

Specification for Common IEEE Styles

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(Invited Paper)

Abstract—Our premise is that a researcher should be able to use his or her time doing research, and not fighting with a text formatter. Modern formatters have macro capability. If the proper macros are written, the text formatting for all IEEE publications may be accomplished automatically. We propose that proponents of various text-processing systems write macro packages for their own systems. The scientific community would benefit greatly. One example is provided for users of the $\text{\LaTeX}$ system. It is available at <http://www-isl.stanford.edu/ieee/> or at the ftp site <ftp://isl.stanford.edu/pub/ieee/>. A similar macro package is being developed for users of Microsoft Word, and can be found at the world-wide-web addresses given in the Conclusion.

Index Terms—Style file, $\text{\LaTeX}$, Microsoft Word, IEEE Publications, Instrumentation and Measurement Technology Conference, IMTC.

I. INTRODUCTION

AN important aspect of research is the writing and submission of papers for publication. Depending on how the paper is to be published, there are various typesetting formats for various purposes, and it is frustrating and time-consuming to have to manually format a paper to follow all of the guidelines.

A much better solution is to have the formatting done automatically. Modern text processors and document-typesetting systems offer this possibility by allowing user-defined macro packages or style files. Sets of macros may be defined to automatically present a document in any required format. Only one person, or a team of people, has to write the macro package, and then the entire scientific community will benefit. The only question is how to make such styles globally available.

Each researcher has his or her own favorite text processor. We believe that if the proponents of the main text processors (e.g., $\text{\LaTeX}$, Microsoft Word, Framemaker, WordPerfect, and so forth¹) cooperate, such macro packages could be created. This would spare a lot of work for both the authors and the editors of the paper. By invoking different macros, the author could immediately transform the style of a document from a draft manuscript into a final camera-ready format, and so forth, without the need for manual formatting. In this document we summarize our expectations for such macro packages, and introduce a candidate solution for the $\text{\LaTeX}$ typesetting system. This package, which we call `ieee.cls`, replaces both the

old `IEEEtran.sty` by Murray and Balemi, and the updated `IEEEtran.cls` by Nüchter. A similar solution is currently being written for users of Microsoft Word.

II. THE DOCUMENT LIFE-CYCLE

Each document to be published, regardless of whether it is destined to be a journal article or a conference paper, goes through a certain life-cycle. At each stage of the life-cycle, there are different formatting needs. This may be summarized as follows:

Draft: The first stage in the life-cycle is the draft stage.

This is when the author is initially writing and editing the manuscript. The formatting of the document should help the author with this task. For example, the main text should be double-spaced, the margins should be wide enough to allow written comments, and a date-and-time stamp should be placed on each page to help with version control.

Internal Review: After the draft version is finalized, the next stage in the life-cycle might be to give the paper to one or more colleagues for review. This stage is an internal review process, as opposed to the formal review done upon submission to the IEEE (see the next stage). Suggestions and criticism at this stage can very much improve the quality of the paper and can save much time in getting the paper published. The formatting for an internal review is fairly flexible. One requirement is that the paper contain a phrase to the effect that the document is preliminary and should not be circulated without permission of the author(s). This can appear in the header or footer of the paper, for example.

Submission for Review: The next stage in the life-cycle is to submit the paper to the IEEE for formal review by anonymous reviewers. This review requires that the paper be formatted differently. In some cases, the title of the paper, and especially the authors' names, must be printed on a separate title page to ensure anonymity of the authors. Double-spacing of the main text is usually required, but not time stamps, and so forth.

Initial Distribution: While the document is submitted or "in-press," it is desirable to be able to distribute the preliminary version (e.g., on the world-wide-web) for the benefit of other researchers. This, once again, will stipulate a different format. The paper should indicate that it is "submitted" or "in-press," and is not the final version, to avoid confusion between the preliminary and eventual printed versions. The date is added on each page to further distinguish this from the final version.

