

# Preparation of Papers for IEEE TRANSACTIONS ON MEDICAL IMAGING

First A. Author, *Fellow, IEEE*, Second B. Author, and Third C. Author, Jr., *Member, IEEE*

## Abstract—

## Index Terms—

### I. INTRODUCTION

THIS document is a template for L<sup>A</sup>T<sub>E</sub>X. You are encouraged to use it to prepare your manuscript. If you are reading a paper or PDF version of this document, please download the L<sup>A</sup>T<sub>E</sub>X.zip file from the IEEE Web site at <https://www.embs.org/tmi/authors-instructions/> to prepare your manuscript. You can also explore using the Overleaf editor at <https://www.overleaf.com/blog/278-how-to-use-overleaf-with-ieee-collabratec-your-quick-guide-to-getting-started#xsVp6tpPkrKM9>

### II. GUIDELINES FOR MANUSCRIPT PREPARATION

Do not change the template font sizes or line spacing to squeeze more text into a limited number of pages. The preferred font is 10-pt Times New Roman. Use italics for emphasis; do not underline words.

Place your figures in the text as you expect them to appear in print. Further instructions on figure usage appear in Section VI. Although IEEE will do the final formatting of your paper, we expect you to approximate the final form appearance for all versions submitted to TMI via ScholarOne® to the extent possible.

#### A. Abbreviations and Acronyms

Define abbreviations and acronyms the first time they are used in the text, even after they have already been defined in the abstract. Abbreviations such as IEEE, SI, ac, and dc do not have to be defined. Abbreviations that incorporate periods should not have spaces: write “C.N.R.S.,” not “C. N. R. S.” Do not use abbreviations in the title unless they are unavoidable (for example, “IEEE” in the title of this article).

This paragraph of the first footnote will contain the date on which you submitted your paper for review. It will also contain support information, including sponsor and financial support acknowledgment. For example, “This work was supported in part by the U.S. Department of Commerce under Grant BS123456.”

The next few paragraphs should contain the authors’ current affiliations, including current address and e-mail. For example, F. A. Author is with the National Institute of Standards and Technology, Boulder, CO 80305 USA (e-mail:author@boulder.nist.gov).

S. B. Author, Jr., was with Rice University, Houston, TX 77005 USA. He is now with the Department of Physics, Colorado State University, Fort Collins, CO 80523 USA (e-mail: author@lamar.colostate.edu).

T. C. Author is with the Electrical Engineering Department, University of Colorado, Boulder, CO 80309 USA, on leave from the National Research Institute for Metals, Tsukuba, Japan (e-mail: author@nrim.go.jp).

#### B. Other Recommendations

Use one space after periods and colons. Hyphenate complex modifiers: “zero-field-cooled magnetization.” Avoid dangling participles, such as, “Using (1), the potential was calculated.” It is not clear who or what used (1). Write instead, “The potential was calculated by using (1),” or “Using (1), we calculated the potential.”

Use a zero before decimal points: “0.25,” not “.25.” Use “cm<sup>3</sup>,” not “cc.” Indicate sample dimensions as “0.1 cm × 0.2 cm,” not “0.1 × 0.2 cm<sup>2</sup>.” The abbreviation for “seconds” is “s,” not “sec.” Use “Wb/m<sup>2</sup>” or “webers per square meter,” not “webers/m<sup>2</sup>.” When expressing a range of values, write “7 to 9” or “7–9,” not “7~9.”

A parenthetical statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.) In American English, periods and commas are located within quotation marks, like “this period.” Other punctuation is placed “outside”! Avoid contractions; for example, write “do not” instead of “don’t.” The serial comma is preferred: “A, B, and C” instead of “A, B and C.”

If you wish, you may write in the first person singular or plural form using the active voice (“I observed that . . .” or “We observed that . . .” instead of “It was observed that . . .”). Remember to check spelling. If your native language is not English, please have a native English-speaking colleague to carefully proofread your paper.

