A Page Make-up Challenge

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The Problem

I have been involved with typesetting relatively complex mathematical and engineering textbooks using TeX since late 1982. These are books that are typically 5–600 pages long with an average of more than a figure per page. Further, the text is liberally endowed with large complex display equations and tables both normal and turned. TeX's page make-up abilities are woefully lacking for this application. This lack is perhaps understandable since Knuth's design goal was to develop a system capable of consistently and beautifully typesetting the volumes of the *Art of Computer Programming*. *Art of Computer Programming* volumes contain few, if any, figures, large display equations or turned tables in the text.

Publishers impose rather stringent page make-up requirements for figure placement in engineering, science and mathematical textbooks. Typical requirements in priority order are:

1. Numbered figures must be inserted in numerical sequence.

2. Numbered figures must be inserted after the first reference to the figure.

3. Numbered figures are to be placed flush left at the top or bottom of the page with minimum $1\frac{1}{2}$ pc and maximum $2\frac{1}{2}$ pc above and/or below the text.

4. Numbered figures should be visible from the first reference.

5. If page make-up places a numbered figure several pages after its first reference, then and only then, may it be placed *before* its first reference. However, it *must be visible* from its first reference.

Figure caption rules somewhat further complicate the problem. Examples for a standard 29 pc page width are:

1. Numbered figures 19 to 29 pc wide have the figure caption positioned flush left 1 pc below the figure × the page measure (hsize).

2. Numbered figures less than 19 pc wide have the figure caption positioned 1 pc to the right of the figure × the remainder of the page width and base-aligned with the figure.

3. Sequentially numbered figures less than 13 pc wide are placed side-by-side in 13 pc wide boxes separated by a 3 pc space. Figure captions are placed flush left 1 pc below each box.

Considering that TeX's output routines do not look ahead very well, it is easy to see that such page make-up rules seriously complicate the task of typesetting and making-up a book of this nature.

The Current Solution

In applications of this nature both Plain TeX's \topinsert and \midinsert commands are known not to work. Further, LaTeX's floating insert commands also do not work. Consequently, it is necessary to essentially do the page make-up by hand *using a computer*! The technique (TeXnique??) is conceptually simple and very labor intensive. The manuscript is broken up into 30–50 page segments within chapter boundaries (a chapter is assumed to always begin on a recto page). The segment is TeX'd. For the pages preceding the first figure reference, white space is inserted or deleted both to balance the length of facing pages and to keep the page length within acceptable limits. No, TeX does not always do it quite correctly, i.e. according to the page make-up rules. Immediately after the first figure reference, white space equal to the figure size is inserted along with the figure caption. If there is sufficient space at the bottom of the page containing the figure reference, called the current page, it is inserted there, if not, it is moved to the top of the next page.

To reiterate, conceptually this technique is quite easy; in practice it is quite difficult. Adding white space and the figure caption to the bottom of the current page must be done by measuring up from the bottom of the page, finding the exact end of line corresponding to the required figure space plus the space occupied by the figure caption and inserting the white space and figure caption at that point in the manuscript. To prevent TeX from reformatting the pages to this point a \vfill\eject is placed at the bottom of the previous page. This, of course, does not always work. TeX occasionally decides that the previous material is best presented with an incomplete last line! When this happens material must be moved — *word-by-word* — from the current page to ahead of the \vfill\eject on the previous page until the result is correct. A similar technique is used when the figure is placed at the top of a page. A combination of these techniques is used when both a top and bottom figure appear on the same page. The *fun* really begins when a page contains large display equations or large numbers of display equations and both top and

bottom figures. The result is a long, possibly nonconverging, iteration process.

As Reference 1 illustrates, doing a book of this type with TeX is quite possible. It is just a bit painful. Unfortunately, it is also not cost effective. Currently, it is less expensive for a book publisher to simply typeset the manuscript using TeX without including figure captions or spaces and use the traditional Xacto knife and glue pot page make-up technique. That offends me as I am sure it does you.

The Challenge

My initial thought was to simply write a \bottominsert macro similar to the \topinsert and \midinsert macros. However, discussions with output routine gurus at the recent Montreal TUG meeting have convinced me that this will not work, at least not very well.

The Challenge then is for the output macro gurus to write a figure placement macro that incorporates items 1–3 above (4 and 5 can be handled manually). The suggested calling sequence for the macro is

\figplace#1#2#3#4

where

#1 is the vertical dimension of the white space to be left for the figure.

#2 is the horizontal dimension of the white space to be left for the figure.

#3 is the figure number.

#4 is the figure caption.

The assumption is that a custom figure caption macro is used within the figure placement macro. A sample figure caption macro might be:

```
% define a figure caption macro.
% #1 is the figure number.
% #2 is the caption.
% the caption is to be set in a 'box'
%    left and right justified 1em to
%    the right of the figure number.
% the size of the box containing the word
%    Figure; its number and the 1em
%    skip are found in box0.
% box1 is \hsize less the width of box0.
% a \vtop is used along with an \halign
%    to obtain the flush left and right effect.
% \spaceskip is used to help in preventing
%    overfull lines.
```

```
\def\figcap#1#2{{%
  \setbox0=\hbox{{\bf Figure #1}\hskip 1em}%
  \setbox1=\vtop{%
    \advance \hsize by-\wd0 \noindent
    \spaceskip=.3em plus.2em minus.2em #2}%
  \halign{## & ## \cr
    \box0 & \box1 \cr}}%
\bigskip
}
```

Unfortunately, other commitments as well as my current level of expertise prevent me from attempting this job.

References

1. Rogers, David F. *Procedural Elements for Computer Graphics*, McGraw-Hill Book Co., New York, 1985.