Final Form: The IEEE uses its own software to format journal papers. The "final" mode of the proposed macro pack-

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¹ Microsoft Word is a trademark of Microsoft Corporation; Framemaker is a trademark of Frame Technology Corporation; WordPerfect is a trademark of Corel Corporation.

age will approximate the style of the published paper as closely as possible. This allows the researcher to estimate page lengths, and to appropriately break equations and scale figures and tables. Perhaps if a standard set of macro packages is developed, the IEEE may eventually adopt it, and then the final-mode would be exactly what is published!

For IEEE conferences, the author may (and often must) provide a camera-ready formatted copy of the paper. In this case, the “final” mode of the macro package produces exactly what is published.

Submission for Publishing: After the paper is accepted, and all the final corrections are made, it must be submitted for publishing. To submit a paper to an IEEE conference, the format of the paper is defined by the specifications used in the “Final Form” stage of the life-cycle. However, if the paper is to be submitted to a journal, there are different formatting requirements for the submitted document.

Final Distribution: After the paper is published, it is beneficial to have an electronic version of the paper (e.g., for distribution on the world-wide-web). This final version should have correct page numbers, the IEEE copyright information, the volume and issue number of the journal, and so forth.

Clearly, it is cumbersome to *manually* re-format a paper for all the stages of its life-cycle. We believe that a better solution is to use macro packages for individual text-processing systems which can automatically format a paper to certain specifications. The format of the paper is automatically changed by changing a single parameter. This is not a dream! This has all been implemented for one text-processing system (see Section IV), and our hope is that various readers and proponents of different text-formatting systems will volunteer to implement these specifications for their favorite text formatter. The entire research community will benefit from these efforts.

III. SPECIFICATIONS

In this section, we give specifications which we feel must be satisfied by a macro package to aid a researcher in preparing papers for publication. We have followed this list very closely when writing the example package `ieee.cls`.

A. Draft Manuscript

The draft mode is the format used while the author writes the manuscript. Its main characteristics are:

- Double spacing, single-column, and acceptably wide margins to allow room for comments and proofreaders' marks.
- A date-and-time stamp on each page to document the time of the printing for help with version control.
- When figures belong to the manuscript, the author may switch among the basic options:
 1. Figures are not printed, but the appropriate space is left in the manuscript.
 2. Figures are not printed, and the captions are included at the marked places with a small empty space.
 3. Figures are inserted into the manuscript.
 4. Figures are inserted one after the other at the end of the manuscript.

5. Figures are inserted, each on a separate page, at the end of the manuscript.

B. Internal Review

The formatting requirements for an internal review are fairly loose. The following are suggestions:

- The following text should be included: “Preliminary version for evaluation: Please do not circulate without the permission of the author(s)”
- The figures should be included in the text, rather than at the end of the document.
- The text should be double-spaced, single-column, with wide enough margins to allow for reviewers' corrections.
- The date should be added to the header of each page.

C. Submission for IEEE Formal Review

The following are desirable for submission to the IEEE:

- The printout would obligatorily be double-spaced, single-column.
- The figures should be placed at the end of the paper and should be identical to the figures to be submitted for publication if the paper is accepted.
- As some of the Transactions require a separation of the title page and the text to provide anonymity, this should be an option.
- The date of submission should be added on the title page and the second page if a separate title page is generated.

D. Transactions-like Printing for Evaluation and Length Measurement

This format should follow as precisely as practicable the format of the journal.

E. Submission for Publication in a Journal

This could be nearly identical to the case in Section III-C. A mark should be placed in the text to show about where each figure should go. Figures may optionally be printed at a larger scale to allow better photographic reproduction. The date of submission and possibly the editor's paper number should be added.

F. Camera-ready Form for Conference Submission

This is the only format that has a very strict and exactly defined layout. This layout will be defined separately for each conference, on the basis of the its author's guide.

G. Electronic Distribution (Initial and Final)

A hardcopy or electronic version of the paper can be useful for distribution during various stages in its life-cycle, but improper information in this distributed form can lead to misunderstanding. The format should provide some specific information.

- If the paper is currently submitted for review, the text “Submitted to (journal or conference name) for publication,” along with the date, should appear on the title page.
- If the paper has been accepted for publication, but is not yet printed, the text “Accepted for publication by (journal or conference name), (in-press)” should appear.

