VECTOR GRAPHICS IN LATEX FOR ACADEMIC PAPERS

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Abstract: This paper deals with issue of creating vector graphics in LATEX . In these days most of technical academic papers are written in LATEX , so it is very important to know how to create vector pictures directly in it, because it will usually looks better than if it is created in 3rd party tool. The output of this article are created models, where one of them is published in world wide open source project summarizing LATEX vector graphics.

Keywords: LATEX , vector graphics

1 INTRODUCTION

In these days, when books and scientific papers are written usually in LATEX, it is common to use some kind of pictures, schemas or other graphical objects. These objects are usually integrated directly into text. It is very important to choose adequate tool for creating these pictures. These days it is hard to imagine that our parents had written diploma thesis in typewriter and bluffing it or writing with ink [1].

The disadvantage of creating vector objects in 3rd party open source tools is that it could not be compatible with older versions and also they could be removed from free market place. It means that if you create some objects and you want to reopen it in this 3rd party tool again it is not certain that it would be possible. Another disadvantage is that you need to always transfer these pictures with document source code and also it is sometimes hard to adapt external pictures into text (size of each picture, font size, font style etc.) [1].

The advantage of using LATEX vector graphics is that it is created directly in text and also it is perfectly adapted in it. The disadvantage is that it takes some time to learn it.

2 BASE PACKAGES

This section will introduce some of possible packages to create vector graphics in LATEX . Graphical objects in LATEX (or TEXin general) document could be created in few ways (i) directly in LATEX with packages and macros (ii) with programs as METAFONT or Integrating graphical objects from external sources and inserting LATEX commands in it [1]. METAPOST.

Some of them are suitable for mathematical objects, some of them for electrotechnical schemas etc.

2.1 PACKAGE PICTURE

Package `picture` is in standard LATEX installation. The signature of this package is following:

```
\begin{picture}(hx,hy)(dx,dy)
...
\end{picture}
```

where *hx, hy* are coordinates of the upper right corner and *dx, dy* are the coordinates of the lower left corner of the rectangle that the system will reserve for the image.

Inside this environment could occur only commands for inserting picture objects as `put` and `multiput`. This environment is suitable for creating lines, frames, arrows, circles, bezier curves and so on.

The example of creating picture with this environment is shown in the Figure 1.
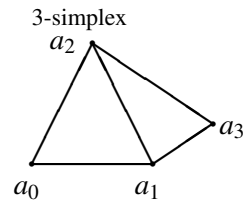
Figure 1: Example of graphical object with picture environment.

```
\begin{picture}(12,4)
    \thicklines
    \put(8,3.3){{\footnotesize $3$-
        simplex}}
    \put(9,3){\circle*{0.1}}
    \put(8.3,2.9){$a_2$}
    \put(8,1){\circle*{0.1}}
    \put(10,1){\circle*{0.1}}
    \put(9.7,0.5){$a_1$}
    \put(11,1.66){\circle*{0.1}}
    \put(8,1){\line(1,0){2}}
    \put(8,1){\line(1,2){1}}
    \put(10,1){\line(-1,2){1}}
\end{picture}
```

2.2 TIKZPICTURE AND PGFPLOTS

Tikzpicture environment is one of the most powerfull LATEX environments these days for vector graphics, it enables to create really nice figures. Approximately 70 % of the figures which could be found in economic literature can be drawn with the tikzpicture commands [3, 4] .
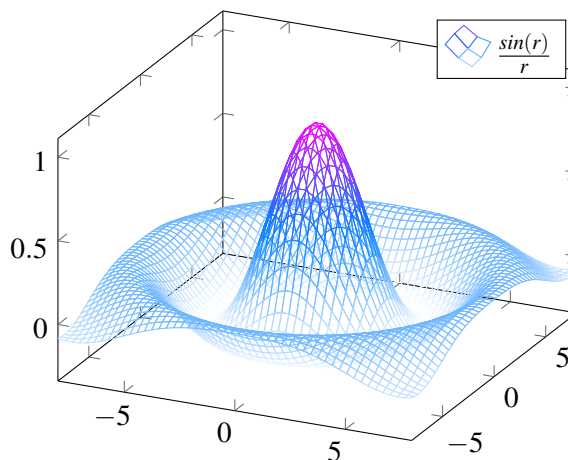

```
\begin{tikzpicture}
\begin{axis}[
    colormap/cool,
]
\addplot3[
    mesh,
    samples=50,
    domain=-8:8,
]
{sin(deg(sqrt(x^2+y^2)))/sqrt(x^2+y^2)};
\addlegendentry{$\frac{sin(r)}{r}$}
\end{axis}
\end{tikzpicture}
```

Figure 2: Example of 3D plot [5].

