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Design and Preparation of Effective Scientific Posters using LaTeX

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Abstract Posters are important presentation tools in scientific conferences. LaTeX offers several packages for designing various types of high quality posters, e.g, *a0poster* and *sciposter*. However, many of the posters we are used to seeing are not effective. They are visually split into columns, conceptually organized in sections, and contain large amounts of text which are likely to disrupt the viewing experience and understanding of the content. In this article, we present an efficient method for preparing visual scientific posters using the PGF package and its syntax layer Ti*k*Z .

Contents

1 Introduction

Posters are used to communicate research results at conferences. Poster sessions are usually crowded, with presenters competing for the audience's attention. The goal of a successful poster is to attract viewers, and a pleasant visual layout will bring them in. It should have good-quality content as well.

One common mistake is using large blocks of text in a small font size. Assuming the poster size is $1,20 \times 0,90\,\text{meters}^2$ and is composed with 12 pt fonts, a person standing 3 meters away from a poster can see all of its elements. But from a distance of 4 meters or more the text becomes unreadable. When the text size is small the material is hard to read, and the potential viewer is likely to grow impatient and lose interest in the presentation.

There are many characteristics that contribute to good visualization of a poster, among them:

- Visual acuity
- Visual comfort
- Default definition of images
- Distance and font size
- Choice of colors

Place this article 1 meter away from yourself and look at the text. You can probably read this text with ease. Now, place it 2 meters away. The words begin to appear blurred and hard to read. The same occurs when you see a poster from afar: the content begins to become difficult to see and as a result, difficult to understand.

Clarity from a distance is the main — but not the only — reason for the design of visual posters. Visual appeal can be also used as a means to better understand the content.

For example, imagine an author who has to convey results of a statistical analysis involving equations, formulas, tables, and text. For someone first seeing the poster, reading and grasping the equations and text can be difficult, impeding comprehension at an intuitive level. In contrast, if the poster is primarily composed of visual elements, the content becomes easier to follow and understand, since we assimilate images easier than text.

Figure 1 is an example of a poster using the standard method: organized in columns, with large amounts of text, and displaying only a few figures. This poster suffers from the problems that many scientific posters fall victim to. Note that the font size of the title and authors' names is large, but the section title and body text font sizes are relatively small. Other problems with this poster include:

- The background color for the section name makes it difficult to understand what is written.
- When the presenter is speaking to a viewer, large amounts of text will distract the listener, who will attempt to read and listen at the same time.
- The size of the first figure is much too small, especially with thin lines used to draw it.
- The equations are very small and, although they are displayed in a different font style, they are almost lost among the text. They are not highlighted in any way.
- Many important expressions and words are used throughout the text, but are not enhanced at all. Instead of improving the visualization, these words are difficult to see.
- The background color used is unnecessary. A white background would be more effective.

As you can see, the standard construction of posters (sections displayed in columns with lots of text and few figures or tables) is not the best. We suggest a new construction, based on the idea that the figures, tables, maps and other visual elements convey the information in a more intuitive way for the audience, enabling a better understanding of the content.