- In addition, for both of the above situations, the following text should be included: “Preliminary version: Please do not circulate without the permission of the author(s).”
- If the version is a reprint, the text “Reprinted from (journal or conference name)” should be included. Additionally, the page numbers should match the printed version, and the volume number, issue number and IEEE copyright information should be included.
- To facilitate the paper’s distribution on the world-wide-web, the height should be set in a way that it can be printed both on A4 and U.S. letter-size paper. A “full” A4 page cannot usually be printed in the United States; the top lines will be missing.

This form should allow a lot of freedom, such as one- or two-column formatting, the inclusion of a cover page, and so on.

IV. THE $\text{\LaTeX}2_{\epsilon}$ CLASS

One text-formatting package in common use by researchers is the $\text{\LaTeX}2_{\epsilon}$ system [1]. Some of its features include a very flexible macro capability, excellent formatting of mathematical equations, seamless integration of text into graphics (using the `psfrag.sty` package; see [2]), and affordable price (it’s free!).

Documents formatted with $\text{\LaTeX}2_{\epsilon}$ must belong to a certain “class.” A class file is a set of macros which tells $\text{\LaTeX}2_{\epsilon}$ how to format the document. For example, the standard classes which are available include an article class, a report class, a book class and a letter class.

For the purpose of writing IEEE papers, we have developed a special $\text{\LaTeX}2_{\epsilon}$ “class” file. Users of $\text{\LaTeX}$ probably know about `IEEEtran.sty`, written by Murray and Balemi. This style was originally devised for evaluation and length measurement, but it is close to meeting some of the above desires. It was written for the now-obsolete $\text{\LaTeX}2.09$, and has been modified for $\text{\LaTeX}2_{\epsilon}$ by Nüchter. The latter, called `IEEEtran.cls`, may be found on the IEEE world-wide-web site. It implements much of the functionality required for the “Final Form” stage of the document life-cycle. We found it helpful as a starting point for this project. Our modified version, called `ieee.cls`, satisfies all of the requirements for each stage of the document life-cycle.

A. Choosing the Paper’s Style

Documents written for $\text{\LaTeX}2_{\epsilon}$ are written as plain text. The $\text{\LaTeX}2_{\epsilon}$ system converts the text into formatted pages. To tell $\text{\LaTeX}2_{\epsilon}$ how to format your document, certain commands need to be entered into the text.

The `ieee.cls` class file makes this very easy. The first line of your document needs to specify a command of the form

```
\documentclass[main-mode,
               sub-mode,
               misc-options]{ieee}
```

where one “main-mode” is chosen from the following:

draft Double-spaced, single-column, with date and time stamp.

submission Double-spaced, suitable for submitting the paper for review, or for submitting the paper for publishing.

compressed Same as “submission,” only single-spaced. This is suitable for archival, internal review, and for some conference proceedings.

final For IEEE journals, this mode approximates the journal’s final form. For IEEE conferences, it formats the paper for a camera-ready printout.

The optional “sub-mode” is chosen from the following:

internal The internal sub-mode can modify either the “submission,” “compressed,” or “final” modes. It changes the header to notify the reader that this is an evaluation preprint, and not to be distributed.

submitted The submitted sub-mode can modify either the “compressed” or “final” modes. It changes the header to notify the reader that this paper has been submitted to a certain journal for publication, and that it is not to be distributed.

inpress The inpress sub-mode is similar to the submitted sub-mode. It can modify either the “compressed” or “final” modes. It changes the header to notify the reader that this paper has been accepted by a certain journal for publication, but that it has not yet been published. It specifies that the paper is not to be distributed.

reprint The reprint sub-mode can modify only the “final” mode. It changes the header to state that the paper is reprinted from a certain journal. It includes proper page numbers, IEEE copyright information and the IEEE log number.

technote When used in combination with “final,” this sub-mode produces a two-column technical note.

The optional “misc-options” are chosen from the following:

titlepage/notitlepage The titlepage option causes a separate title page to be produced. The notitlepage option (default) does not produce a separate title page.

anonymous By default, all author information is included in the typeset paper. However, if the “anonymous” option is selected, author information is omitted from the paper (except for on the optional title page). Author information is omitted from the title line on the first page of the paper and from the header on all pages. The author’s affiliation is omitted from the first page, and the author’s biography is also omitted. Anonymity may be required when submitting a paper for review.

invited If the paper is an invited paper (as this one is), the “invited” option prints (*Invited Paper*) under the authors’ names on the first page of the paper.

