Preparation of Papers for Communication of IEEE TAP (2023)

Michael Shell, *Senior Member, IEEE,* and John Doe

***Abstract*—This document describes the most common article elements and how to use the IEEEtran class with LaTeX to produce files that are suitable for submission to the IEEE. If you read this document from a MS Word template, please disreguard all the LaTeX information. IEEEtran can produce conference, journal, and technical note (correspondence) papers with a suitable choice of class options.**

***Index Terms*—Article submission, IEEE, IEEEtran, journal, LaTeX, paper, template, typesetting. For further help please go to https://www.ieee.org/publications/services/thesaurus.html**

I. Introduction

THIS file is intended to serve as a "sample article file" for IEEE journal papers produced under LaTeX using IEEEtran.cls version 1.8b and later. The most common elements are covered in the simplified and updated instructions in "IEEEtran_how-to.pdf." It is assumed that the reader has a basic working knowledge of LaTeX. Those who are new to LaTeX are encouraged to read Tobias Oetiker's "The Not So Short Introduction to LaTeX," available at: http://tug.ctan.org/info/lshort/english/lshort.pdf which provides an overview of working with LaTeX.

II. The Design, Intent, and Limitations of the Templates

The templates are intended to **approximate the final look and page length of the articles/papers**. **They are NOT intended to be the final produced work that is displayed in print or on IEEEXplore®**. They will help to give the authors an approximation of the number of pages that will be in the final version. The structure of the LaTeX files, as designed, enable easy conversion to XML for the composition systems used by the IEEE. The XML files are used to produce the final print/IEEEXplore pdf and then converted to HTML for IEEEXplore.

III. Where to Get LaTeX Help — User Groups

The following online groups are helpful to beginning and experienced LaTeX users. A search through their archives can provide many answers to common questions.

http://www.latex-community.org/
https://tex.stackexchange.com/

IV. Other Resources

See [1], [2], [3], [4], [5] for resources on formatting math into text and additional help in working with LaTeX.

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Michael Shell is with University of BCA. John Doe is with with University of ABC.

V. Text

For some of the remainer of this sample we will use dummy text to fill out paragraphs rather than use live text that may violate a copyright.

Use either SI (MKS) or CGS as primary units. (SI units are strongly encouraged.) English units may be used as secondary units (in parentheses). This applies to papers in data storage. For example, write "15 Gb/cm^2 (100 Gb/in^2)." An exception is when English units are used as identifiers in trade, such as "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^2." The surface electromyography(sEMG) is among the most direct bio-potential signals representing muscle movement information. sEMG is used to evaluate motor conditions in medical and research fields, and it is currently expanding into more general fields, such as health monitoring, prosthesis and orthosis control, and human-machine interfaces. Accordingly, there is an increasing demand for an overall sensor system capable of long-term stable signal recording, and including an intention decoding algorithm.

Recently, textile-based sEMG sensor have been getting attention for long-term wearable sensor system. Textiles ensure comfort to the wearer by modifying their shape to fit the body curvature.

Therefore, in this research, we propose an sEMG sensor system from the fast and precise customizable fabrication method of the fabrics sEMG sensor to motion intention algorithm. We introduce a 2.5D laser-cutting-based fabrication method on the densely weaved conductive fabric. Because the entire manufacturing process can be automated without human intervention, as shown in (1) mint aut quat eos explis ad quodi debis deliqui aspel earcius.

$$x = \sum_{i=0}^{n} 2iQ. \tag{1}$$

Mass production is also possible and sensors of various sizes and shapes necessary for the different human body parts can be exactly manufactured as designed. In addition, within the range where laser cutting is possible, various attempts in previous studies on electrodes can be employed. In this study, we integrated foams with robust performance for EEG and ECG with a focus on long-term use. While previous studies have shown the feasibility of foam electrodes, this study shows how electrodes containing foamed electrodes can be grafted into the proposed fabrication method and their performance for use as small-sized sEMG sensor electrodes. Our proposed sEMG system integrates a motion intention algorithm to form a complete and intelligent muscle interface from fabrication to application. Among many sEMG-based intention recognition applications, we demonstrate the effectiveness of our sEMG system by gesture recognition, as hand gestures are among the most intuitive methods for human communication and human-machine interaction.

