $\neq$ Introduction

- **Abstract:** Self-contained summary for *experts*.
- **Introduction:** Gentle, relies on the rest of the paper, wider audience.

Both are expected to be redundant.

Introduction and abstract

Grandmothering: Act of explaining what the reader probably knows without being comprehensible if the reader does not.

Get to the point, avoid this:

> The problem of X has attracted considerable interest in the research community ...

Introduction and abstract

Avoid table of contents in paragraph form:

> This paper is organized as follows. In Section 2, we describe local transformations in k dimensions. In Section 3, we describe an incremental approach for constructing k-D Delaunay triangulations using local transformations. In Section 4, we prove that this approach always constructs a Delaunay triangulation. In Section 5, we describe three algorithms and a data structure based on this approach. In Section 6, we discuss the time complexities of the algorithms and present experimental results from our implementation of these algorithms.

Introduction and abstract

Consider the rest of the introduction:

> Our approach generates k-D Delaunay triangulations (Section 3) from local transformations in k d dimensions (Section 2). We demonstrate that this approach always constructs a triangulation (Section 4), and we describe three algorithms and a data structure based on this approach (Section 5) and analyze the temporal complexities of such algorithms and validate them with several experiments (Section 6).

Introduction and abstract

About the introduction [Adelson]

1. Start by stating which problem you are addressing, keeping the audience in mind. They must care about it, which means that sometimes you must tell them why they should care about the problem.
2. Then state briefly what the other solutions are to the problem, and why they aren't satisfactory. If they were satisfactory, you wouldn't need to do the work.
3. Then explain your own solution, compare it with other solutions, and say why it's better.

...

Related work

About related work [Adelson]

4. Talk about related work where similar techniques and experiments have been used, but applied to a different problem.

(related work might be part of the introduction)

Related work

Related work $\neq$ Previous work

Do not just describe related work, **relate it!**.

Related work

Bashing previous work will never make your work look better, it will make you look unfair.

Be **thorough and respectful**. Acknowledge your debt.

Contribution / Body

Start with a **meaningful overview** (or don't bother):

- Summary of your big technical idea.
- High level understanding of how your method works.
- **Overview figure:** self contained, in a single glance gives this high level understanding.

It should make easier to read subsequent technical sections. If it does not, remove it.

Contribution / Body

- Organize it with a logical flow.
- Provide **signposting** (where you come from? where you're going?).
- Heavy linking (references) forward and backward.
- If you directly use previous work, just say so.

Contribution / Body

Achieve **reproducibility**: practitioners (e.g., skilled students) should be able to reproduce your work from the text. Don't assume some steps are obvious.

Also release code / data.

Experiments / results

The sole purpose of the experiments / results section is to **validate** all the claims you have done throughout the text.

However, while performing the experiments, you might get **new findings**.

Experiments / results

- Comparison w.r.t. related work.
- Comparison vs. discarded alternatives.
- Numerical / visual experiments.
- Experiments that illustrate limitations / assumptions.
- ...

Conclusions / discussion

A conclusion is not an introduction in past tense.

Reflect on things that were difficult to discuss without the reader already knowing the details of your approach.

Conclusions / discussion

Future work is optional (never its own section) and can make your paper look weak

> Here is a list all the ideas we wanted to do but could not get to work in time for the conference submission deadline. We didn do any of the following things: (1) Make it run faster by porting it to GPU. (2) ...

Conclusions / discussion

Instead, if possible, use future work to empower your own contributions.

> The results of the third experiment not only validates our approach, but suggests that there exists a correlation between A and B that could be explored in future work.

Conclusions / discussion

Instead, if possible, use future work to empower your own contributions.

> This is the first time that both often mutually exclusive approximations have been combined together in such a complementary way, which we hope fosters further research about more sophisticated combinations.

Conclusions / discussion

Recopilate and discuss assumptions and limitations, but never on the last sentence / paragraph.

> Our experiments show that our approach outperforms related work by almost an order of magnitude, and provides interesting insights about the topic. Still, it only works under the following assumptions (...) which limits its aplicability.

Conclusions / discussion

Better:

> Our approach works under the following assumptions (...) which limits its aplicability. Still, our experiments show that it outperforms related work by almost an order of magnitude, and provides interesting insights about the topic.

