Creating Figures and Graphs with LaTeX

Figures and graphs are created using the "figure" environment given below:

> **\begin**{figure}**[***where***]**
>
> *figure*
>
> **\end**{figure}

In the above syntax, *figure* stands for the contents of the 'picture' environment together with a possible **\caption** command. The argument *where* specifies the allowed locations for the table. For example, when **\begin{**figure**}[t]** is typed, it means that the figure will appear on the top of the page.

An example figure developed by using LaTeX commands is given below. The resulting figure is displayed in Figure 1.1. **\put{***x_coord, y_coord***}{***pic_element***}** is used to position the picture element , *pic_element*. **\framebox{***x_dimen,y_dimen***}[***pos***]{***text***}** is used to produce a rectangular box with *x_dimen* width, and *y_dimen* height, and a *text* inside the box. p*os* determines where the *text* will be printed such that "tl" prints the text at the top left of the box.

To refer this figure inside the text, **\label{**fig:lnlblock**}** command is used with a marker of "fig:lnlblock". Then, **\ref{**fig:lnlblock**}** can be used to refer this figure whenever it is needed to print the figure number in the text.

```
-------------------- Figure example -----------------------------
\begin{figure}[h]
\setlength{\unitlength}{0.14in}            % selecting unit length
\centering                                 % used for centering Figure
\begin{picture}(32,15)     % picture environment with the size (dimensions)
                           % 32 length units wide, and 15 units high.
\put(3,4){\framebox(6,3){$H_{B}(q)$}}
\put(13,4){\framebox(6,3){$N[\cdot]$}}
\put(23,4){\framebox(6,3){$H_{C}(q)$}}
\put(0,5.5){\vector(1,0){3}}\put(9,5.5){\vector(1,0){4}}
\put(19,5.5){\vector(1,0){4}}\put(29,5.5){\vector(1,0){3}}
\put(-1,6.5) {$u(k)$}\put(30,6.5) {$y(k)$} \put(9.5,6.5)
{$x_{B}(k)$}\put(19.5,6.5) {$x_{C}(k)$}
\end{picture}
\caption{An LNL Block Oriented Model Structure} % title of the Figure
\label{fig:lnlblock}                       % label to refer figure in text
\end{figure}
-------------------- end of the example -----------------------
```
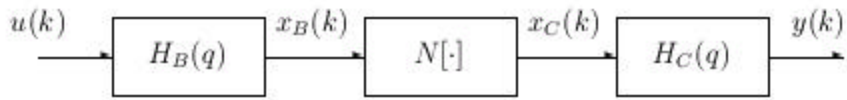
File: FigureHelp1

Figure 1.1. An LNL Block Oriented Model Structure

However, the easier way of a inserting a figure or a graph in the text is to draw it using a figure program, and import it into the LaTeX tex file. This is described below.

Importing Graphics and Figures

a)   Formats of Graphics Supported by LaTeX

A figure in a separate PostScript file (*.ps) or Encapsulated PostScript file (*.eps) can be included in a LaTeX document using the `graphicx` package, i.e., putting **\usepackage{**graphics**}** to the beginning of the tex file. Thus, if a student starts to draw figures or graphs, the files should be created in the ps or eps forms.

Most mathematical or scientific graphics software allows you to export graphics (figures, diagrams, graphs) in ps or eps forms; this includes Mathematica, Maple, Matlab, IDL, and xfig. For instance, in the Matlab figure window, choosing the Export option under File menu, a figure file can be created in the eps format.

If a student has some figures created earlier in different file formats, i.e., jpeg, bitmap, etc., they must be converted to ps or eps forms.

b)   Converting Graphs to PS or EPS Format

GIF, JPEG, TIFF images can be converted to PostScript form with "xv" software, among other methods (http://www.trilon.com/xv/). Also, figures can be converted to the PS format using "Adobe Photoshop" (http://www.adobe.com/products/photoshop/main.html).

The common figure file format is JPEG. For example, scanner programs generally produce scanned figures in the JPEG format, and PS is not accessible. There is dos environment software, "jpeg2ps", which can convert a JPEG file to a PS formatted file. It is free, and can be downloaded from the website: http://www.pdflib.com/jpeg2ps/.

There is a web site (http://wheel.compose.cs.cmu.edu:8001/cgi-bin/browse/objweb) that does file conversion, but the quality of the final figures may vary. Examine the converted document after it is done to check its resolution.