VI. Some Common Elements

A. Sections and Subsections

Enumeration of section headings is desirable, but not required. When numbered, please be consistent throughout the article, that is, all headings and all levels of section headings in the article should be enumerated. Primary headings are designated with Roman numerals, secondary with capital letters, tertiary with Arabic numbers; and quaternary with lowercase letters. Reference and Acknowledgment headings are unlike all other section headings in text. They are never enumerated. They are simply primary headings without labels, regardless of whether the other headings in the article are enumerated.

B. Citations to the Bibliography

The coding for the citations is made with the LaTeX `\cite` command. This will display as: see [1].

For multiple citations code them separately with comas as follows: `\cite{ref1}, \cite{ref2}, \cite{ref3}` which will produce [1], [2], [3].

C. Lists

In this section, we will consider three types of lists: simple unnumbered, numbered, and bulleted. There have been many options added to IEEEtran to enhance the creation of lists.

A plain unnumbered list:

bare_jrnl.tex
bare_conf.tex
bare_jrnl_compsoc.tex
bare_conf_compsoc.tex
bare_jrnl_comsoc.tex

A simple numbered list:

1) bare_jrnl.tex
2) bare_conf.tex
3) bare_jrnl_compsoc.tex
4) bare_conf_compsoc.tex
5) bare_jrnl_comsoc.tex

A simple bulleted list:

- bare_jrnl.tex
- bare_conf.tex
- bare_jrnl_compsoc.tex
- bare_conf_compsoc.tex
- bare_jrnl_comsoc.tex

D. Figures

Fig. 1 is an example of a floating figure using the graphicx package. Note that `\label` must occur AFTER (or within) `\caption`. For figures, `\caption` should occur after the `\includegraphics`.

Fig. 2(a) and 2(b) is an example of a double column floating figure using two subfigures. (The subfig.sty package must be loaded for this to work.) The subfigure `\label` commands are set within each subfloat command, and the `\label` for the overall figure must come after `\caption`. `\hfil` is used as a separator to get equal spacing. The combined width of all the parts of the figure should do not exceed the text width or a line break will occur.

Note that often IEEE papers with multi-part figures do not place the labels within the image itself (using the optional argument to `\subfloat[]`), but instead will reference/describe all of them (a), (b), etc., within the main caption. Be aware that for subfig.sty to generate the (a), (b), etc., subfigure labels, the optional argument to `\subfloat` must be present. If a subcaption is not desired, leave its contents blank, e.g.,`\subfloat[]`.

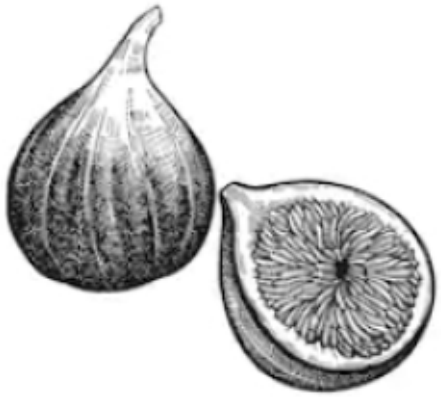


Fig. 1. Simulation results for the network.

TABLE I
An Example of a Table

One	Two
Three	Four

VII. Tables

Note that, for IEEE-style tables, the `\caption` command should come BEFORE the table. Table captions use title case. Articles (a, an, the), coordinating conjunctions (and, but, for, or, nor), and most short prepositions are lowercase unless they are the first or last word. Table text will default to `\footnotesize` as the IEEE normally uses this smaller font for tables. The `\label` must come after `\caption` as always.

VIII. Algorithms

Algorithms should be numbered and include a short title. They are set off from the text with rules above and below the title and after the last line. Algorithm titles should be in title case, followed by ending punctuation.