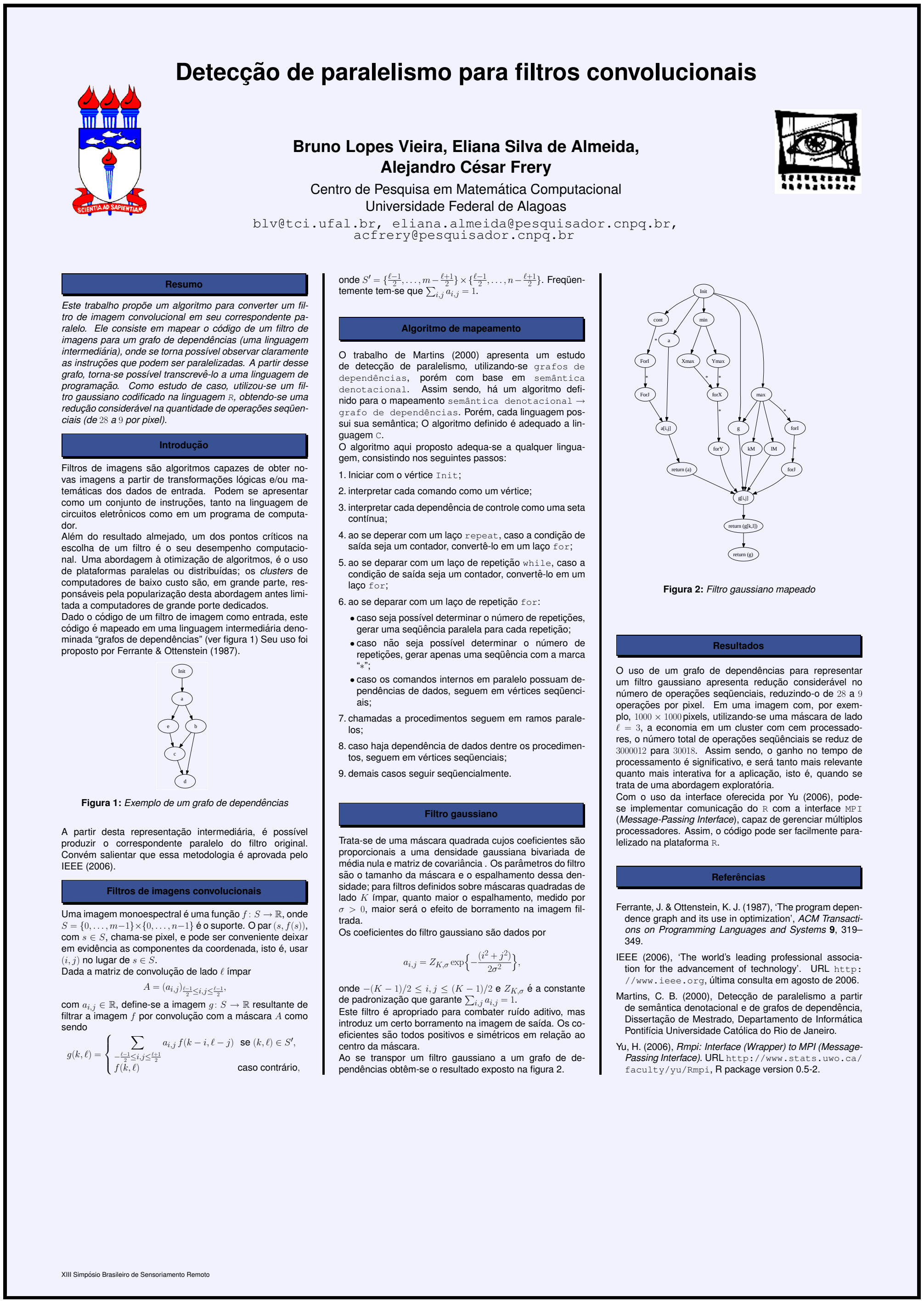

Figure 1: Example of a poster built with large amounts of text and few visual elements [7]

2 PGF and Ti*k*Z

As mentioned in Section 1, we can use LaTeX to produce posters with high visual quality, using any of the poster classes. Many of the problems described above can be overcome by using better visual elements, and we have found Ti*k*Z and PGF to be useful tools for this. We will demonstrate how to use the Ti*k*Z package for planning and producing a good visual poster. We start by explaining the structure of PGF package and follow with an introduction to the motivation for its use. Then we present example code and graphics constructed with Ti*k*Z , and conclude the paper discussing libraries and utilities for poster creation.

2.1 Structure

The PGF package was first described by Till Tantau [5]. PGF stands for "portable graphics format" or (in author's words) "pretty, good, functional". This package was created to produce graphics in an "inline" manner, using TeX commands. Furthermore, PGF consists of three different layers, which we briefly describe:

system layer: provides abstraction of what is running in the driver, which is merely a program that takes an input and makes a conversion to the appropriate output (like dvips or pdfTeX). Since each driver has its own way and syntax for the generation of graphics, PGF abstracts these different methods so users do not need to worry about this issue.

basic layer: makes graphics production easier by providing a set of basic user-friendly commands that facilitates the use of the system layer.

frontend layer: provides a set of commands that aids the use of the basic layer. This is the layer intended for the user, because it is composed of simple and intuitive commands.