Using graphicx package and Creating Imported Figures

Under LaTeX2e, you add the line

\usepackage[dvips**]{**graphicx**}**

to the beginning of your document, after the **\documentclass** line (this can be seen in the iitsample.tex file). To include an eps or a ps formatted file into a LaTeX tex file, **\includegraphics{***file_name***}** command is used. An example for including an eps file called matlab.eps into the text is given below.

```
-------------------- Figure Importing example -----------------------------
\begin{figure}[ht]
  \centering                % centering figure
  \scalebox{0.5}            % rescale the figure by a factor of 0.8
  {\includegraphics{matlab.eps}} % importing figure
  \label{fig:exm}              % labeling to refer it inside the text
\end{figure}
-------------------- end of the example -----------------------
```
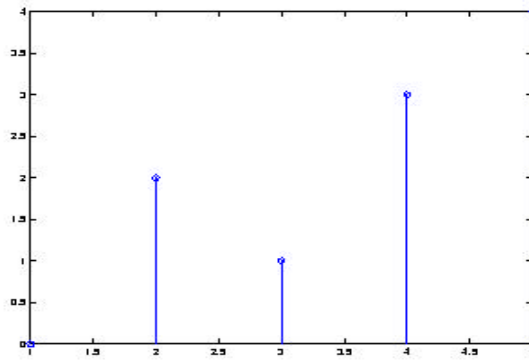
Figure 1.2. Fuel Metabolism

\scalebox{*scale***}** command is used to modify the size of the file by a scale factor. A figure can be rotated by an angle of *value* using the command:

\includegraphics[*angle = value***]{***file_name***}**

For example, in the above example, the figure can be rotated counter-clockwise by 30° using **{\includegraphics[**angle=30**]{**matlab.eps**}}** command. The output is shown in Figure 1.3
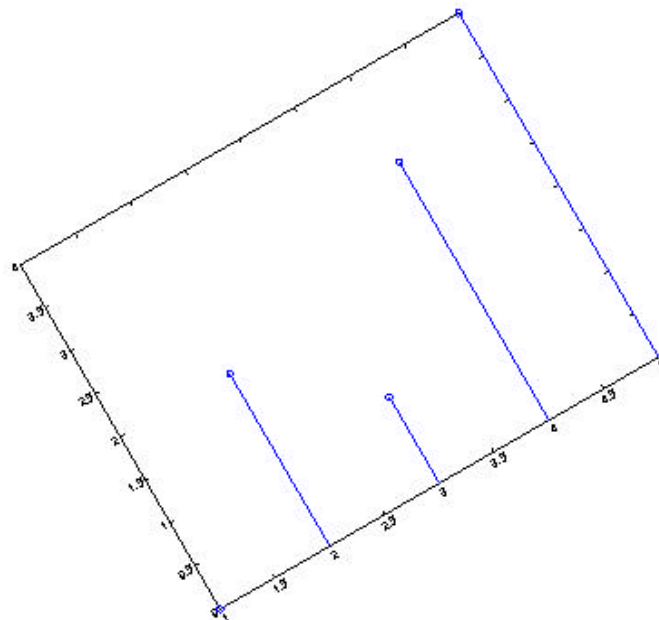

Figure 1.3. Fuel Metabolism

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To create a figure in *landscape* mode, *rotating* package should be included with **\usepackage{**rotating**}** command. Then, the figure is inserted between **\begin{**sidewaysfigure**}**, and **\end{**sidewaysfigure**}** commands. The figure given in Figure 1.2 can be created in landscape mode as given below, and the screen capture of it is shown in Figure 1.4.

```
--------Figure Example in Landscape Mode -------
\begin{sidewaysfigure}
\centering
\scalebox{0.5}
{\includegraphics{matlab.eps}}
\caption{Fuel Metabolism}
\label{fig:Lexm}
\end{sidewaysfigure}
-------------------------end--------------------
```