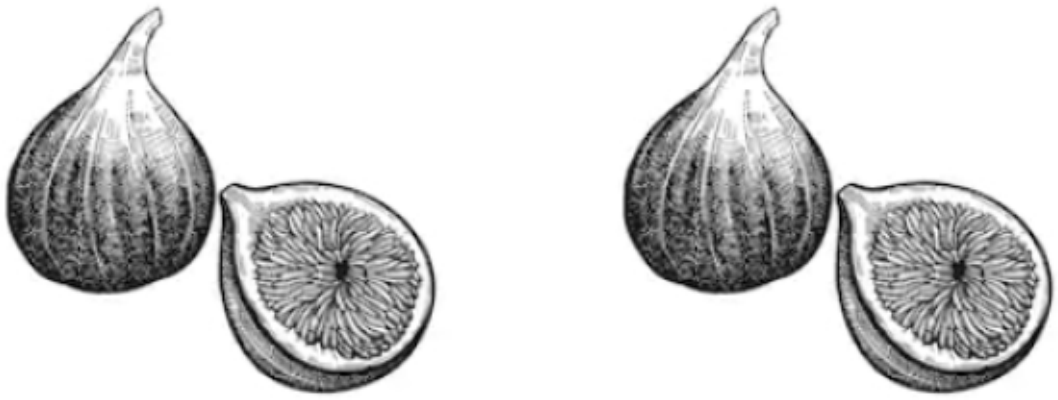
Algorithm 1 Weighted Tanimoto ELM.

TRAIN($\mathbf{XT}$)
select randomly $W \subset \mathbf{X}$
$N_{\mathbf{t}} \leftarrow |\{i : \mathbf{t}_i = \mathbf{t}\}|$ **for** $\mathbf{t} = -1, +1$
$B_i \leftarrow \sqrt{\text{MAX}(N_{-1}, N_{+1})/N_{\mathbf{t}_i}}$ **for** $i = 1, ..., N$
$\hat{\mathbf{H}} \leftarrow B \cdot (\mathbf{X}^T\mathbf{W})/(\not\Vdash\mathbf{X} + \not\Vdash\mathbf{W} - \mathbf{X}^T\mathbf{W})$
$\beta \leftarrow \left(I/C + \hat{\mathbf{H}}^T\hat{\mathbf{H}}\right)^{-1} (\hat{\mathbf{H}}^T B \cdot \mathbf{T})$
return $\mathbf{W}, \beta$

PREDICT($\mathbf{X}$)
$\mathbf{H} \leftarrow (\mathbf{X}^T\mathbf{W})/(\not\Vdash\mathbf{X} + \not\Vdash\mathbf{W} - \mathbf{X}^T\mathbf{W})$
return SIGN($\mathbf{H}\beta$)

IX. Mathematical Typography and Why It Matters

Typographical conventions for mathematical formulas have been developed to **provide uniformity and clarity of presentation across mathematical texts**. This enables the readers of those texts to both understand the author's ideas and to grasp new concepts quickly. While software such as LaTeX and MathType® can produce aesthetically pleasing math when used properly, it is also very easy to misuse the software, potentially resulting in incorrect math display.



(a) (b)

Fig. 2. An example of a double-column wide (or page wide) floating figure using two subfigures.

IEEE aims to provide authors with the proper guidance on mathematical typesetting style and assist them in writing the best possible article. As such, IEEE has assembled a set of examples of good and bad mathematical typesetting [1], [2], [3], [4], [5].

Further examples can be found at http://journals.ieeeauthorcenter.ieee.org/wp-content/uploads/sites/7/IEEE-Math-Typesetting-Guide-for-LaTeX-Users.pdf

Please use standard LaTeX codes for symbols when possible. Avoid using personal customized macros or definitions as they may not be supported at IEEE.

A. Display Equations

The simple display equation example shown below uses the "equation" environment. To number the equations, use the `\label` macro to create an identifier for the equation. LaTeX will automatically number the equation for you.

$$x = \sum_{i=0}^{n} 2iQ. \tag{2}$$

is coded as follows:

```
\begin{equation}
\label{deqn_ex1}
x = \sum_{i=0}^{n} 2{i} Q.
\end{equation}
```

To reference this equation in the text use the `\ref` macro. Please see (2)
is coded as follows:

```
Please see (\ref{deqn_ex1})
```

B. Equation Numbering

Consecutive Numbering: Equations within an article are numbered consecutively from the beginning of the article to the end, i.e., (1), (2), (3), (4), (5), etc. Do not use roman numerals or section numbers for equation numbering.