The PGF package is available at CTAN website `CTAN:ftp://tug.ctan.org/pub/tex-archive/graphics/pgf/base/doc/generic/pgf/pgfmanual.pdf` [2].

2.2 Why should I use Ti*k*Z ?

Because it is a tool of easy manipulation for producing good visual posters! Moreover, Ti*k*Z can be used along with other LaTeX styles and classes, e.g. *article*, *beamer*, *book*, and poster styles. It can also be used in the same document with other packages and environments, including *graphicx* and $\mathcal{A}\mathcal{M}\mathcal{S}$-LaTeX. A few packages may conflict with Ti*k*Z , but workarounds are available for some of these issues (not discussed in this article).

The use of Ti*k*Z has been described by others, including [4] which presents some of its possibilities for producing graphics (coordinate systems, angles and shapes, among others). Below are a few examples, some of which can be found in the Ti*k*Z and PGF Manual for version 2.00, while others were adapted for our own purposes.

```
\begin{tikzpicture}[scale=3]

\clip (-2,-0.2) rectangle (2,0.8);
\draw[step=.5cm,gray,very thin](-1.4,-1.4) grid (1.4,1.4);
\filldraw[fill=green!20,draw=green!50!black]
(0,0) -- (3mm,0mm) arc (0:30:3mm) -- cycle;
\draw[->] (-1.5,0) -- (1.5,0) coordinate (x axis);
\draw[->] (0,-1.5) -- (0,1.5) coordinate (y axis);
\draw (0,0) circle (1cm);

\draw[very thick,red] (30:1cm) -- node[left=1pt,fill=white]
{$\sin \alpha$}(30:1cm |- x axis);
\draw[very thick,blue] (30:1cm |- x axis) -- node[below=2pt,fill=white]
{$\cos \alpha$}(0,0);
\draw[very thick,orange] (1,0) -- node[right=1pt,fill=white]
{$\displaystyle \tan \alpha \color{black}=
\frac{{\color{red}\sin \alpha}}{\color{blue}\cos \alpha}$}
(intersection of 0,0--30:1cm and 1,0--1,1) coordinate (t);

\draw (0,0) -- (t);
\foreach \x / \xtext in {-1, -0.5 / -\frac{1}{2}, 1}
\draw (\x cm,1pt) -- (\x cm,-1pt) node[anchor=north,fill=white]{$\xtext$};
\foreach \y / \ytext in {-1, -0.5/ -\frac{1}{2}, 0.5 / \frac{1}{2}, 1}
\draw (1pt,\y cm) -- (-1pt,\y cm) node[anchor=east,fill=white]{$\ytext$};

\end{tikzpicture}
```

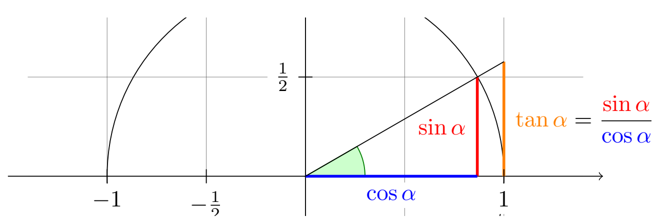

Figure 2: Use of Ti*k*Z for geometric pictures and trigonometric functions

```
\usetikzlibrary{mindmap}

\begin{tikzpicture}[root concept/.append style={concept color=red!50,minimum size=2cm},
level 1 concept/.append style={sibling angle=45},mindmap]

\node [concept] {Root concept} [clockwise from=45]

child { node[concept] (c1) {child}}
child { node[concept] (c2) {child}}
child { node[concept] (c3) {child}};

\draw [concept connection] (c1) edge (c2)
                                edge (c3)
                           (c2) edge (c3);

\end{tikzpicture}
```