Figure 1.4. Fuel Metabolism
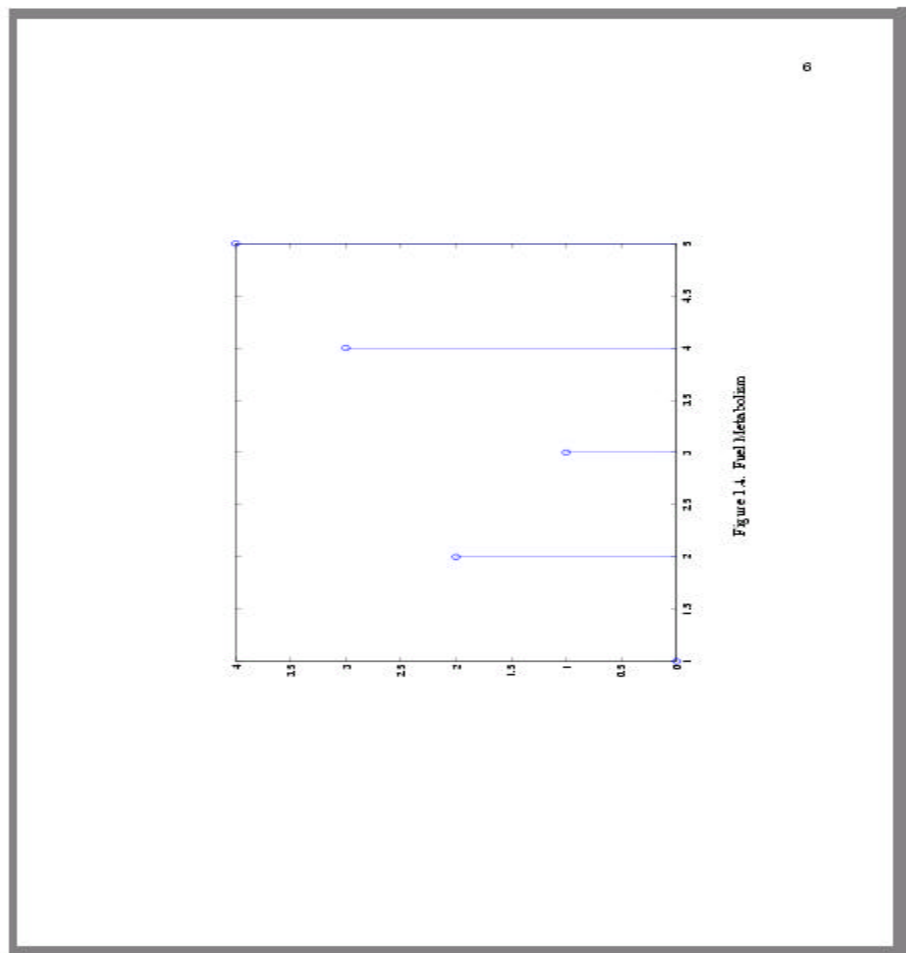
Creating Subfigures

To create subfigures, *subfigure* and *epsfig* packages should be included, i.e., **\usepackage{**subfigure**}** and **\usepackage{**epsfig**}**. These packages can be downloaded from the website: http://www.ctan.org. An example is given below with its output shown in Figure 1.5. It has particular captions "Big" and "Small", and it also has a global caption "Fuel Metabolism".

```
-------- Example with Subfigures ------------
\begin{figure}[h]
  \centering
\mbox{\subfigure[Big]{\epsfig{figure=matlab.eps,width=3in}}\quad
     \subfigure[Small]{\epsfig{figure=matlab.eps,width=2in}}}
 \caption{Fuel Metabolism}
  \label{fig:SubF}
\end{figure}
------------------------end-------------------
```
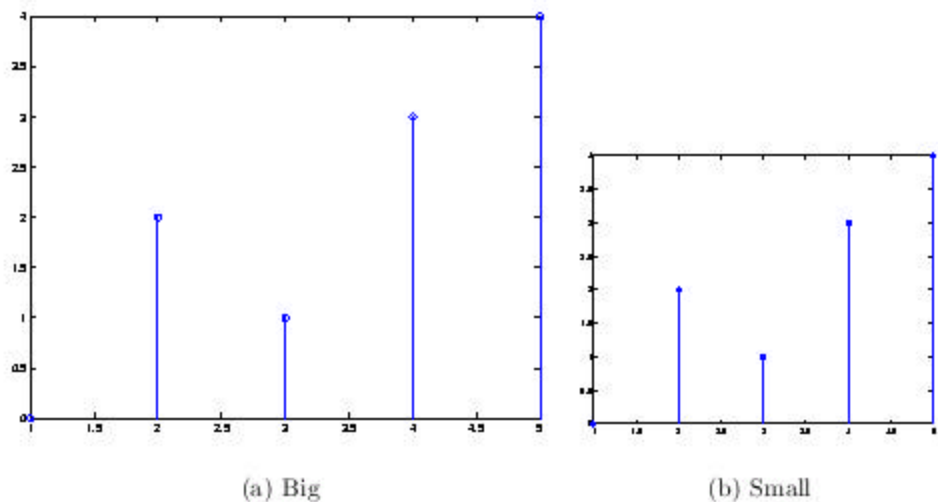

(a) Big   (b) Small

Figure 1.5. Fuel Metabolism