IEEE Photonics Author Submission Guide: Setting up your LaTeX 2ε Files

Abstract: This article describes how to use the IEEEphot class with LaTeX to produce papers that are suitable for submission to the Institute of Electrical and Electronics Engineers (IEEE). IEEEphot class is based on IEEEtran class file, which has been updated for the different layout of IEEE Photonics.

Index Terms: Class, IEEEphot, LaTeX, paper, style, template, typesetting.

1. Introduction

Authors may choose to submit their papers to *IEEE Photonics* in LaTeX 2ε. The layout design for *IEEE Photonics* has been implemented as a LaTeX 2ε class file. The `IEEEphot` class file is based on the `IEEEtran` class file.

It is assumed that the reader has at least a basic working knowledge of LaTeX. Those so lacking are strongly encouraged to read some of the excellent literature on the subject. General support for LaTeX-related questions can be obtained via the Internet newsgroup `comp.text.tex`.

Commands that differ from the standard LaTeX interface, or that are provided in addition to the standard interface, are explained in this guide. This guide is not a substitute for the LaTeX manual itself. Authors planning to submit their papers in LaTeX are advised to use `IEEEphot.cls` as early as possible in the creation of their files.

Authors using LaTeX to create PDF files with smooth fonts are advised to read Adobe FaxYI Document Number 131303 by Kendall Whitehouse. Type 1 PostScript versions of the Computer Modern fonts are now freely available and are normally installed with new TeX/LaTeX software.

Please place any additional command definitions at the very start of the LaTeX file, before the `\begin{document}`. For example, user-defined `\def` and `\newcommand` commands that define macros for technical expressions should be placed here. Other author-defined macros should be kept to a mininum. Please do not customize the IEEE Photonics macros or class file, or redefine macros that are already in the class file, and please do not include additional definitions unless they are actually used in the paper.

1.1. The IEEEphot Document Class

The use of LaTeX document classes allows a simple change of class to transform the appearance of your document. The `IEEEphot` class file preserves the standard LaTeX interface such that any document that can be produced using the standard LaTeX `article` class can also be produced with the `IEEEphot` class file.

It is likely that the make up will change after file submission. For this reason, we ask you to ignore details such as slightly long lines, page stretching, or figures falling out of synchronization, because these details can be dealt with at a later stage. Use should be made of symbolic references (`\ref`) in order to protect against late changes of order, etc.

1.2. Using the IEEEphot Class File

If the file `IEEEphot.cls` is not already in the appropriate system directory for LaTeX files, either arrange for it to be put there or copy it to your working directory. The `IEEEphot` document class is implemented as a complete class, *not* a document style option. In order to use the IEEE Photonics document class, replace `article` by `IEEEphot` in the `\documentclass` command at the beginning of your document:

```
\documentclass{article}
```

is replaced by

```
\documentclass{IEEEphot}
```

2. Class Options

There are a number of class options that can be used to control the overall mode and behavior of IEEEphot. These are specified in the traditional LaTeX way.

2.1. 9pt, 10pt, 11pt, 12pt

There are four possible values for the normal text size. 10pt is used by the vast majority of papers.

2.2. draft, draftcls and final

IEEEphot provides draft mode as well as the normal final mode. The draft mode provides a larger (double) line spacing to allow for editing comments as well as extra margins on all four sides of the paper. The standard draft option puts every package used in the document into draft mode. With most graphics packages, this has the effect of disabling the rendering of figures. If this is not desired, one can use the draftcls option instead to yield a draft mode that will be confined within the IEEEphot class so that figures will be included as normal.

2.3. oneside, twoside

These options control whether the layout follows that of single-sided or two-sided (duplex) printing. Because the side margins are normally centered, the main notable difference is in the format of the running headings.

3. The Title Page

The parts of the document unique to the title area are created using the standard LaTeX command `\maketitle`. Before this command is called, the author must declare all of the text objects that are to appear in the title area.

3.1. PaperTitle

The paper title is declared as follows:

```
\title{Volume Extreme Ultraviolet Holographic Imaging\\
With Numerical Optical Sectioning}
```

in the standard LaTeX manner. Line breaks(`\\`) may be used to equalize the length of the title lines.

