The sfg package*

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1 Documentation

This style file defines some commands to draw signal flow graphs using LaTeX 2ε. Signal flow graphs (SFG) are used by electrical and electronics engineers and graph theorists. If you haven't heard of SFGs before, then sfg.sty is probably not useful for you.

If you really want to know what a signal flow graph is, you might read one of the references given below.

The package sfg requires the packages 'pstricks' and 'fp'. It therefore requires LaTeX 2ε and a reasonably fast machine.

To draw a signal flow graph, you should proceed as follows:

1. Insert `\usepackage{pstricks,sfg}` in your LaTeX 2ε-file.
2. Draw your SFG on graph paper[1] and determine the size of the picture in units (squares).
3. Set the unitlength using `\sfgsetunit`.
4. Set the arrowlength, node radius and label offsets using `\sfgsetsize`.
5. In a LaTeX picture environment of the size you determined above,
   - first draw all paths using `\sfgbranch` and `\sfgcurve`,
   - then draw all nodes using `\sfgnode` and `\sfgtermnode`.

*This manual corresponds to sfg v0.91, dated 22. 08. 2007.

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[1] I mean the paper with a 4 mm, 5 mm or 1/8 in grid on it...

2 Setting the Controlling Parameters

\sfgsetunit{⟨*length*⟩} sets \unitlength and the PS unit to ⟨*length*⟩, and defines the default pstricks linewidth as 0.4 pt. This has an influence on *all* ps-tricks commands that are used afterwards.

\sfgsetsize{⟨*nr*⟩}{⟨*al*⟩}{⟨*no*⟩}{⟨*ao*⟩} sets the node radius to ⟨*nr*⟩ units, the arrow-length to ⟨*al*⟩ units, the offset of the nodes' labels to ⟨*no*⟩ units and the offset of the arrows' labels to ⟨*ao*⟩ units. All four parameters are numbers.

\sfgsetangle{⟨*an*⟩} sets the incidence angle of sfgcurves ⟨*an*⟩ degrees. Default value: 60 degrees.

\sfgsetarrowloc{⟨*mid*⟩} sets the location of the sfgbranch's arrow. 0.5 means in the middle, 0.1 means 10 % of the branch length from the first node. Default value: 0.5

\sfgsetlines{⟨*li_len*⟩}{⟨*lii*⟩}{⟨*liii*⟩} sets the line thickness \sfg@Li (used for all lines) to ⟨*li_len*⟩, the thickness \sfg@Lii (used for terminal nodes) to ⟨*lii*⟩ × ⟨*li_len*⟩, and the thickness \sfg@Liii to ⟨*liii*⟩ × ⟨*li_len*⟩. It also resets the default pstricks linewidth to the new \sfg@Li.

Default values: \sfg@Li = 0.40 pt
\sfg@Lii = 1.80 × \sfg@Li
\sfg@Liii = 3 × \sfg@Li

3 Drawing signal flow graph (SFG) branches

\sfgbranch{⟨*dx*⟩}{⟨*dy*⟩}{⟨*pos*⟩}{⟨*text*⟩} draws a straight SFG branch from $(0, 0)$ to $(\langle dx\rangle, \langle dy\rangle)$. An arrow is placed in the middle of the branch, and a label ⟨*text*⟩ is typeset near the arrow. The parameter ⟨*pos*⟩ is explained below (see \sfgnode).

The distance of the label from the arrow's centre as well as the arrow's length can be set using \sfgsetsize.

The location of the arrow can be changed using \sfgsetarrowloc.

\sfgcurve{⟨*dx*⟩}{⟨*dy*⟩}{⟨*off*⟩}{⟨*pos*⟩}{⟨*text*⟩} draws a curved SFG path from $(0, 0)$ to $(\langle dx\rangle, \langle dy\rangle)$. The arrow's position is ⟨*off*⟩ units left of the middle of the path (⟨*off*⟩ can be negative to put the arrow right of the path). The curve leaves the endpoints in an angle of 60 degrees (this value can be changed using \sfgsetangle) if possible. If the arrow is too far away from the straight path, the angle is increased to guarantee a "nice" curve, and a warning message is issued.

4 Drawing Nodes

\sfgnode{⟨*pos*⟩}{⟨*text*⟩} draws a node with label ⟨*text*⟩. ⟨*pos*⟩ decides where the label is typeset. It is a number between 0 and 7. After the command

```
\sfgsetcompass
```

eight macros named after compass directions can be used.

3	2	1		\NW	\N	\NE
4	.	0	or	\W	.	\E
5	6	7		\SW	\S	\SE

The distance of the label from the node's centre as well as the node's radius can be set using `\sfgsetsize`.

\sfgtermnode{⟨*pos*⟩}{⟨*text*⟩} draws a terminal node (black circle filled white).

5 Example:

```
\documentclass[11pt,a4paper]{article}
\usepackage{pstricks,sfg}
\pagestyle{empty}
\setlength{\parindent}{0pt}

\begin{document}
\sfgsetunit{0.5cm}
\sfgsetsize{0.12}{0.4}{0.5}{0.3}
\sfgsetcompass
\begin{picture}(27,4)
                              % branches related to node 2
  \put(6,2){\sfgbranch{3}{0}\S{$\frac{1}{R_1}$}}
  \put(9,2){\sfgbranch{3}{0}\N{\boldmath $Z_2$}}
  \put(18,2){\sfgcurve{-9}{0}{2}\S{$\frac{1}{R_2}$}}
  \put(24,2){\sfgcurve{-15}{0}{-2}\N{$sC_1$}}
                              % branches related to node 3
  \put(12,2){\sfgbranch{3}{0}\N{$\frac{1}{R_2}$}}
  \put(15,2){\sfgbranch{3}{0}\N{\boldmath $Z_3$}}
                              % input, voltage gain, output
  \put(0,2){\sfgcurve{6}{0}{2}\N{$1$}}
  \put(18,2){\sfgcurve{6}{0}{-2}\S{$\alpha_{\mathrm{V}}$}}
  \put(24,2){\sfgbranch{3}{0}\S{$1$}}
                              % nodes
  \put(0,2){\sfgtermnode\S{$V_{\mathrm{in}}$}}
  \put(3,2){\sfgnode\S{$I_1$}}
```

```
  \put(6,2){\sfgnode\S{$V_1$}}
  \put(9,2){\sfgnode\S{$I_2$}}
  \put(12,2){\sfgnode\S{$V_2$}}
  \put(15,2){\sfgnode\S{$I_3$}}
  \put(18,2){\sfgnode\S{$V_3$}}
  \put(21,2){\sfgnode\S{$I_4$}}
  \put(24,2){\sfgnode\S{$V_4$}}
  \put(27,2){\sfgtermnode\S{$V_{\mathrm{out}}$}}
\end{picture}
\end{document}
```

6 References

[Chen, 1995, Chapters 7, 8 and 18]
Wai-Kai Chen. The Circuits and Filters Handbook. CRC Press, Inc., 1995.

or have a look at the original papers by Samuel Mason:

[119]
Samuel J. Mason. Feedback theory — some properties of signal flow graphs. Proceedings of the Institute of Radio Engineers, 41(9):1144–1156, September 1953.

[120]
Samuel J. Mason. Feedback theory — further properties of signal flow graphs. Proceedings of the Institute of Radio Engineers, 44(7):920–926, July 1956.