*Daire2compaire: 18-758 Final Project*

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*Abstract*—This electronic document is a “live” template. The various components of your paper [title, text, heads, etc.] are already defined on the style sheet, as illustrated by the portions given in this document. *(Abstract)*

# Introduction

WORDS Baseband Modulation. Baseband Demodulation.

# Basic Design

The basic design was split into two portions, “Transmit” and “Receive.” The transmit constructed the frequency preamble, the timing synchronization, the pilot signals and the messages. Those components were combined into a single signal, split into in-phase and quadrature components, convolved with a pulse filter, and recombined for transmission. Once the signal was received, six processes were applied to determine the effectiveness of the demodulation process.

**BASEBAND MODULATION**

## Bit-Symbol Mapping

Using the QPSK (or 4-QAM) bit to symbol mapping below, the sequence (*xk*) was determined.

|  |  |
| --- | --- |
| **Bits** | **xk** |
| 11 | 1+j |
| 01 | -1+j |
| 00 | -1-j |
| 10 | 1-j |

## Matched Filtering

Following the timing recovery, matched filtering was applied to each arm (in-phase and quadrature) of the received signal to reduce the noise. The matched filter was the mirror of the original square-root raised cosine filter, .

## Sampling

Sampling was performed on the in-phase and quadrature outputs from the matched filtering at intervals of kT, where .

## Equalization – One Tap Channel

A one-tap channel was used to convert the ISI channel into an equivalent channel, similar to the AWGN channel. For every pilot in the signal, a one-tap channel was applied to equalize the message following the pilot signal. The system makes an estimation of the channel gain, , with at each pilot since the pilot is known to both the receiver and the transmitter.

**BASEBAND DEMODULATION**

## Timing Recovery

After receiving the transmitted signal () and allowing for the phase lock loop to settle, the timing recovery was applied to the received signal. The timing recovery correlated the received signal with the timing signal and found where the timing signal ended in the received signal.

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## Bit Detection – Minimum Distance

The values of are precisely guessed using a minimum distance detector , following the creation of the equivalent channel in the one-tap channel.

## Bit Error Rate (BER) Calculation

For QPSK (or 4-QAM) the following BER equation is used.

# Advanced Design

Identify applicable sponsor/s here. *(sponsors)*

Before you begin to format your paper, first write and save the content as a separate text file. Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

## Abbreviations and Acronyms

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

## Units

* Use either SI (MKS) or CGS as primary units. (SI units are encouraged.) English units may be used as secondary units (in parentheses). An exception would be the use of English units as identifiers in trade, such as “3.5-inch 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 that you use in an equation.
* Do not mix complete spellings and abbreviations of units: “Wb/m2” or “webers per square meter”, not “webers/m2”. Spell out units when they appear in text: “. . . a few henries”, not “. . . a few H”.
* Use a zero before decimal points: “0.25”, not “.25”. Use “cm3”, not “cc”. (*bullet list*)

## Equations

The equations are an exception to the prescribed specifications of this template. You will need to determine whether or not your equation should be typed using either the Times New Roman or the Symbol font (please no other font). To create multileveled equations, it may be necessary to treat the equation as a graphic and insert it into the text after your paper is styled.

Number equations consecutively. Equation numbers, within parentheses, are to position flush right, as in (1), using a right tab stop. To make your equations more compact, you may use the solidus ( / ), the exp function, or appropriate exponents. Italicize Roman symbols for quantities and variables, but not Greek symbols. Use a long dash rather than a hyphen for a minus sign. Punctuate equations with commas or periods when they are part of a sentence, as in

 

Note that the equation is centered using a center tab stop. Be sure that the symbols in your equation have been defined before or immediately following the equation. Use “(1)”, not “Eq. (1)” or “equation (1)”, except at the beginning of a sentence: “Equation (1) is . . .”

## Some Common Mistakes

* The word “data” is plural, not singular.
* The subscript for the permeability of vacuum **0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter “o”.
* In American English, commas, semi-/colons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)
* 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).
* Do not use the word “essentially” to mean “approximately” or “effectively”.
* In your paper title, if the words “that uses” can accurately replace the word “using”, capitalize the “u”; if not, keep using lower-cased.
* Be aware of the different meanings of the homophones “affect” and “effect”, “complement” and “compliment”, “discreet” and “discrete”, “principal” and “principle”.
* Do not confuse “imply” and “infer”.
* The prefix “non” is not a word; it should be joined to the word it modifies, usually without a hyphen.
* There is no period after the “et” in the Latin abbreviation “et al.”.
* The abbreviation “i.e.” means “that is”, and the abbreviation “e.g.” means “for example”.