### III. MATH

#### A. Equations

Number equations consecutively with equation numbers in parentheses flush with the right margin, as appears in (1). Refer to “(1),” not “Eq. (1)” or “equation (1),” except at the beginning of a sentence: “Equation (1) is . . .” To make your equations more compact, you may use the solidus (/), the exp function, or appropriate exponents. Use parentheses to avoid ambiguities in denominators. Punctuate equations when they are part of a sentence, as in

$$E = mc^2. \quad (1)$$

Be sure to define the symbols in your equation before the equation appears or immediately following. Italicize symbols (*T* might refer to temperature, but *T* is the unit tesla).

## B. $\text{\LaTeX}$ -Specific Advice

Use “soft” (e.g., `\eqref{Eq}`) cross references instead of “hard” references (e.g., (1)). This will make it possible to combine sections, add equations, or change the order of figures or citations without having to manually change equation references.

Do not use the `{eqnarray}` equation environment. Use `{align}` or `{IEEEeqnarray}` instead. The `{eqnarray}` environment leaves unsightly spaces around relation symbols.

Note that the `{subequations}` environment in  $\text{\LaTeX}$  will increment the main equation counter even when there are no equation numbers displayed.

$\text{\LaTeX}$  only functions in conjunction with local .bib files. If you use  $\text{\LaTeX}$  to produce the bibliography you must attach the .bib files.

$\text{\LaTeX}$  can’t read your mind. If you assign the same label to both a subsection and a table, you may find that Table I has been cross referenced as Table IV-B3.

$\text{\LaTeX}$  does not have precognitive abilities. If you put a `\label` command before the command that updates the counter it’s supposed to be using, the label will pick up the last counter to be cross referenced instead. In particular, a `\label` command should not go before the caption of a figure or a table.

Do not use `\nonumber` inside the `{array}` environment. It will not stop equation numbers inside `{array}` and it might stop a wanted equation number in the surrounding equation.

If you are submitting your paper to a colorized journal, you can use the following two lines at the start of the article to ensure its appearance resembles the final copy:

```
\documentclass[journal,twoside,web]{ieeecolor}
\usepackage{Journal_Name}
```

## IV. UNITS

Use either SI (MKS) or CGS as primary units. (SI units are strongly encouraged.) English units may be used as secondary units (in parentheses). For example, write “1 kg (2.2lb).” An exception exists for when English units are used as identifiers in commercial products, such as a “3½-in disk drive.” Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity in an equation.

The SI unit for magnetic field strength  $H$  is A/m. However, if you wish to use units of T, either refer to magnetic flux density  $B$  or magnetic field strength symbolized as  $\mu_0 H$ . Use the center dot to separate compound units, e.g., “A·m<sup>2</sup>.”

## V. GUIDELINES FOR GRAPHICS PREPARATION AND SUBMISSION

### A. Types of Graphics

The following list outlines the different types of graphics published in IEEE journals. They are categorized based on their construction, and use of color / shades of gray:

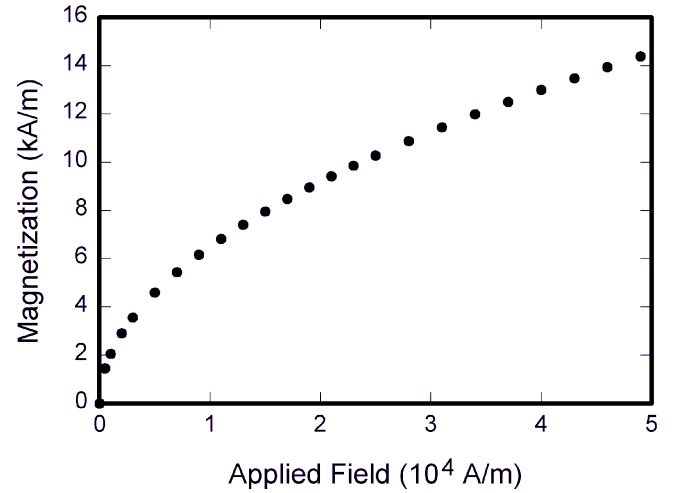


Fig. 1. Magnetization as a function of applied field. It is good practice to explain the significance of the figure in the caption.