9pt, 10pt, 11pt, 12pt You may manually choose the paper’s type size. You should not need to do this since the “correct” size is automatically chosen. However, if you want, you may use these to change the type size of the main text. (“9pt” is a bit of a hack to retain backward-compatibility.)

narroweqnarray This fixes a $\text{\LaTeX}$ bug. The spacing around the “=” sign in equation arrays is changed to be the same as in displayed math.

inline Compresses the horizontal spacing of in-text math

equations. The authors think that the resulting equations look better than those normally produced by $\text{\LaTeX}$.

Already we can see the power of `ieee.cls`. By changing a single parameter in the first line of the document, the user can change the entire format of the paper!

B. Plug-Ins

The main `ieee.cls` file specifies the formatting required for a generic IEEE journal. However, some journals have their own formatting particularities. For example, journals of the IEEE Signal Processing Society have centered figure captions, and all other journals have left-justified captions. Journals of the IEEE Computer Society are formatted very differently from journals of all other societies. Furthermore, each conference has its own style.

Rather than burdening the main `ieee.cls` file with the definitions required for each journal, we have placed this task on small “plug-in” files designed to work with `ieee.cls`. For example, to format a document for the IEEE Transactions on Computers, specify (after the `\documentclass` command):

```
\usepackage{ieeetc}
```

Plug-in files are also used to format papers for conferences. The main mode of the paper should be “final,” and the conference style-file should be loaded. For example,

```
\usepackage{IEEEimtc}
```

specifies the style needed for the IEEE Instrumentation and Measurement Technology Conference.

At the moment, plug-in files exist for almost all of the IEEE journals (see the world-wide-web site mentioned in the Conclusion for up-to-date information on which are supported), but only a few conferences. However, as the use of the `ieee.cls` package increases, additional plug-ins will be created.

C. More Definitions

In addition to specification of the modes and options for the paper, several more things need to be defined. For a regular IEEE journal submission, define the journal name in the form

```
\journal{IEEE Trans.\ Something}
```

The journal name is used to compose the header for each page. To add any other information after the journal name, use `\titletext`. For example, to indicate the editor’s manuscript number on a preprint, you would type something like

```
\titletext{, TN\#9999.}
```

The date is printed in the header for certain combinations of document options (e.g., for the submission mode). If you would like to pre-date or post-date the article, type, for example,

```
\renewcommand{\today}{July 4, 1776}
```

To specify the IEEE copyright information on the first page of a reprint, type

```
\ieeecopyright{xxx--xxx/97\$10.00  
\copyright\ 1997 IEEE}
```

Reprints also contain either an “IEEE log number,” a “publisher item identifier,” or similar publishing information in the lower left column on the first page. This can be entered as

```
\lognumber{xxxxxxx}
```

or

```
\pubitemident{S xxxx--xxx(97)xxxx--x}
```

or

```
\loginfo{Manuscript received... }
```

To specify the first page of a reprint of a paper beginning on page 103 of a journal, you would type

```
\firstpage{103}
```

Finally, for a conference, the location and date are specified as, for example,

```
\confplacedate{Ottawa, Canada,  
May 19--21, 1997}
```

D. The Title Information

The title-and-author information for a paper is entered as follows. Define:

```
\title[Short Title]{Title of paper}  
\author[Short Names]{First  
Author\member{Student  
Member}\authorinfo{Department  
of Electrical Engineering\Some  
University, Somewhere CA,  
90210, USA}%  
\and{ }Second Author\member{Senior  
Member}\authorinfo{Department  
of Electrical Eng...}  
\and{ }and Third  
Author\member{Fellow}\authorinfo{...}  
}
```

The `\title` command may be used with or without the optional first parameter specified within square brackets. If the parameter is present, it is used as the title placed in the header on each page. Otherwise, the actual title is used for both the header and the title page.