An excellent style manual for science writers is [7].

# Using the Template

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## Authors and Affiliations

The template is designed so that author affiliations are not repeated each time for multiple authors of the same affiliation. Please keep your affiliations as succinct as possible (for example, do not differentiate among departments of the same organization). This template was designed for two affiliations.

### For author/s of only one affiliation (Heading 3): To change the default, adjust the template as follows.

#### Selection (Heading 4): Highlight all author and affiliation lines.

#### Change number of columns: Select the Columns icon from the MS Word Standard toolbar and then select “1 Column” from the selection palette.

#### Deletion: Delete the author and affiliation lines for the second affiliation.

### For author/s of more than two affiliations: To change the default, adjust the template as follows.

#### Selection: Highlight all author and affiliation lines.

#### Change number of columns: Select the “Columns” icon from the MS Word Standard toolbar and then select “1 Column” from the selection palette.

#### Highlight author and affiliation lines of affiliation 1 and copy this selection.

#### Formatting: Insert one hard return immediately after the last character of the last affiliation line. Then paste down the copy of affiliation 1. Repeat as necessary for each additional affiliation.

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## Identify the Headings

Headings, or heads, are organizational devices that guide the reader through your paper. There are two types: component heads and text heads.

Component heads identify the different components of your paper and are not topically subordinate to each other. Examples include Acknowledgments and References and, for these, the correct style to use is “Heading 5”. Use “figure caption” for your Figure captions, and “table head” for your table title. Run-in heads, such as “Abstract”, will require you to apply a style (in this case, italic) in addition to the style provided by the drop down menu to differentiate the head from the text.

Text heads organize the topics on a relational, hierarchical basis. For example, the paper title is the primary text head because all subsequent material relates and elaborates on this one topic. If there are two or more sub-topics, the next level head (uppercase Roman numerals) should be used and, conversely, if there are not at least two sub-topics, then no subheads should be introduced. Styles named “Heading 1”, “Heading 2”, “Heading 3”, and “Heading 4” are prescribed.

## Figures and Tables

### Positioning Figures and Tables: Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be below the figures; table heads should appear above the tables. Insert figures and tables after they are cited in the text. Use the abbreviation “Fig. 1”, even at the beginning of a sentence.

1. Table Type Styles

| Table Head | Table Column Head | | |
| --- | --- | --- | --- |
| Table column subhead | Subhead | Subhead |
| copy | More table copya |  |  |

a. Sample of a Table footnote. *(Table footnote)*

1. Example of a figure caption. *(figure caption)*

Figure Labels: Use 8 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader. As an example, write the quantity “Magnetization”, or “Magnetization, M”, not just “M”. If including units in the label, present them within parentheses. Do not label axes only with units. In the example, write “Magnetization (A/m)” or “Magnetization {A[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”.

##### Acknowledgment *(Heading 5)*

The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression, “One of us (R. B. G.) thanks . . .” Instead, try “R. B. G. thanks”. Put sponsor acknowledgments in the unnum-bered footnote on the first page.

##### References

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Number footnotes separately in superscripts. Place the actual footnote at the bottom of the column in which it was cited. Do not put footnotes in the reference list. Use letters for table footnotes.

Unless there are six authors or more give all authors' names; do not use “et al.”. Papers that have not been published, even if they have been submitted for publication, should be cited as “unpublished” [4]. Papers that have been accepted for publication should be cited as “in press” [5]. Capitalize only the first word in a paper title, except for proper nouns and element symbols. For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [6].

1. G. Eason, B. Noble, and I. N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955. *(references)*

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To have non-visible rules on your frame, use the MSWord “Format” pull-down menu, select Text Box > Colors and Lines to choose No Fill and No Line.

1. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.
2. I. S. Jacobs and C. P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.
3. K. Elissa, “Title of paper if known,” unpublished.
4. R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.
5. Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, “Electron spectroscopy studies on magneto-optical media and plastic substrate interface,” IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].