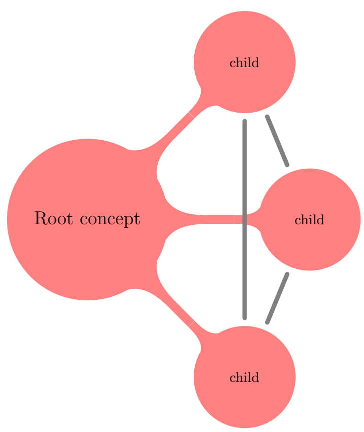

Figure 3: Use of Ti*k*Z for graphics with connected and related elements

```
\usetikzlibrary{automata}

\begin{tikzpicture}[every state/.style={draw=blue!50,very thick,fill=blue!20},
node distance=4cm]

\node[state,initial] (q0) {$q_0$};
\node[state] (q1) at (2,2) {$q_1$};
\node[state] (q2) at (2,−2) {$q_2$};
\node[state,accepting] (q3) at (4,0) {$q_3$};
```

```
\path[->] (q0) edge [above] node {\textbf{0}} (q1)
               edge [below] node {\textbf{1}} (q2)
          (q1) edge [above] node {\textbf{1}} (q3)
               edge [loop above] node {\textbf{0}} ()
          (q2) edge [below] node {\textbf{0}} (q3)
               edge [loop below] node {\textbf{1}} ();
\end{tikzpicture}
```

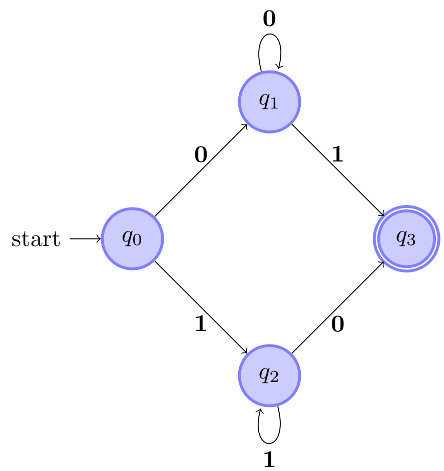

Figure 4: Ti*k*Z can be used for drawing automata and Turing machines

2.3 Ti*k*Z libraries

Many libraries in the Ti*k*Z package allow relatively easy construction of images and other elements. We will only present a few in this article; the interested reader is directed to the PGF and Ti*k*Z manual for more references and examples. Some libraries are useful for preparing a visual scientific poster because they include building blocks for scientific objects such as tables, flowcharts, automata, and maps.

Below are some libraries that are useful for building a visual scientific poster.

automata: provides shapes and styles for drawing finite state automata and Turing machines (see the example in Figure 4).

mindmap: intended for the creation of mindmaps or concept maps. A mind-map is a graphical representation of a concept, together with related concepts and annotations.

decorations: a set of several libraries that defines decorations for improving figures or tables. This is very useful for adding supporting information to the poster.

shapes: allows the creation of a variety of shapes and figures. This is a set of several shape libraries.

For a more detailed information, the reader is referred to the Ti*k*Z Manual [5]:

3 Producing your poster

In this section we describe our strategy for building visual scientific posters, with the aim of easily producing easy-to-understand posters. We do not adhere to a specific class but instead focus on displaying content using Ti*k*Z .

3.1 Considerations about graphics

Having presented Ti*k*Z , we will discuss some techniques for better construction of visual posters. These guidelines follow Tufte's book *The Visual Display of Quantitative Information* [6], which explains techniques for displaying graphics, tables, and other visual information media. According to Tufte, graphics should:

– Show the data (this is the main function, but not the only one).
– Induce the viewer to think about the content, and not about the display design, formatting, or technology.
– Avoid distorting what the data have to say.
– Present many numbers and information in a limited space.
– Induce the viewer to compare different parts of data or identify relationships among them.

Complex concepts that convey lots of information need to be explained in a dynamic way. Illustrations or graphics should be detailed, structured, and focused on the richness and precision of visual information in a clear and concise way.

3.2 Vector or bitmap images? Which format to choose?

In order to maximize the visual appeal, we propose the use of the vector format for images, unless true bitmap data, such as a picture captured by a digital camera or scanner, must be displayed. Photographs, icons, and pictures downloaded from the internet are bitmaps, or raster images, usually in JPG, BMP, GIF or PNG format. A bitmap is a data structure (generally a matrix of pixels) that represents an image, and is the main format shown by a computer monitor. Problems occur when trying to zoom in on these types of images, since the amount of information is limited by the resolution.