In the Figure 2 is shown example of possibility to plot 3D picture, as you can see the source code in LATEX for it is very short. Another example which is very common in scientific papers are bar graphcs. Bar graphs could be also very easily created with tikzpicture environment. Following example (see Figure 3) shows sample of it.
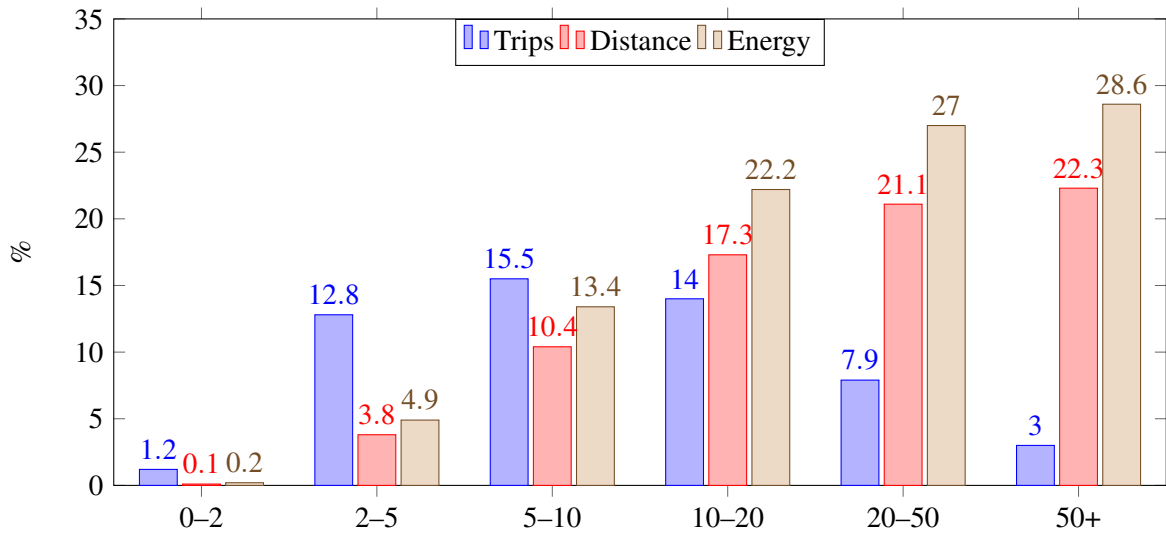
Figure 3: Bar chart example [5].

Source code of this example is quite longer, so there is the link to see this source code [1]. In this figure are two important facts, one is that it is possible to make table with data and another that there is option in `axis` to load these data into bar chart.

Tikz package is very widespread in the LaTeX community. Consequently, there are a lot of aggregates in this package that are dedicated to a specific industry. For example in the Figure 4 is shown a schema from electrotechnics branch regarding dynamic inverse-gamma-equivalent circuit.
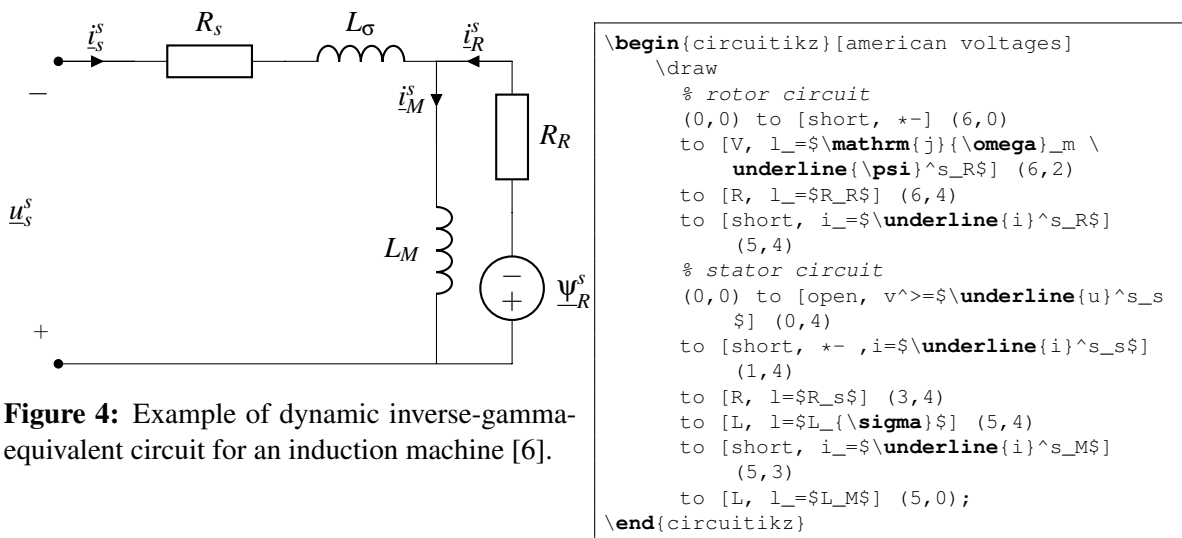
Figure 4: Example of dynamic inverse-gamma-equivalent circuit for an induction machine [6].

```
\begin{circuitikz}[american voltages]
    \draw
        % rotor circuit
        (0,0) to [short, *-] (6,0)
        to [V, l_=$\mathrm{j}{\omega}_m \
            underline{\psi}^s_R$] (6,2)
        to [R, l_=$R_R$] (6,4)
        to [short, i_=$\underline{i}^s_R$]
            (5,4)
        % stator circuit
        (0,0) to [open, v^>=$\underline{u}^s_s
            $] (0,4)
        to [short, *- ,i=$\underline{i}^s_s$]
            (1,4)
        to [R, l=$R_s$] (3,4)
        to [L, l=$L_{\sigma}$] (5,4)
        to [short, i_=$\underline{i}^s_M$]
            (5,3)
        to [L, l_=$L_M$] (5,0);
\end{circuitikz}
```

In next section is described the process of deploying pictures to open source community.