TABLE I  
UNITS FOR MAGNETIC PROPERTIES

Symbol	Quantity	Conversion from Gaussian and CGS EMU to SI <sup>a</sup>
$\Phi$	magnetic flux	1 Mx $\rightarrow$ $10^{-8}$ Wb = $10^{-8}$ V·s
$B$	magnetic flux density, magnetic induction	1 G $\rightarrow$ $10^{-4}$ T = $10^{-4}$ Wb/m <sup>2</sup>
$H$	magnetic field strength	1 Oe $\rightarrow$ $10^3/(4\pi)$ A/m
$m$	magnetic moment	1 erg/G = 1 emu $\rightarrow$ $10^{-3}$ A·m <sup>2</sup> = $10^{-3}$ J/T
$M$	magnetization	1 erg/(G·cm <sup>3</sup> ) = 1 emu/cm <sup>3</sup> $\rightarrow$ $10^3$ A/m
$4\pi M$	magnetization	1 G $\rightarrow$ $10^3/(4\pi)$ A/m
$\sigma$	specific magnetization	1 erg/(G·g) = 1 emu/g $\rightarrow$ 1 A·m <sup>2</sup> /kg
$j$	magnetic dipole moment	1 erg/G = 1 emu $\rightarrow$ $4\pi \times 10^{-10}$ Wb·m
$J$	magnetic polarization	1 erg/(G·cm <sup>3</sup> ) = 1 emu/cm <sup>3</sup> $\rightarrow$ $4\pi \times 10^{-4}$ T
$\chi, \kappa$	susceptibility	1 $\rightarrow$ $4\pi$
$\chi_\rho$	mass susceptibility	1 cm <sup>3</sup> /g $\rightarrow$ $4\pi \times 10^{-3}$ m <sup>3</sup> /kg
$\mu$	permeability	1 $\rightarrow$ $4\pi \times 10^{-7}$ H/m = $4\pi \times 10^{-7}$ Wb/(A·m)
$\mu_r$	relative permeability	$\mu \rightarrow \mu_r$
$w, W$	energy density	1 erg/cm <sup>3</sup> $\rightarrow$ $10^{-1}$ J/m <sup>3</sup>
$N, D$	demagnetizing factor	1 $\rightarrow$ $1/(4\pi)$

Vertical lines are optional in tables. Statements that serve as captions for the entire table do not need footnote letters.

<sup>a</sup>Gaussian units are the same as cg emu for magnetostatics; Mx = maxwell, G = gauss, Oe = oersted; Wb = weber, V = volt, s = second, T = tesla, m = meter, A = ampere, J = joule, kg = kilogram, H = henry.

1) *Color/Grayscale figures*: Figures that are meant to appear in color, or shades of black/gray. Such figures may include photographs, illustrations, multicolor graphs, and flowcharts.

2) *Line Art figures*: Figures that are composed of only black lines and shapes. These figures should have no shades or half-tones of gray, only black and white.

3) *Author photos*: Not allowed for papers in TMI.

4) *Tables*: Data charts which are typically black and white, but sometimes include color.

## B. Multipart figures

Multipart figures are comprised of more than one sub-figure presented together. If a multipart figure is made up of multiple figure types (one part is lineart, and another is grayscale or color) the figure should meet the strictest applicable guidelines.

## C. File Formats For Graphics

Format and save your graphics as one of the following approved file types: PostScript (.PS), Encapsulated PostScript (.EPS), Tagged Image File Format (.TIFF), Portable Document Format (.PDF), Portable Network Graphics (.PNG), or Meta-post (.MPS). After the paper is accepted, any included graphics must be submitted alongside the final manuscript files.

## D. Sizing of Graphics

Most charts, graphs, and tables are one column wide (3.5 inches / 88 millimeters) or page wide (7.16 inches / 181 millimeters). The maximum depth of a graphic is 8.5 inches (216 millimeters). When choosing the depth of a graphic, please allow space for a caption. Authors are allowed to size figures between column and page widths, but it is recommended not to size figures less than column width unless necessary.