Vector-based figures employ geometrical primitives such as points, lines, curves, shapes, and polygons instead of pixels. This favors the quality of the rendered images in, say, a poster, because the image is not distorted when expanded. Caution is needed, however, for vector images are recommended mostly for graphs, tables, and elements which can be represented by primitive geometrical forms. A careful choice of the proper format is needed to ensure high visual quality.

3.3 The elements of a poster

To start, divide the poster into two parts: heading and content. In the heading, be sure the title is shown clearly, since it makes the first impression on the audience. Choose an adequate font size and style. The authors' names should be placed just below the title in a slightly smaller font size. Include the authors' institution and contact information (address or email). It may be a good idea to include the institution's logo in the header; in that case, place it next to the title, and use a high-resolution image.

Now, we concentrate on the poster's content. Start the poster by limiting its area to a Ti*k*Z environment using the **tikzpicture** command. Everything inside this environment will be an object (see below) or a link that produces connections.

```
\begin{tikzpicture}
...
\end{tikzpicture}
```

Next, define each object as a node (`\node`). A node can be text, an image, a table or another LaTeX element:

```
\begin{tikzpicture}

\node (<label>) at (<coordinates>)[<options>]{<element>};
...

\end{tikzpicture}
```

Using nodes for representing elements makes their manipulation easy. Labels (<**label**>) and colors (<**options**>) can be added, their position can be modified (<**coordinates**>), they can be rotated (<**options**>), codes can be detached (<**options**>), and the elements can be linked, allowing a better understanding of transitions of work stages and the subject as a whole.

We recommend putting the first node in position $(0,0)$, so that the following nodes will have a position relative to this one. See the example:

```
\begin{tikzpicture}

\node (myfirstnode) at (0,0)[shape=circle,draw=black,fill=gray!20]
{\textbf{\large My first node is a circle!}};

\end{tikzpicture}
```

The next example shows three nodes. The first node is placed, and the other two are arranged relative to it:

```
\begin{tikzpicture}

\node (firstnode) at (0,0)[shape=circle,draw=black,fill=gray!20]
{\textbf{
\begin{tabular}{c}
This node is\\
in (0,0) position
\end{tabular}
}};

\node (secondnode) at (5,0)[shape=circle,draw=black,fill=gray!20]
{\textbf{
\begin{tabular}{c}
This node is\\
in (5,0) position
\end{tabular}
}};

\node (thirdnode) at (0,5)[shape=circle,draw=black,fill=gray!20]
{\textbf{\begin{tabular}{c}
This node is\\
in (0,5) position
```

```
\end{tabular}
}};

\end{tikzpicture}
```

The images generated by these examples are:

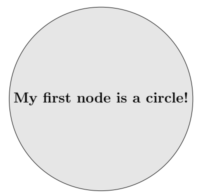

Figure 5: Example of first node centered in $(0,0)$ position

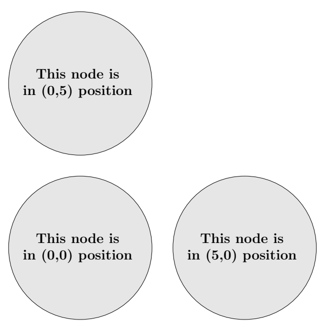

Figure 6: Two nodes with positions based on the position of the first node

3.4 Linking elements

This is an important part of constructing your poster. Links describe every step of your work through visual connections. Here are some tips for creating your links:

– Follow a chronological order so that readers are not confused.

– Choose significant nodes only, and describe them fully.

– Choose pictures or graphics that describe the processes well.
– Highlight the results or most important stages.

We will show how to create links for the nodes defined in Subsection 3.3 with the command `\draw`. The syntax of `\draw` is:

```
\begin{tikzpicture}

\draw[<options>] (<start point>) to (<final point>) node[<options>]{<element>};
...

\end{tikzpicture}
```

Now onto the links of the elements of Figure 6:

```
\begin{tikzpicture}

\node (firstnode) at (0,0)[shape=circle,draw=black,fill=gray!20]
{\textbf{
\begin{tabular}{c}
This node is\\
in (0,0) position
\end{tabular}
}};

\node (secondnode) at (7,0)[shape=circle,draw=black,fill=gray!20]
{\textbf{
\begin{tabular}{c}
This node is\\
in (7,0) position
\end{tabular}
}};

\node (thirdnode) at (0,7)[shape=circle,draw=black,fill=gray!20]
{\textbf{\begin{tabular}{c}
This node is\\
in (0,7) position
\end{tabular}
}};

\draw[->,double] (firstnode) to (secondnode) node[midway,above,sloped,text height=1.5cm]
{right arrow};
\draw[->,double] (firstnode) to (thirdnode) node[midway,above,sloped,text height=1.5cm]
{up arrow};

\end{tikzpicture}
```