3   RESULTS

Motivation of this paper was to create vector pictures and publish it to open source community. This was achieved with created flow chart diagram (see Figure 5), which was published on world wide

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[1]https://tex.stackexchange.com/a/157028

open source project summarizing LATEX vector graphics[2]. Source code of this picture is quite long, so the full version of it is ommited from this paper, but it could be found on the following page[3].
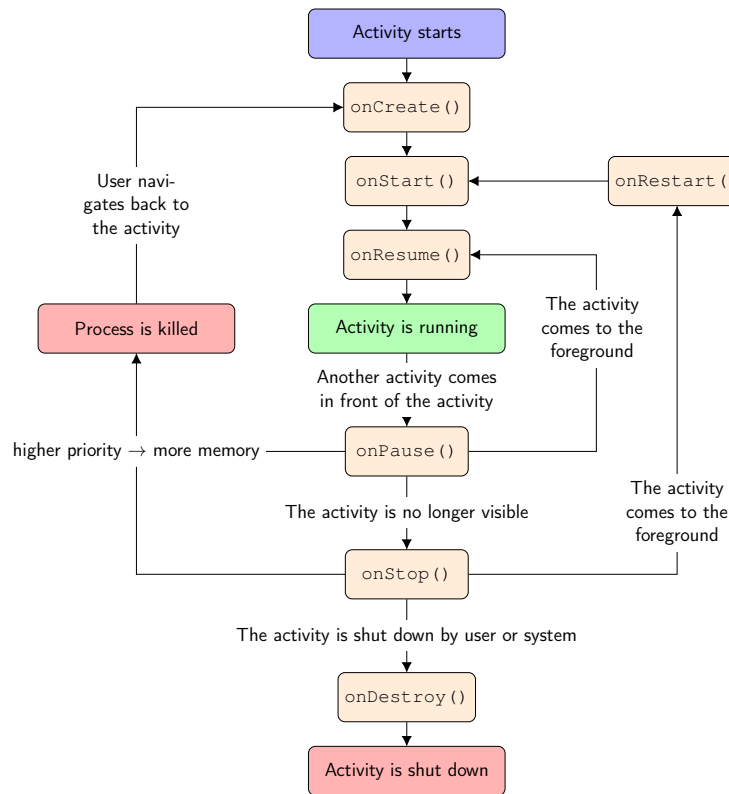
Figure 5: Example of flow chart diagram, which was published on `http://texample.net/tikz/examples/android/` site.

On the page it is possible to see that it is really easily possible to create nodes and connect them with the lines.
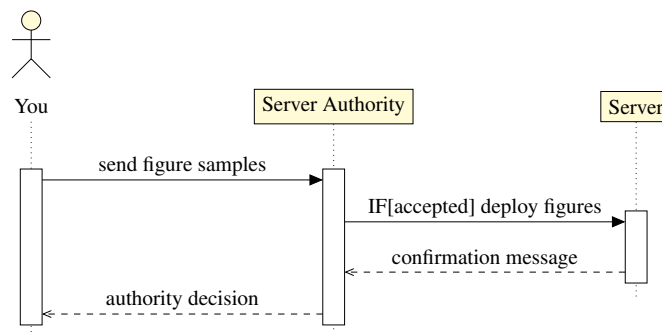
Figure 6: The process of deploying figures to TEXample server.

The next part after picture creation is to publish it. It is necessary to contact Stefan Kottwitz, who is one of the most famous book author in LATEX community, and takes care of this page. To upload some vector figure on this page it is necessary to contact him and send him sample figures. If he decides that one of these samples is quite good than it will be uploaded there.

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[2]http://texample.net/
[3]`http://texample.net/tikz/examples/android/`

The process of deploying vector figure on T_EXample server is shown in Figure 6.

4 CONCLUSION

This article describes possibilities of creating vector figures in LaTeX. This is really hot topic, because these days the most papers in technical area are written in LaTeX. Some key packages for creating vector graphics were presented. The most important package these days for fancy figures is package `tikz` with combination of `pgfplots` and other derivatives from it. This article also describes a process of deploying LaTeX vector figures to world wide open source page for vector graphics. The most important result is that one of the sample figures was published on world wide page for vector LaTeXgraphics[4]. The advantages and disadvantages of using LaTeX and other 3rd party tool were also discussed.

REFERENCES

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[4]`http://www.texample.net/tikz/examples/author/pavel-seda/`