Entering the author information is perhaps the most complicated part of using this class. However, if the above template is used, everything should work well. *Note that some types of documents ignore some of the author information.* For example, conference proceedings and technical notes do not print IEEE membership information.

As with the title command, there is an optional first parameter. If it is specified, it is used as the authors’ names for the header on every odd page of an final-mode manuscript, for example. Otherwise, no author information is printed in the header.

The membership status of an author is entered via the `\member` command, and the author’s affiliation is specified with the `\authorinfo` command. Note that the content required in the `\authorinfo` command tends to vary depending on whether the paper is for a conference or for a journal.

The number of manual changes are small, and must be done by a human anyway. The example given is for an IMTC conference.

Finally, note that the authors are separated by an `\and` command. This command *does not* insert the word “and” between author names, but allows $\text{\LaTeX}2_{\epsilon}$ to separate them intelligently. If the word “and” is required before the final author’s name, it must be inserted additionally.

The title page or lines are actually produced by the command

```
\maketitle
```

E. Document Preliminaries

Users of the old `IEEEtran.sty` style will find the rest of the instructions to be very familiar. The abstract is specified

```
\begin{abstract}
...
\end{abstract}
```

The keywords (or index terms) are specified via

```
\begin{keywords}
...
\end{keywords}
```

MANY of the IEEE journals typeset the first character to be two lines tall, as in this paragraph. Furthermore, the rest of the first word is set in capital letters. This can be done using the command

```
\PARstart Many of the IEEE...
```

JUST for fun, and perhaps to make your draft submissions look a little snazzy, you can also start the first paragraph with a calligraphic character by, for example,

```
\PARstartCal Just for fun...
```

The user should be aware that these larger characters may not be available on all systems, and $\text{\LaTeX}2_{\epsilon}$ may need to run METAFONT to generate them.

The main body of the paper is written according to standard $\text{\LaTeX}2_{\epsilon}$ convention. We should also mention that, as with the package `IEEEtran.cls`, theorems and proofs may be defined as in this example:

```
\newtheorem{theorem}{Theorem}
...
\begin{theorem}[Theorem name]
  Consider the system ...
\end{theorem}
\begin{proof}
  The proof is trivial.
\end{proof}
```

F. The End of the Paper

The references in the paper are formatted with $\text{BIB}\text{\TeX}$ via the special IEEE $\text{BIB}\text{\TeX}$ style file `IEEEbib.bst`. This file has not been modified by us, and may be found on the IEEE world-wide-web server. To use it, insert the following lines in your paper where the references are to be placed:

```
\bibliographystyle{IEEEbib}
\bibliography{filename}
```

where *filename.bib* is the name of the bibliography database file comprising all your $\text{BIB}\text{\TeX}$ entries. The $\text{\LaTeX}2_{\epsilon}$ manual explains how to use $\text{BIB}\text{\TeX}$ and how to create bibliography files.

Finally, regular journal papers should include the biographies of their authors. This may be done simply as shown in the following:

```
\begin{biography}{Istv\'{a}n Koll\'{a}r}
(M'87--SM'93--F'97) was born...
```

```
From September 1993 to June 1995, ...
\end{biography}
```

An optional first parameter specifies the file that contains the author’s “photograph.”

```
\begin{biography}[face.ps]{Gregory L.
Plett} (S'97) was born ...
\end{biography}
```

This can be especially useful for preprints and reprints of the document. If you do not specify this first parameter, a framed empty box is printed; however, any file that is recognized by `\includegraphics` may be used. The aspect ratio of the photograph should be approximately 25 by 32. If it is a few percent away from the desired aspect ratio, the picture is resized non-proportionally. Otherwise, it is shrunk proportionally to fit the space and is then placed, centered, in a box of the correct size; a warning message “Too wide/tall” is printed.

Note that a single blank line in the biography environment causes paragraph separation. But beware: Multiple blank lines in a row will leave a larger vertical space between paragraphs.

V. PUTTING IT ALL TOGETHER

To be perfectly clear, Fig. 1 summarizes the commands necessary to format a document using the `ieee.cls` file. The $\text{\LaTeX}2_{\epsilon}$ source for this paper is also available at the world-wide-web site mentioned in the Conclusion, furnishing a more complete example.