It is important to mention that the links may also have content such as a label, text, or a **node**. Link formats may be lines, simple arrows, double arrows, or

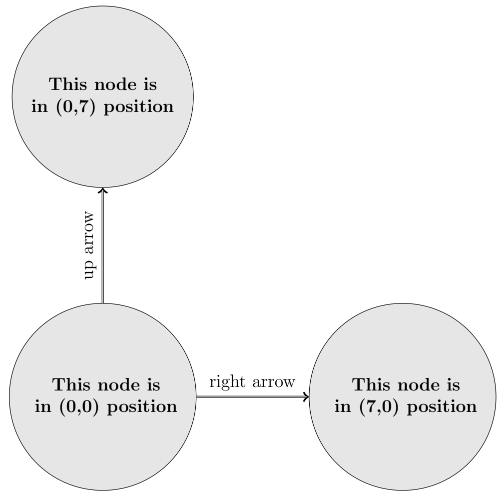

Figure 7: Linking three nodes with double arrows

drawings, each being adjustable through parameters or libraries to fit the user's needs.

3.5 Colors

The use of color is important for understanding an environment. Because it strongly impacts the visual perception, it is important to choose the correct color for each case. For example, color-impaired people may not be able to tell red from green if used for essential contrasts [6], on the other hand, blue can be distinguished from other colors by most color-deficient people.

According to [6] the mind's eye does not readily give a visual ordering to colors, so avoid using color for ordering the importance of items. An alternative is to vary shades of gray. These show varying quantities better than color, and they provide an easily-perceptible order of topics.

4 Examples of good visual scientific posters

Figures 8 and 9 (which were used for the presentations of references [1, 3], respectively) are good examples of visual posters[1] which follow the guidelines pre-

1. We thank the authors for allowing the use of these posters

sented in Section 3.

Note in Figure 8 that the three images which represent the first step of the procedure have a proper size, allowing the audience to understand the content without much effort. In addition, each figure is labeled, facilitating its understanding.

The second step of the work is represented by an equation and input data. Each element has proper highlighting by choosing appropriate background color, font size, and font style. This stage represents the work's methodology, and the poster enhances its importance by centering it with respect to the poster.

Finally, the last step of the work displays the results of the research through four tables. Each table has a label and a highlighted background. The most relevant results were enhanced further by different colors (green for positive results and red for the negative ones).