## E. Resolution

The proper resolution of your figures will depend on the type of figure it is as defined in the “Types of Figures” section. Author photographs, color, and grayscale figures should be at least 300dpi. Lineart, including tables should be a minimum of 600dpi.

## F. Vector Art

While IEEE does accept and even recommends that authors submit artwork in vector format, it is our policy is to rasterize all figures for publication. This is done in order to preserve figures’ integrity across multiple computer platforms.

## G. Colorspace

The term colorspace refers to the entire sum of colors that can be represented within a given medium. For our purposes, the three main colorspace are grayscale, RGB (red/green/blue) and CMYK (cyan/magenta/yellow/black). RGB is generally used with on-screen graphics, whereas CMYK is used for printing purposes.

All color figures should be generated in RGB or CMYK colorspace. Grayscale images should be submitted in grayscale colorspace. Line art may be provided in grayscale OR bitmap colorspace. Note that “bitmap colorspace” and “bitmap file format” are not the same thing. When bitmap colorspace is selected, .TIF/.TIFF are the recommended file formats.

## H. Accepted Fonts Within Figures

When preparing your graphics IEEE suggests that you use of one of the following Open Type fonts: Times New Roman, Helvetica, Arial, Cambria, and Symbol. If you are supplying EPS, PS, or PDF files all fonts must be embedded. Some fonts may only be native to your operating system; without the fonts embedded, parts of the graphic may be distorted or missing.

A safe option when finalizing your figures is to strip out the fonts before you save the files, creating “outline” type. This converts fonts to artwork that will appear uniformly on any screen.

## I. Using Labels Within Figures

1) *Figure Axis labels*: Figure axis labels are often a source of confusion. Use words rather than symbols. As an example, write the quantity “Magnetization,” or “Magnetization M,” not just “M.” Put units in parentheses. Do not label axes only with units. As in Fig. 1, for example, write “Magnetization (A/m)” or “Magnetization ( $A \cdot m^{-1}$ ),” not just “A/m.” Do not label axes with a ratio of quantities and units. For example, write “Temperature (K),” not “Temperature/K.”

Multipliers can be especially confusing. Write “Magnetization (kA/m)” or “Magnetization ( $10^3$  A/m).” Do not write “Magnetization (A/m)  $\times 1000$ ” because the reader would not know whether the top axis label in Fig. 1 meant 16000 A/m or 0.016 A/m. Figure labels should be legible, approximately 8 to 10 point type.

2) *Subfigure Labels in Multipart Figures and Tables*: Multipart figures should be combined and labeled before final submission. Labels should appear centered below each subfigure in 8 point Times New Roman font in the format of (a) (b) (c).

## J. Referencing a Figure or Table Within Your Paper

When referencing your figures and tables within your paper, use the abbreviation “Fig.” even at the beginning of a sentence. Do not abbreviate “Table.” Tables should be numbered with Roman numerals.

## K. Submitting Your Graphics

Format your paper with the graphics included within the body of the text as you would expect to see the paper in print. Please do this at each stage of the review, from first submission to final files. For final files only, after the paper has been accepted for publication, figures should also be submitted individually in addition to the manuscript file using one of the approved file formats. Place a figure caption below each figure; place table titles above the tables. Do not include captions or borders in the uploaded figure files.

## L. File Naming

Figures (line artwork or images) should be named starting with the first 5 letters of the corresponding author’s last name. The next characters in the filename should be the number that represents the figure’s sequential location in the article. For example, in author “Anderson’s” paper, the first three figures might be named *ander1.tif*, *ander2.tif*, and *ander3.ps*.

Tables should contain only the body of the table (not the caption) and should be named similarly to figures, except that ‘.t’ is inserted in-between the author’s name and the table number. For example, author Anderson’s first three tables would be named *ander.t1.tif*, *ander.t2.ps*, and *ander.t3.eps*.

Author photographs or biographies are not permitted in IEEE TMI papers.