Style

Style

KISS

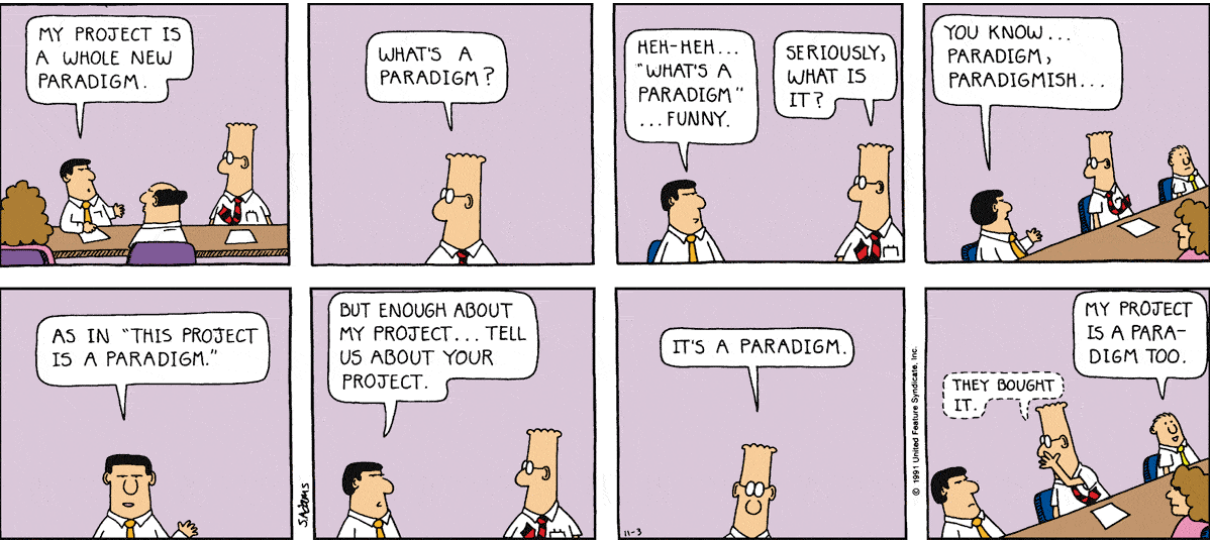
Style

KISS
Keep It Simple, Stupid

Make your reader's life as easy as you can.

Simplicity

- Avoid complicated sentences.
- Place emphatic words **at the end**.
- Don't introduce two ideas in one sentence.


MY PROJECT IS A WHOLE NEW PARADIGM.
WHAT'S A PARADIGM?
HEH-HEH... "WHAT'S A PARADIGM" ...FUNNY.
SERIOUSLY, WHAT IS IT?
YOU KNOW... PARADIGM, PARADIGMISH...
AS IN "THIS PROJECT IS A PARADIGM."
BUT ENOUGH ABOUT MY PROJECT... TELL US ABOUT YOUR PROJECT.
IT'S A PARADIGM.
THEY BOUGHT IT.
MY PROJECT IS A PARA-DIGM TOO.
SKELLYS
11-3
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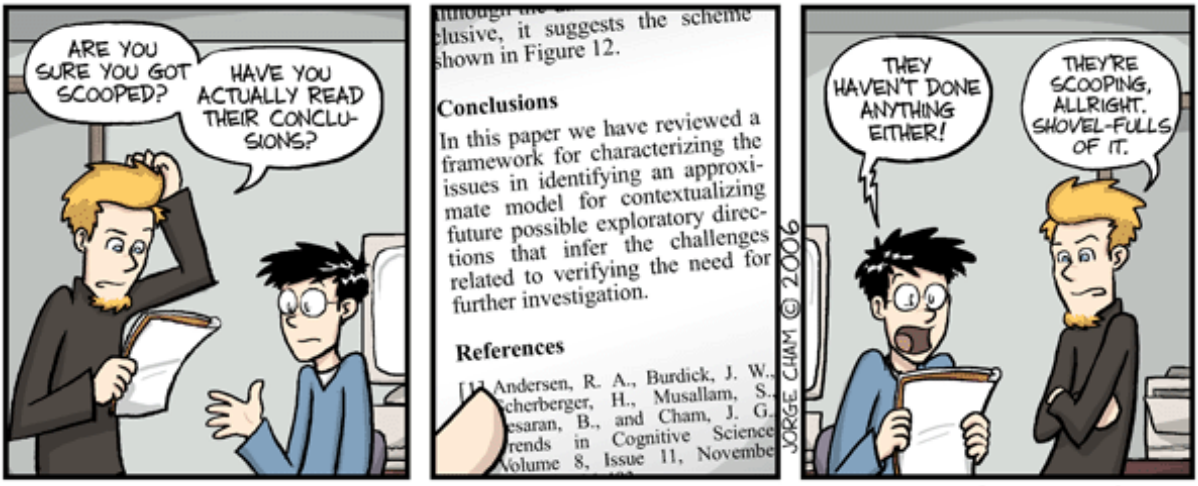
Simplicity

Avoid buzzwords: Paradigm, framework...