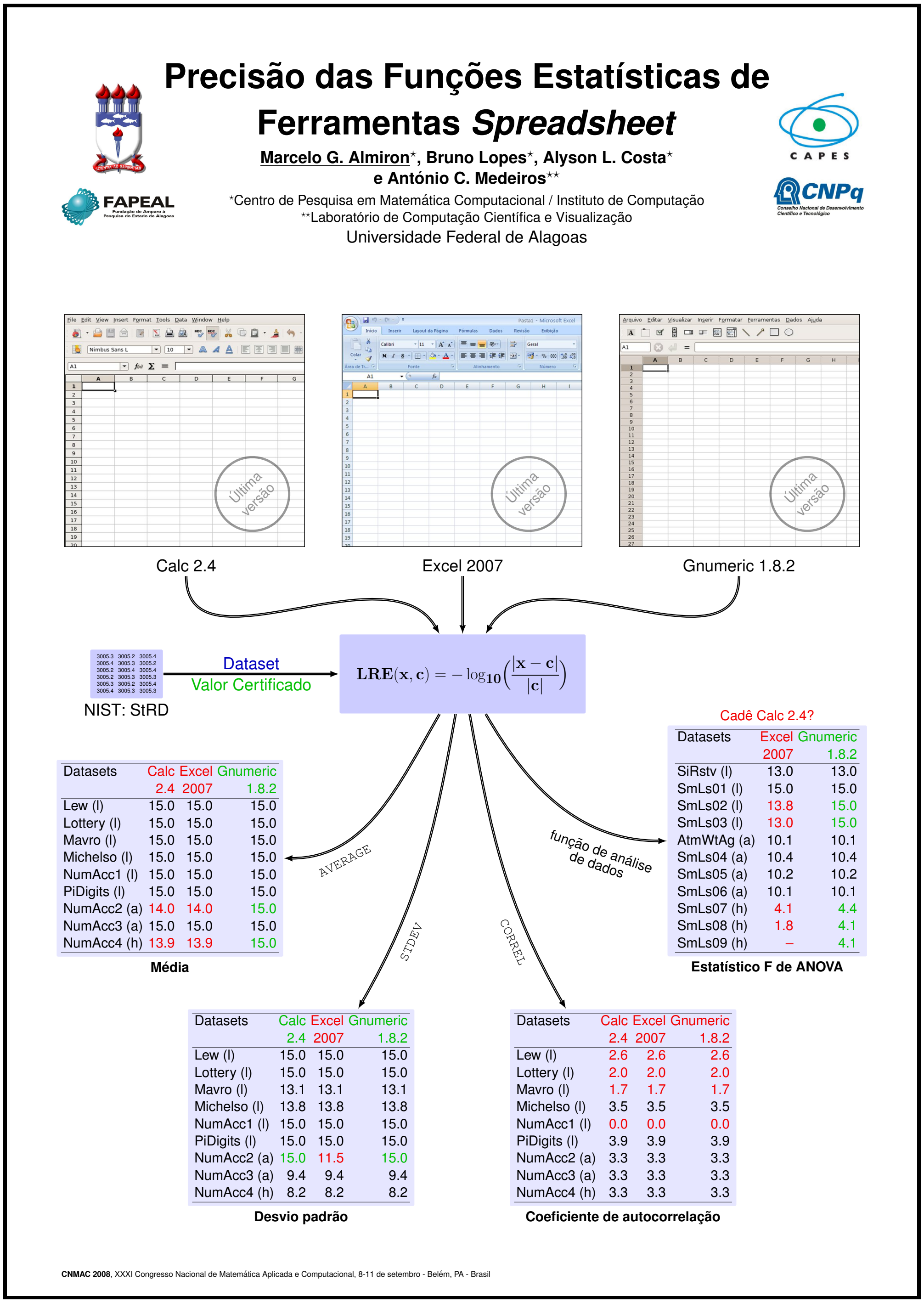

Figure 8: Example of a good visual poster [1]