VI. FIGURES

Figures in the text require special attention. First, when submitting a paper for printing, it is often required that the figures and tables be at the end of the paper. This can be handled by the `endfloat.sty` package, which is part of the standard $\text{\LaTeX}2_{\epsilon}$ distribution.

The documentation for the “endfloat” package is somewhat daunting, but all that should be required is to specify

```
\usepackage{endfloat}
```

before the `\begin{document}` command in the paper. The default options should work well.

Whether or not you use the `endfloat.sty` package, encapsulated postscript (EPS) files may be included simply in the text by

```
\includegraphics{figname.eps}
```

```

\documentclass[final]{IEEE}

\begin{document}

\title[Specification for ...]{%
  Specification for ...}

\author[PLeTT AND KOLL\{'A}R]{%
  Gregory L. Plett\member{Student
  Member},\authorinfo{G.\ L.\
  Plett is ...}
  and Istv\{'a}n
  Koll\{'a}r\member{Fellow}\authorinfo{I.\
  Koll\{'a}r is ...}
}

\journal{IEEE Transactions on ...}

\maketitle

\begin{abstract}
Our premise...
\end{abstract}

\begin{keywords}
Style file...
\end{keywords}

\section{Introduction}
\PARstart An important aspect of...

\bibliographystyle{IEEEbib}
\bibliography{bib-file}

\begin{biography}{Gregory L. Plett} (S'97)
...
\end{biography}

\end{document}

```

Fig. 1. Input used to produce this paper.

Partial documentation for the `\includegraphics` command is available in the $\text{\LaTeX}2_{\epsilon}$ user's guide [1], [2], and complete documentation is available in `epslatex.ps`, included in the standard distribution of $\text{\LaTeX}2_{\epsilon}$. The reader should note that the new `\includegraphics` command supersedes the older style-packages `epsfig.sty` and `psfig.sty`, which are no longer required.

The reader may also wish to investigate the very powerful `psfrag.sty` package, which is again part of the standard distribution. It allows one to change labels in EPS files to use $\text{\LaTeX}$'s fonts, and it produces a very polished looking paper.

A. Figure Management with `ieeefig.sty`

Finally, we have developed another package to aid in figure preparation. It is called `ieeefig.sty`, and is especially suited for use with the `psfrag.sty` package. It provides a practical method to manage a large number of figures efficiently. It is designed to work with `IEEE.cls`, but will also work with all of the standard $\text{\LaTeX}2_{\epsilon}$ classes (e.g., for writing reports, writing books, or creating presentation transparencies). The `ieeefig.sty` package is loaded by specifying (after the `\documentclass` command)

```
\usepackage[options]{ieeefig}
```

The options will be discussed shortly.

To use the `ieeefig.sty` package, you must place each figure in its own $\text{\LaTeX}2_{\epsilon}$ file (e.g., *figname.tex*). The file *figname.tex* contains all of the commands necessary to produce the figure. These commands might include `\psfrag` commands to replace labels in an EPS file with $\text{\LaTeX}$ formatted text, and the command necessary to load the EPS file.

The figure is included in the text of the paper via the following commands:

```

\begin{figure}
  \figdef[dim]{figname}
  \caption{This figure...}
  \label{fig:figname}
\end{figure}

```

It is automatically centered in its column. (The optional argument in square brackets, "dim," is the vertical size of the figure. It defines the amount of vertical space to be skipped if the "blank" option is used.)

Through separation of the figure-generating commands from the main paper, the figure is portable and may be re-used in other papers, reports or presentations. It also permits `ieeefig.sty` to perform some useful tasks. These tasks are controlled either by the options used when loading the style or by a series of commands. The available options may be chosen from the following:

draft Displays the filename *figname.tex* in the margin. Also displays the height of the figure. In this way, you can determine the correct value of the optional argument "dim" of the `\figdef` command.

final Does not display the filename or height of the figure.
blank Instead of displaying figures, `\figdef` will leave a vertical space on the page. The height of the vertical space is specified by the optional argument "dim" of the `\figdef` command. By omitting figures, you will allow $\text{\LaTeX}2_{\epsilon}$ to compile your document more quickly. This option may also be selected in the document by the command `\draftfigstrue`.