WWW.PHDCOMICS.COM

Simplicity

Avoid the passive form, as it is convoluted and denotes the doer is unknown or irrelevant.

An experiment that compares A and B has been performed.

We have performed an experiment to compare A and B.

Simplicity

Use concrete language.

The algorithm achieves a reasonably good results even for input data with moderate error.

The algorithm achieves 6% relative error with respect to ground truth for data with up to 20% signal to noise ratio.

Simplicity

Rewrite, rewrite, rewrite.

When rewriting, consider the possibility that the best solution might be simply **removing innecesary parts of the text**.

Venue

Adapt your writing style to the corresponding venue.

For that, you need to read papers from the corresponding venue.

Venue

- Check the venue's style **rules**.
- In practice this means to **download the LaTeX template**.
- There might be more rules (paper squeezing, bibliography identification, figure placement)

Citations

Citations are not nouns.

As discussed in [Kenobi77], these aren't the droids you are looking for.

Previous work concludes that these are not the droids you are looking for [Kenobi77].

Citations

You can also use names and short cites :

As discussed in [Kenobi77], these aren't the droids you are looking for.

As discussed by Kenobi [1977], these are not the droids you are looking for.

Citations

If you remove all parenthetical citations from the paper, you should still have complete, grammatically correct sentences.

> As discussed in, these aren't the droids you are looking for.

> As discussed by Kenobi, these are not the droids you are looking for.

Equations

A mathematical text is, before everything else, a text.

Equations

Equations (inline or display) are part of the sentence. Treat them as nouns.

> The equation $2H_2 + 1O_2 \rightarrow 2H_2O$ represents how hydrogen and oxygen react to form water.

Equations

Equations (inline or display) are part of the sentence. Treat them as nouns.

Reflected radiance $L_o(\mathbf{x}, \omega_\mathbf{o})$ is calculated from the so called Render Equation,

$$L_o(\mathbf{x}, \omega_\mathbf{o}) = \int_\Omega {}_\mathbf{n} L_i(\mathbf{x}, \omega_\mathbf{i}) f_r(\mathbf{x}, \omega_\mathbf{i}, \omega_\mathbf{o})(\mathbf{n} \cdot \omega_\mathbf{i}) d\omega_\mathbf{i} \,,$$

where $\Omega_\mathbf{n}$, the integration range, represents the hemisphere centered in the normal $\mathbf{n}$ ...

Equations

Equations (inline or display) are part of the sentence. Treat them as nouns.

> ... where the mass-energy equivalence is described by Einstein's famous equation
>
> $$E = mc^2 .$$

Figures and tables

- All figures (and tables) sould always **be referenced** from the text.
- Should appear **after** the first reference.
- Check **legibility** even in grayscale.
- Caption of a figure is **below** the figure, caption of a table is **above** the table.
- If possible, **avoid excess white space** (go for text width or column width)

Figures and tables

Make captions self-contained (be redundant with the text)

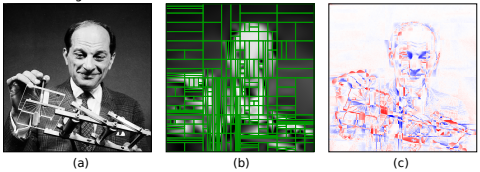


Figure X: *Integration of a two-dimensional function with a control variate.*

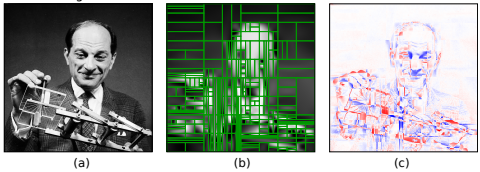
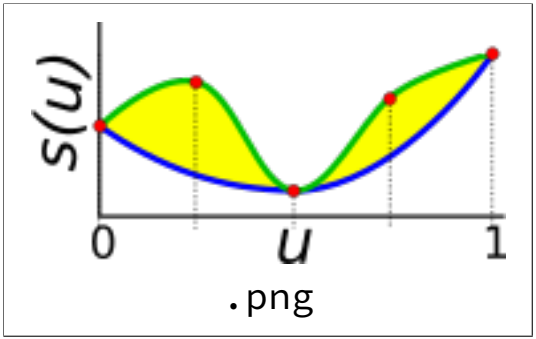
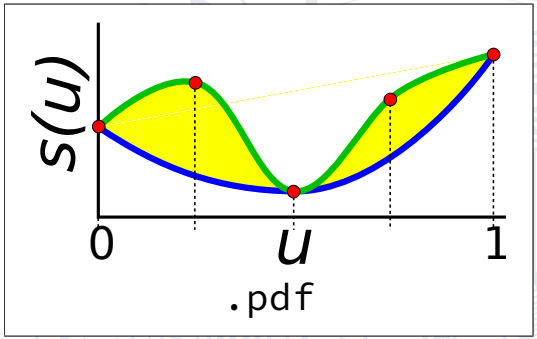


