Automatic Contrast Enhancement on Medical Images using Fuzzy C-Means

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*Abstract*— The present work presents a proposal for contrast enhancement on medical images in order to achieve a clearer image for the identification of features related to pathologies, as a tool for diagnosis. The fuzzy C-means algorithm allows to detect the elements corresponding to different tissues and the background, creating clusters representing each one, the optimal number of clusters is found using the fuzzy partition coefficient. Once that they are identified, different defuzzyfication methods are used to create the new image. The method is compared to histogram equalization, demonstrating less artifacts and influence of the background in the final result.

Keywords— Fuzzy, clusters, contrast, medical, images, optimal.

# Introduction (*Heading 1*)

For digital images the contrast on image processing refers to the measure of dispersion of the pixels among all the possible values in the histogram for a defined format. It is associated with the visual perception of the details on the image, as some images can be perceived as mainly dark, bright or gray when the range of the pixels can be located at a specific part of the histogram. Some images can also be perceived as having high contrast, when there is a combination of very dark and very bright pixels. This problem can be found on medical images, remote-sensing images, microscopy and even common photography. The contrast enhancement techniques aims to spread the values of the original image on a uniform way across the histogram, improving the perception of the objects on the resulting image.

The contrast enhancement for medical images is a field that through many years has become an important tool for improving the quality of studies and thus making it clearer to identify visual characteristics on them that are related to pathologies and could not be seen at simple sight. These problems are provoked due to the relatively low visual quality that some studies present depending on how they were acquired the quality of the sensor and even the perception of different tissues in a particular study.

# Ease of Use

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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.”
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* Use a zero before decimal points: “0.25,” not “.25.” Use “cm3,” not “cc.” (*bullet list*)

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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

(1)

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## 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).
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* 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].

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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.

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1. Table Styles

| Table Head | Table Column Head | | |
| --- | --- | --- | --- |
| Table column sub head | Sub head | Sub head |
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*Sample of a Table footnote. (Table footnote)*

We suggest that you use a text box to insert a graphic (which is ideally a 300 dpi resolution TIFF or EPS file with all fonts embedded) because this method is somewhat more stable than directly inserting a picture.

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. *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 unnumbered footnote on the first page.

##### References

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For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [6].

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