noblank This is the complement of the **blank** option. Figures are shown. This option may also be selected in the document via the command `\draftfigsfalse`.

frame This option causes each figure to be surrounded by a box, which can help determine whether the bounding box on an EPS file is correct. The bounding box often must be adjusted if the `psfrag.sty` package is being used and labels go outside the boundary of the figure. If the bounding box is incorrect, the figure will not be centered properly, and the spacing before and after the figure will be incorrect. To adjust the bounding box, see the `trim` command below. This option may also be selected in the document using the command `\figframestrue`.

noframe Frames are not drawn around figures. This option may also be selected in the document through the command `\framefigsfalse`.

If EPS files are being loaded in the *figname.tex* file, they should be loaded using the command

`\inserteps[trim=a b c d]{figname.eps}`

This command inserts the EPS file *figname.eps* at the correct scale. It also adjusts the bounding box by trimming off *a*, *b*, *c*, and *d* points from the left, bottom, right and top edges of the figure, respectively. Negative trim amounts increase the size of the bounding box. If any `\psfrag` statements have been made for this figure, they will take effect with this command.

Finally, to scale all EPS figures by a constant “num” use

`\setfigscale{num}`

This is very useful for specifying different scales for presentation transparencies and for reports. If the `\setfigscale` command is in the main paper text, then it applies to all figures from that point in the paper onward. If it is inside of an individual *figname.tex* file, then it applies only to that figure.

VII. WISH LIST FOR `ieee.cls`

The $\text{\LaTeX}2_{\epsilon}$ class package, `ieee.cls`, used in conjunction with the `endfloat.sty` and `ieeefig.sty` packages provides nearly all the desired functionality of a package to format IEEE papers. Several things remain outstanding, however.

The biggest omission is that “plug-ins” exist for only a few conferences. We hope that researchers who have developed styles for other IEEE conferences will modify their styles to fit within the `ieee.cls` framework, and will then contribute their work to the scientific community.

A more subtle issue is that none of the two-column modes balance the columns on the last page of the paper. The standard package `multicol.sty` may be able to help, but it apparently does not allow single-column figures and tables. Perhaps some $\text{\TeX}$ pert out there can fix this. Right now, the only work-around is for the user to manually insert a `\newpage` at the appropriate place to try to balance the columns on the last page of the paper. This is a poor solution at best.

Finally, the multi-blank-line bug in the biography environment should be fixed. Until it is, the work-around is to be careful to leave only a single blank line between paragraphs.

VIII. CONCLUSION

We have outlined a specification for macro packages to aid an author of papers for IEEE publications. Additionally, we have provided a $\text{\LaTeX}2_{\epsilon}$ class which accomplishes most of these goals. Users of other text-formatting systems are encouraged to write similar macro packages for the benefit of the research community. Anyone interested in this task should contact the second author via e-mail.

The $\text{\LaTeX}2_{\epsilon}$ class, which was used as an example here, is provided on an “as-is” basis at

<http://www-is1.stanford.edu/ieee/>

or at

<ftp://isl.stanford.edu/pub/ieee/>

Any bug report is welcome, especially if accompanied by the solution! Reports should be made, via e-mail, to the first author.

A similar macro package is under development for users of Microsoft Word. It is available at

<http://www.ifm.liu.se/Meastech/Bjorn/IMTC.html>

At the present time, it is able to format papers for the IEEE Instrumentation and Measurement Technology Conference. References to both packages can also be found on the IM Society page

<http://www.ieee.org/society/im/im.htm>

We hope that this paper sparks interest and imagination. We also hope that the $\text{\LaTeX}2_{\epsilon}$ and Microsoft Word classes save many researchers much work.

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- [1] Leslie Lamport, *A Document Preparation System: $\text{\LaTeX}$ User's Guide and Reference Manual*, Addison-Wesley, Reading, MA, 2nd edition, 1994. Be sure to get the updated version for $\text{\LaTeX}2_{\epsilon}$!
- [2] Michel Goossens, Frank Mittelbach, and Alexander Samarin, *The $\text{\LaTeX}$ Companion*, Addison-Wesley, Reading, MA, 1994.



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