Appendix Equations: The continuation of consecutively numbered equations is best in the Appendix, but numbering as (A1), (A2), etc., is permissible.

Hyphens and Periods: Hyphens and periods should not be used in equation numbers, i.e., use (1a) rather than (1-a) and (2a) rather than (2.a) for subequations. This should be consistent throughout the article.

C. Multi-Line Equations and Alignment

Here we show several examples of multi-line equations and proper alignments.

A single equation that must break over multiple lines due to length with no specific alignment.

$$\begin{multline}\text{The first line of this example}\\ \text{The second line of this example}\\ \text{The third line of this example}\end{multline} \tag{3}$$

is coded as:

```
\begin{multline}
\text{The first line of this example}\\
\text{The second line of this example}\\
\text{The third line of this example}
\end{multline}
```

A single equation with multiple lines aligned at the = signs

$$a = c + d \tag{4}$$
$$b = e + f \tag{5}$$

is coded as:

```
\begin{align}
a &= c+d \\
b &= e+f
\end{align}
```

The `align` environment can align on multiple points as shown in the following example:

$$x = y \qquad X = Y \qquad a = bc \tag{6}$$
$$x' = y' \qquad X' = Y' \qquad a' = bz \tag{7}$$

is coded as:

```
\begin{align}
x &= y & X & =Y & a &=bc\\
x' &= y' & X' &=Y' &a' &=bz
\end{align}
```

D. Subnumbering

The amsmath package provides a `subequations` environment to facilitate subnumbering. An example:

$$f = g \tag{8a}$$
$$f' = g' \tag{8b}$$
$$\mathcal{L}f = \mathcal{L}g \tag{8c}$$

is coded as:

```
\begin{subequations}\label{eq:2}
\begin{align}
f&=g \label{eq:2A}\\
f' &=g' \label{eq:2B}\\
\mathcal{L}f &= \mathcal{L}g \label{eq:2c}
\end{align}
\end{subequations}
```

E. Matrices

There are several useful matrix environments that can save you some keystrokes. See the example coding below and the output.

A simple matrix:

$$\begin{matrix} 0 & 1 \\ 1 & 0 \end{matrix} \tag{9}$$

is coded as:

```
\begin{equation}
\begin{matrix}  0 &  1 \\
1 &  0 \end{matrix}
\end{equation}
```

A matrix with parenthesis

$$\begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix} \tag{10}$$

is coded as:

```
\begin{equation}
\begin{pmatrix} 0 & -i \\
 i &  0 \end{pmatrix}
\end{equation}
```

A matrix with square brackets

$$\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} \tag{11}$$

is coded as:

```
\begin{equation}
\begin{bmatrix} 0 & -1 \\
1 &  0 \end{bmatrix}
\end{equation}
```

A matrix with curly braces

$$\begin{Bmatrix} 1 & 0 \\ 0 & -1 \end{Bmatrix} \tag{12}$$

is coded as:

```
\begin{equation}
\begin{Bmatrix} 1 &  0 \\
0 & -1 \end{Bmatrix}
\end{equation}
```

A matrix with single verticals

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix} \tag{13}$$

is coded as:

```
\begin{equation}
\begin{vmatrix} a &  b \\
c &  d \end{vmatrix}
\end{equation}
```

A matrix with double verticals

$$\begin{Vmatrix} i & 0 \\ 0 & -i \end{Vmatrix} \tag{14}$$

is coded as:

```
\begin{equation}
\begin{Vmatrix} i &  0 \\
0 & -i \end{Vmatrix}
\end{equation}
```

F. Arrays

The `array` environment allows you some options for matrix-like equations. You will have to manually key the fences, but there are other options for alignment of the columns and for setting horizontal and vertical rules. The argument to `array` controls alignment and placement of vertical rules.