3.2. Author Names

The name and associated information is declared with the `\author` command. A typical `\author` command is like this:

```
\author{P.~W.~Wachulak,~\IEEEmembership{Member,~IEEE},
M.~C.~Marconi,~\IEEEmembership{Senior Member,~IEEE},
R.~A.~Bartels,\\
```

```
C.~S.~Menoni,~\IEEEmembership{Fellow, IEEE}, J.~J.~Rocca}

\affil{NSF ERC for Extreme Ultraviolet Science \& Technology and
Department of Electrical and Computer\\
Engineering, Colorado State University, Fort Collins 80521 USA}
```

The `\IEEEmembership` command is used to produce the italic font that indicates the authors' IEEE membership status. However, if needed, regular line breaks (`\\`) can be used within `\author`. In order to get proper line breaks and spacing, it is important to correctly use and control the spaces within `\author`. Use nonbreaking spaces(~) to ensure that name/membership pairs remain together.

3.3. Running Headings

The running headings are declared with the `\markboth{}{}` command. The first argument contains the journal name information and the second contains the author name and paper title. For example:

```
\markboth{IEEE Photonics Journal}{%
Wachulak et al.: Volume Extreme Ultraviolet Holographic Imaging}
```

3.4. DOI Information

The DOI information is placed within the `\doiinfo` command:

```
\doiinfo{DOI: 10.1109/JPHOT.2009.2011111\\
0018-9448/\$25.00 \copyright 2009 IEEE}%
```

3.5. Maketitle

At the beginning of your article, the title should be generated in the usual way using the `\maketitle` command.

3.6. Receivedinfo

The `receivedinfo` is generally the first part of a paper after `\maketitle`.

```
\maketitle

\begin{receivedinfo}%
Manuscript received March 3, 2008;
revised November 10, 2008.
First published December 10, 2008.
Current version published February 25, 2009.
This research was sponsored by the National ... National Science Foundation.
\end{receivedinfo}
```

3.7. Abstract and Index Terms

The abstract text is placed within the `abstract` environment, followed immediately by the key words (index terms) enclosed in a `keywords` environment:

```
\begin{abstract}
Three-dimensional images were obtained using a single high
numerical aperture hologram recorded in a high-resolution
photoresist with a table top $\alpha = 46.9$ nm laser...
\end{abstract}

\begin{IEEEkeywords}
Holography, image analysis.
```

```
\end{IEEEkeywords}
```

4. Sections

Sections and their headings are declared in the usual LaTeX fashion via the following commands:

```
\section
\subsection
\subsubsection
\paragraph
```

5. Citations

Citations are formed with the `\cite` command as usual. IEEEphot will produce citation numbers that are individually bracketed in IEEE style. ("[1], [5]" as opposed to the more common "[1, 5]" form.) The base IEEEphot does not sort or produce compressed "ranges" when there are three or more adjacent citation numbers. However, IEEEphot predefines some format control macros to facilitate easy use with Donald Arseneau's cite.sty package [1]. So, all an author has to do is to call cite.sty:

```
\usepackage{cite}
```

and the adjacent citation numbers will automatically be sorted and compressed (ranged) IEEE style. (Of course, multiple adjacent citations should always all be declared within a single `\cite`, comma separated, for this to work.)

`\cite` also allows for an optional note (e.g., `\cite[Th.7.1]{mshell01}`). If the `\cite` with note has more than one reference, the note will be applied to the last of the listed references. It is generally desirable that if a note is given, only one reference should be listed in that `\cite`.

6. Equations

Equations are created using the traditional equation environment:

```
\begin{equation}
\label{eqn_example}
x = \sum\limits_{i=0}^{z} 2^{i}Q
\end{equation}
```

which yields

$$x = \sum_{i=0}^{z} 2^{i} Q \tag{1}$$

Use the displaymath environment instead if no equation number is desired. When referring to equations, articles in IEEE publications do not typically use the word "equation," but rather just enclose the equation number in parentheses, e.g.,

```
... as can be seen in (\ref{eqn_example}).
```

6.1. Multiline Equations

As `IEEEphot` class is based on `IEEEtran`, so it provides the same commands for multiline equations which are available in `IEEEtran` class. For example:

```
\setlength{\arraycolsep}{0.0em}
\begin{eqnarray}
Z&{}={}&x_1 + x_2 + x_3 + x_4 + x_5 + x_6 \nonumber\\
&&+a + b\\
```