Figure X: *Integration of a two-dimensional function (a), its piecewise-polynomial approximation used as control variate (b, boundaries of each region in green), and the corresponding residual (c, where red and blue are the positive and negative residual, respectively).*

Figures and tables

Preffer vector image formats when possible






LATEX

LaTeX

Word (or Libre/OpenOffice)

LaTeX

If any venue forces you to use Word, run away, flash yourself and forget that this venue ever existed.

LaTeX best practices

- Do not commit generated files into svn/git.
- Split into multiple files (use `\input`).
- Put graphics in a subfolder (avoid poluting root tex folder).
- Use consistent references for `\label` and `\ref` (`sec:overview`, `eqn:sampling` ...).

LaTeX maths

Learn other equation environments (`align`)

```
\begin{equation}
a^2 = b^2 + c^2
\end{equation}
\begin{equation}
a^2 - c^2 = b^2
\end{equation}
```

$$a^2 = b^2 + c^2$$
$$a^2 - c^2 = b^2$$

```
\begin{align}
a^2 &= b^2 + c^2 \\
a^2 - c^2 &= b^2
\end{align}
```

$$a^2 = b^2 + c^2$$
$$a^2 - c^2 = b^2$$

LaTeX maths

- Be consistent with notation: define new macros.
- Label and number all equations (although you do not need to reference all of them).
- Use `\eqref` instead of `\ref` (adds parenthesis).
- For parenthesis, use `\left` and `\right` (size adaptation).

LaTeX as programming language

Macros for notation:

```
\renewcommand{\exp}[1]{e^{#1}}
\newcommand{\vect}[1]{\mathbf{#1}}
\newcommand{\matr}[1]{\mathbf{#1}}
\newcommand{\domain}{\Omega}
\newcommand{\pathDomain}{\domain_{X}}
\newcommand{\primaryDomain}{\domain_{U}}
\newcommand{\norm}[1]{\left\lVert #1 \right\rVert}
```

LaTeX as programming language

Macros for facilitating referencing:

```
1  \newcommand{\Fig}[1]{Figure~\ref{fig:#1}}
2  \newcommand{\Figs}[2]{
3     Figures~\ref{fig:#1} and \ref{fig:#2}}
4
5  \newcommand{\Eq}[1]{Equation~\eqref{eq:#1}}
6  \newcommand{\Eqs}[2]{
7     Equations~\eqref{eq:#1} and \eqref{eq:#2}}
8  \newcommand{\Eqss}[3]{
9     Equations~\eqref{eq:#1}, \eqref{eq:#2}, and \eqref{eq:#3}}
10 \newcommand{\EqsTo}[2]{
11    Equations~\eqref{eq:#1}-\eqref{eq:#2}}
```

LaTeX as programming language

Macros for commenting within the text:

```
1 \newcommand{\note}[3][magenta]{
2     {\color{#1}(\textbf{\textit{#2}: #3)}}}
3 \newcommand{\adolfo}[1]{\note[green]{Adolfo}{#1}}
```

... Figure 6 suggests that the convergence increases with parameter α (***Adolfo*: Figure 6 probably suggests so, but it would look much better in blue and magenta**) but ...

LaTeX as programming language

Macros for commenting within the text:

```
1 \newcounter{todoCounter}
2 \newcommand{\todo}[1]{\refstepcounter{todoCounter}
3       \note[blue]{ToDo \thetodoCounter}{#1}}
```

6.2 Results

(*ToDo 1*: Perform experiments)

(*ToDo 2*: Write results)

Acknowledgements

Standing on the shoulders of

- Wojciech Jarosz – https://cs.dartmouth.edu/wjarosz/writing.html
- Fredo Durand – https://people.csail.mit.edu/fredo/PUBLI/writing.pdf
- Aaron Hertzman – http://www.dgp.toronto.edu/~hertzman/advice/writing-technical-papers.pdf
- Jim Kajiya – https://www.siggraph.org//sites/default/files/kajiya.pdf
- Bill Freeman – https://billf.mit.edu/sites/default/files/documents/cvprPapers.pdf
- Random googling
- Adrian Jarabo – just talking
- My co-authors and my own experience.

Writing (papers)

Research and Innovation Tools and Activities

Ana Cristina Murillo – Adolfo Muñoz

Master on Robotics, Graphics and Computer Vision

Departamento de
Informática e Ingeniería
de Sistemas

Universidad Zaragoza