A simple array

$$\left(\begin{array}{cccc} a+b+c & uv & x-y & 27 \\ a+b & u+v & z & 134 \end{array} \right) \tag{15}$$

is coded as:

```
\begin{equation}
\left(
\begin{array}{cccc}
a+b+c & uv & x-y & 27\\
a+b & u+v & z & 134
\end{array} \right)
\end{equation}
```

A slight variation on this to better align the numbers in the last column

$$\left(\begin{array}{cccr} a+b+c & uv & x-y & 27 \\ a+b & u+v & z & 134 \end{array} \right) \tag{16}$$

is coded as:

```
\begin{equation}
\left(
\begin{array}{cccr}
a+b+c & uv & x-y & 27\\
a+b & u+v & z & 134
\end{array} \right)
\end{equation}
```

An array with vertical and horizontal rules

$$\left(\begin{array}{c|c|c|r} a+b+c & uv & x-y & 27 \\ \hline a+b & u+v & z & 134 \end{array} \right) \tag{17}$$

is coded as:

```
\begin{equation}
\left(
\begin{array}{c|c|c|r}
a+b+c & uv & x-y & 27\\
a+b & u+v & z & 134
```

```
\end{array} \right)
\end{equation}
```

Note the argument now has the pipe "|" included to indicate the placement of the vertical rules.

G. Cases Structures

Many times cases can be miscoded using the wrong environment, i.e., `array`. Using the `cases` environment will save keystrokes (from not having to type the `\left\lbrace`) and automatically provide the correct column alignment.

$$z_m(t) = \begin{cases} 1, & \text{if } \beta_m(t) \\ 0, & \text{otherwise.} \end{cases}$$

is coded as follows:

```
\begin{equation*}
{z_m(t)} =
\begin{cases}
1,&{\text{if}}\ {\beta }_m(t),\\
{0,}&{\text{otherwise.}}
\end{cases}
\end{equation*}
```

Note that the "&" is used to mark the tabular alignment. This is important to get proper column alignment. Do not use `\quad` or other fixed spaces to try and align the columns. Also, note the use of the `\text` macro for text elements such as "if" and "otherwise."

H. Function Formatting in Equations

Often, there is an easy way to properly format most common functions. Use of the `\` in front of the function name will in most cases, provide the correct formatting. When this does not work, the following example provides a solution using the `\text` macro:

$$d_R^{KM} = \underset{d_l^{KM}}{\arg\min}\{d_1^{KM}, \ldots, d_6^{KM}\}.$$

is coded as follows:

```
\begin{equation*}
 d_{R}^{KM} = \underset {d_{l}^{KM}}
 {\text{arg min}} \{ d_{1}^{KM},
 \ldots,d_{6}^{KM}\}.
\end{equation*}
```

I. Text Acronyms Inside Equations

This example shows where the acronym "MSE" is coded using `\text{}` to match how it appears in the text.

$$\text{MSE} = \frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2$$

```
\begin{equation*}
 \text{MSE} = \frac {1}{n}\sum _{i=1}^{n}
(Y_{i} - \hat {Y_{i}})^{2}
\end{equation*}
```

X. Conclusion

The conclusion goes here.

Appendix
Proof of the Zonklar Equations

Use `\appendix` if you have a single appendix: Do not use `\section` anymore after `\appendix`, only `\section*`. If you have multiple appendixes use `\appendices` then use `\section` to start each appendix. You must declare a `\section` before using any `\subsection` or using `\label` (`\appendices` by itself starts a section numbered zero.)

Acknowledgments

This should be a simple paragraph before the References to thank those individuals and institutions who have supported your work on this article.

References Section

You can use a bibliography generated by BibTeX as a .bbl file. BibTeX documentation can be easily obtained at: http://mirror.ctan.org/biblio/bibtex/contrib/doc/ The IEEEtran BibTeX style support page is: http://www.michaelshell.org/tex/ieeetran/bibtex/

Simple References

You can manually copy in the resultant .bbl file and set second argument of `\begin` to the number of references (used to reserve space for the reference number labels box).

References [9] to [14] are added to show how to cite datasets and articles that have article numbers instead of page numbers or doi.

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