TABLE I
MATH SPACINGS USED BY LATEX

Size	Width	Cmd.	Used for	Example
small	1/6 em	\,	symbols	ab
medium	2/9 em	\:	binary operators	$a+b$
large	5/18 em	\;	relational operators	$a=b$
negative small	−1/6 em	\!	misc. uses	ab

```
&&+{}a + b\\
&&{}+a + b\\
&&{+}\:a + b
\end{eqnarray}
\setlength{\arraycolsep}{5pt}
```

which yields

$$Z = x_1 + x_2 + x_3 + x_4 + x_5 + x_6$$
$$+a + b \tag{1}$$
$$+a + b \tag{2}$$
$$+\,a + b \tag{3}$$
$$+\,a + b \tag{4}$$

7. Floating Structures

Authors should keep in mind when choosing an appropriate optional placement argument for the figure/table environments that most IEEE journals strongly favor the positioning of floats to the top of the page and rarely, if ever, use bottom floats.

7.1. Figures

Figures handled in the standard LaTeX manner. For example:

```
\begin{figure}[t]
\centering
\includegraphics[width=21pc]{mouse}
\caption{(a) Diagram of the experimental setup.
(b) Detail of the test object used.}
\label{fig_env}
\end{figure}
```

Note that (1) figures should be centered via the LaTeX `\centering` command—this is a better approach than using the center environment which adds unwanted vertical spacing; (2) the caption follows the graphic; and (3) any labels must be declared after (or within) the caption command.

When referring to figures in typical IEEE papers, authors should use the abbreviation “Fig.”, but if you want to use the full word “Figure”. IEEEphot provides the string macro `\figurename` which contains the correct name to use for the given formatting mode.

The `\includegraphics` command is the modern, preferred way of including images and provides a flexible interface that makes it easy to scale graphics to size. To use it, the graphics or graphicx (the latter is recommended) must first be loaded.

It is strongly recommended that authors be familiar with the graphics package documentation [3] as well as Keith Reckdahl’s excellent Using Imported Graphics in LaTeX [4]. The reader is reminded

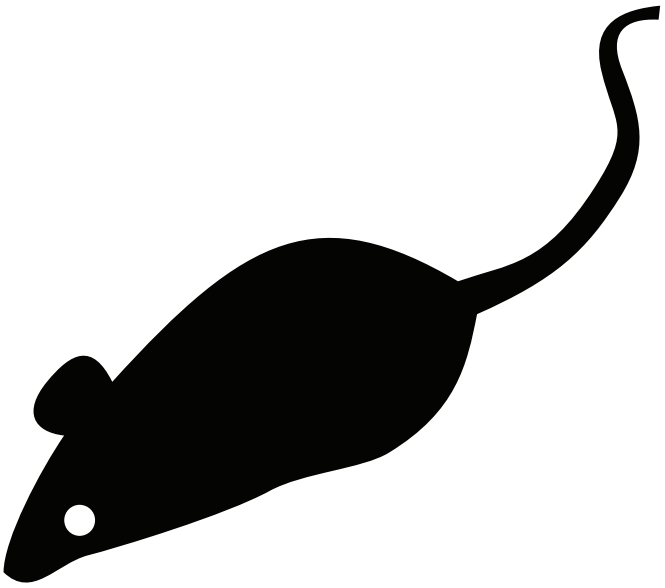

Fig. 1. (a) Diagram of the experimental setup. (b) Detail of the test object used.

that the “draftcls”, not “draft”, class option must be selected in order to get draft papers with visible figures.

Encapsulated PostScript (EPS) or Portable Document Format (PDF) is the preferred graphics format for LaTeX work. Furthermore, the user’s drawing/graphing application should be capable of outputting directly in EPS (or PDF) vector form (which will not degrade or pixelize when magnified)—although photos will likely have to be in (EPS/PDF) bitmap form.