### M. Checking Your Figures: The IEEE Graphics Analyzer

The IEEE Graphics Analyzer enables authors to pre-screen their graphics for compliance with IEEE Transactions and Journals standards before submission. The online tool, located at <http://graphicsqc.ieee.org/>, allows authors to upload their graphics in order to check that each file is the correct file format, resolution, size and colorspace; that no fonts are missing or corrupt; that figures are not compiled in layers or have transparency, and that they are named according to the IEEE Transactions and Journals naming convention. At the end of this automated process, authors are provided with a detailed report on each graphic within the web applet, as well as by email.

For more information on using the Graphics Analyzer or any other graphics related topic, contact the IEEE Graphics Help Desk by e-mail at [graphics@ieee.org](mailto:graphics@ieee.org).

### N. Color Processing/Printing in IEEE Journals

All IEEE Transactions, Journals, and Letters allow an author to publish color figures on IEEE Xplore® at no charge, and automatically convert them to grayscale for print versions. In most journals, figures and tables may alternatively be printed in color if an author chooses to do so. Please note that this service comes at an extra expense to the author. If you intend to have print color graphics, include a note with your final paper indicating which figures or tables you would like to be handled that way, and stating that you are willing to pay the additional fee.

## VI. SOME COMMON MISTAKES

The word “data” is plural, not singular. The subscript for the permeability of vacuum  $\mu_0$  is zero, not a lowercase letter “o.” Use the word “micrometer” instead of “micron.” A graph within a graph is an “inset,” not an “insert.” The word “alternatively” is preferred to the word “alternately” (unless you really mean something that alternates). Use the word “whereas” instead of “while” (unless you are referring to simultaneous events). Do not use the word “essentially” to mean “approximately” or “effectively.” Do not use the word “issue” as a euphemism for “problem.” When compositions are not specified, separate chemical symbols by en-dashes; for example, “NiMn” indicates the intermetallic compound  $\text{Ni}_{0.5}\text{Mn}_{0.5}$  whereas “Ni–Mn” indicates an alloy of some composition  $\text{Ni}_x\text{Mn}_{1-x}$ .

Be aware of the different meanings of the homophones “affect” (usually a verb) and “effect” (usually a noun), “complement” and “compliment,” “discreet” and “discrete,” “principal” (e.g., “principal investigator”) and “principle” (e.g., “principle of measurement”). Do not confuse “imply” and “infer.”

Prefixes such as “non,” “sub,” “micro,” “multi,” and “ultra” are not independent words; they should be joined to the words they modify, usually without a hyphen. There is no period after the “et” in the Latin abbreviation “*et al.*” (it is also italicized). The abbreviation “i.e.,” means “that is,” and the abbreviation “e.g.,” means “for example” (these abbreviations are not italicized).

A general IEEE styleguide is available at <http://www.ieee.org/web/publications/authors/transjnl/index.html>.

## VII. CONCLUSION

A conclusion section is not required. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

## APPENDIX AND THE USE OF SUPPLEMENTAL FILES

Appendices, if needed, appear before the acknowledgment. If an appendix is not critical to the main message of the manuscript and is included only for thoroughness or for reader reference, then consider submitting appendices as supplemental materials. Supplementary files are available to readers through IEEE Xplore® at no additional cost to the authors but they do not appear in print versions. Supplementary files must be uploaded in ScholarOne as supporting documents, but for accepted papers they should be uploaded as Multimedia documents. Refer readers to the supplementary files where appropriate within the manuscript text using footnotes.<sup>1</sup>

## ACKNOWLEDGMENT

The preferred spelling of the word “acknowledgment” in American English is without an “e” after the “g.” Use the singular heading even if you have many acknowledgments. Avoid expressions such as “One of us (S.B.A.) would like to thank . . . .” Instead, write “F. A. Author thanks . . . .” In most cases, sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page, not here.

<sup>1</sup>Supplementary materials are available in the supporting documents/multimedia tab. Further instructions on footnote usage are in the Footnotes section on the next page.