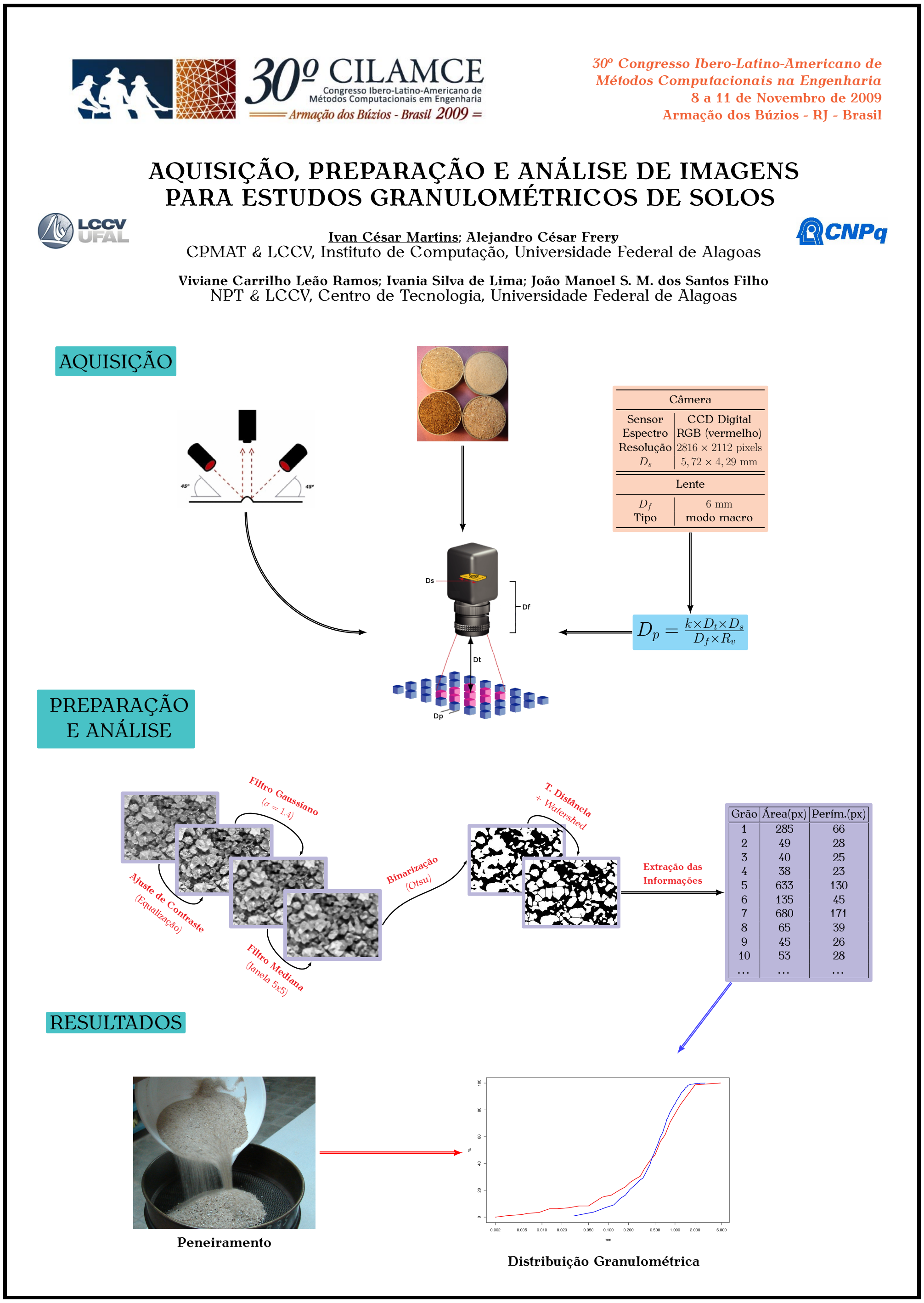

Figure 9: Example of a good visual poster [3]

5 Conclusion

In this paper, we presented a method for making visual scientific posters that aim at promoting better understanding by their audience. We presented LATEX tools that can be used to attain this objective.

In summary, when producing a visual poster we recommended the follow steps:

1. Determine the main stages of work.
2. Choose one or more graphics that represents each step (this step is very important, so spend as much time as needed on it).
3. Put them in visual logical order, emphasizing the most important.
4. Link them with significant visual clues.

6 Acknowledgment

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References

[1] M. Almiron, B. Lopes, A. L. C. Oliveira, A. C. Medeiros, and A. C. Frery. Precisão das funções estatísticas de ferramentas spreadsheet: uma análise comparativa. In *Anais do XXXI Congresso Nacional de Matemática Aplicada e Computacional*, 2009.

[2] CTAN team. CTAN the Comprehensive TeX Archive Network, February 2010.

[3] Ivan César Martins, Alejandro César Frery, Ivania Silva de Lima, João Manoel Sampaio Mathias dos Santos Filho, and Viviane Carrilho Leão Ramos. Aquisição, preparação e análise de imagens para estudos granulométricos de solos. In *Anais do 30º Congresso Ibero-Latino-Americano de Métodos Computacionais na Engenharia*, 2009.

[4] Andrew Mertz and William Slough. Graphics with Ti*k*Z . *The PracTEX Journal*, (1), 2007.

[5] Till Tantau and Mark Wibrow. *The Ti*kZ *and* PGF *Packages*, February 2008.

[6] Edward Rolf Tufte. *The Visual Display of Quantitative Information*. Graphic Press, 2nd edition, September 2002.

[7] B. L. Vieira, E. S. de Almeida, and A. C. Frery. Detecção de paralelismo para filtros convolucionais. In *Anais do XIII Simpósio Brasileiro de Sensoriamento Remoto*, pages 6257–6264, 2007.