7.2. Tables

Tables are handled in a similar fashion, but with a few notable differences. For example, the code results in Table II is as follows:

```
\begin{table}[!t]
\renewcommand{\arraystretch}{1.3}
\caption{A Simple Example Table}
\label{table_example}
\centering
\begin{tabular}{c||c}
\hline
\bfseries First & \bfseries Next\\
\hline\hline
1.0 & 2.0\\ \hline
\end{tabular}
\end{table}
```

Note that IEEE places table captions before the tables. Within the table environment, the default text size is footnotesize which is what IEEE typically uses for tables. When using the tabular environment to construct tables, it is usually a good idea to increase the value of `\arraystretch` above unity to “open up” the table rows a tad. Also, IEEE often uses tables with “open sides,” (without vertical lines along each side) although the “closed side” form (e.g., Table I) is more commonly used for the tables within this document.

TABLE II
A SIMPLE EXAMPLE TABLE

First	Next
1.0	2.0

Unfortunately, the standard LaTeX tabular environment has a number of shortcomings. Two notable problems are: 1) the corners where lines meet are improperly formed and 2) it is not very flexible in terms of user control. For these reasons, authors are urged to look into some of the other packages for making tables. A good one that provides revised "drop-in replacements" for both the tabular and array environments is Frank Mittelbach's and David Carlisle's array package [5]. Even more powerful (and complex) are the tabular and array environments provided by the mdwtab.sty package which is part of MarkWooding's MDW Tools [2].

As an alternative, IEEEphot offers the IEEE eqnarraybox command, which can also be used to produce tables of high quality.

8. Lists

8.1. Itemize

The itemized lists will normally automatically calculate the width of whatever symbol the current list level is using, so that a user can just call `\begin{itemize}...\end{itemize}` without doing anything special. Furthermore, the autolabelwidth feature will work properly even if `\labelitemX` has been redefined (where "X" indicates "i, ii, ... iv", whichever is appropriate) before the list begins. However, if any item symbols are to be specified via `\item[X]` (this is rare and may well be nonstandard as far as IEEE related work is concerned), then the following form can be used:

```
\begin{itemize}[\IEEEsetlabelwidth{Z}]
\item[X] blah
\item[Y] blah
.
.
\end{itemize}
```

where "Z" is the longest label in the list.

8.2. Enumerate

The important thing to note about enumerated lists is that the `\labelwidth` will default to the length of "9)" in the normal size and style. Therefore, the width of the longest label will have to be manually specified if any of the following conditions are true:

1) a top level list has more than nine items;
2) a relevant `\labelenumX` or `\theenumX` has been redefined;
3) `\item[X]` has been used to manually specify labels;
4) the labels are using a font that is not the normal size and style;
5) the enumerated list is nested (i.e., not at the top level) and is therefore not using Arabic digits as labels.

For example:

```
\begin{enumerate}[\IEEEsetlabelwidth{12)}]
\item blah
\item blah
.
.
```

```
% 12 items total
\end{enumerate}
```

8.3. Description

Generally speaking, the longest label width will always have to be specified for description lists. Furthermore, the author may wish to use `\IEEEmathlabelsep` for `\labelsep` when building a math symbol list. For example:

```
\begin{description}[\IEEEsetlabelwidth{$\alpha\omega
\pi\theta\mu$}\IEEEusemathlabelsep]
\item[$\gamma\delta\beta$] Is the index of..
\item[$\alpha\omega\pi\theta\mu$] Gives the..
.
.
\end{description}
```

Sometimes it can be difficult to ascertain from inspection which of the labels is the longest. For such cases, a little diagnostic code may be helpful to measure a length and then to display the result on the console:

```
\newlength{\mydiaglen} % put in preamble
.
.
\settowidth{\mydiaglen}{$\alpha\beta\gamma$}
\showthe\mydiaglen
```

9. Theorems and Proofs

Theorems and related structures such as axioms, corollaries, and lemmas, are handled in the traditional LaTeX fashion. The user must first declare the structure name via the

```
\newtheorem{struct_type}{struct_title}[in_counter]
```

command where `struct_type` is the user chosen identifier for the structure, `struct_title` is the heading that is used for the structure, and `in_counter` is an optional name of a counter whose number will be displayed with the structure number and whose update will reset the structure counter. Most IEEE papers use sequential theorem numbering throughout the entire work, so an `in_counter` is usually not specified. However, those papers that do use `in_counter` usually use "section" such that the section number is the first part of each theorem number. After the structure is defined, it can be used via

```
\begin{struct_type}[extra_title]
.
.
\end{struct_type}
```

where `extra_title` is an optional name that is displayed with the structure. For example, the most common way to handle theorems would be to use

```
\newtheorem{theorem}{Theorem}
```

followed, as needed, by environments like

```
\begin{theorem}[Einstein-Podolsky-Rosenberg]
```

Sometimes it is desirable that a structure share its counter with another structure. This can be accomplished by using the alternate form of \newtheorem

```
\newtheorem{struct_type}[num_like]{struct_title}
```

where num_like is the name of an existing structure.

IEEE theorem numbers are prefixed by the section number they were defined in (e.g., 2.5). This presents a difficulty with appendixes (especially when numbered with Roman numerals) because the theorem numbers will not be unique. To remedy this, within Roman-numbered appendixes, IEEEphot will add an “A” prefix (e.g., A2.5). For Alpha number appendixes, theorem numbering is more straightforward (e.g., A.5, B.5, etc.). For a single appendix, a constant “A” prefix is used (e.g., A.5).

9.1. Proofs

Proofs are easily handled by the predefined IEEEproof environment:

```
\begin{IEEEproof}
.
.
\end{IEEEproof}
```

The Q.E.D. symbol ”■” is automatically placed at the end of each proof. If needed, the symbol can be manually accessed via the \IEEEQED command. Both the closed (default) ”■” and open ”□” forms are provided as \IEEEQEDclosed and \IEEEQEDopen, respectively. To change the default from closed to open (some journals and/or authors prefer the open form), just redefine \IEEEQED as desired:

```
\renewcommand{\IEEEQED}{\IEEEQEDopen}
```

IEEEproof also supports an optional argument that allows the default string ”Proof” to be overridden:

```
\begin{IEEEproof}[Proof of Theorem \ref{thm:my}]
```

10. End Sections

10.1. Appendixes

The \appendix command is used to start a single appendix. An optional argument can be used to specify a title:

```
\appendix[Proof of the Zonklar Equations]
```

After issuing \appendix, the \section command will be disabled and any attempt to use \section will be ignored and will cause a warning message to be generated. (The single appendix marks the end of the enumerated sections and the section counter is fixed at zero—one does not state “see Appendix A” when there is only one appendix, instead “see the Appendix” is used.) However, all lower \subsection commands and the \section* form will work as normal as these may still be needed for things like acknowledgments.

\appendices is used when there is more than one appendix section. \section is then used to declare each appendix:

```
\section{Proof of the First Zonklar Equation}
```

The mandatory argument to section can be left blank (\section{}) if no title is desired. It is important to remember to declare a section before any additional subsections or labels that refer to section (or subsection, etc.) numbers. As with \appendix, the \section* command and the lower \subsection commands will still work as usual.

There are two appendix numbering conventions used by IEEE. Capital letters (e.g., "Appendix B") and Roman numerals (e.g., "Appendix II"). The former appears to be more popular and is the IEEEphot default. Use the IEEEphot class option romanappendices to get Roman numbered appendices.

Some authors prefer to have the appendix number to be part of equation numbers for equations that appear in an appendix. This can be accomplished by redefining the equation numbers as

```
\renewcommand{\theequation}{\thesection.\arabic{equation}}
```

before the first appendix equation. For a single appendix, the constant "A" should be used in place of 10.

10.2. Acknowledgments

Acknowledgments and other unnumbered sections are created using the `\section*` command:

```
\section*{Acknowledgment}
\addcontentsline{toc}{section}{Acknowledgment}
```

The second, optional, command is needed to manually add such sections to the table of contents (which is rarely used, but some authors may do so with draft papers) as well as the document's PDF bookmarks (if using hyperref.sty).

10.3. Bibliographies

Bibliographies are most easily (and correctly) generated using the IEEEtran BIBTEX package [7] which is easily invoked via

```
\bibliographystyle{IEEEtran}
\bibliography{IEEEabrv,mybibfile}
```

See the IEEEtran BIBTEX package documentation for more information.

When submitting the document source (.tex) file to external parties, it is strongly recommended that the BIBTEX .bbl file be manually copied into the document (within the traditional LaTeX bibliography environment) so as not to depend on external files to generate the bibliography and to prevent the possibility of changes occurring therein.

References

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