OPTIMIZACIÓN MULTIOBJETIVO PARA LA MEJORA DEL CONTRASTE BASADA EN CLAHE.

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ABSTRACT

The abstract should appear at the top of the left-hand column of text, about 0.5 inch (12 mm) below the title area and no more than 3.125 inches (80 mm) in length. Leave a 12 mm (0.5 in.) space between the end of the abstract and the beginning of the main text. The abstract should contain about 100 to 150 words, and should be identical to the abstract text submitted electronically along with the paper cover sheet. All manuscripts must be in English, printed in black ink.

Index Terms— One, two, three, four, five

1. INTRODUCCIÓN

Los aparatos médicos se pueden conectar a computadoras y digitalizar las imágenes que construyen [?, ?]; sin embargo, la captura de la imagen a través de éstos dispositivos no está exenta de problemas: la captura puede sufrir de adición de ruido, mucha oscuridad, bajo contraste, entre otros. Por tanto, es necesario realizar un procesamiento previo de manera a que las imágenes puedan ser analizadas posteriormente; ésto es particularmente importante para las imágenes médicas, debido a la cantidad de detalles finos e importantes que poseen.

Contrast Limited Adaptive Histogram Equalization (CLAHE) es un algoritmo de mejora de contraste local basado en la división de la imagen en bloques y la ecualización del histograma de cada bloque en forma independiente, el cual fué propuesto en [?]. CLAHE ha demostrado obtener buenos resultados principalmente en imágenes con bajo contraste [?] e imágenes médicas [?, ?], debido a que en este último grupo se priorizan los detalles de la imagen. Una característica importante de CLAHE es que posee dos parámetros de entrada que controlan la mejora del contraste que se obtiene como resultado. De manera a obtener una solución satisfactoria se deben escoger valores apropiados de éstos parámetros. Debido a que el rango de parámetros a elegir es sumamente amplio, se necesita de una metaheurística que permita encontrar valores de entrada de CLAHE que den los resultados más satisfactorios de manera efectiva.

2. CONTRAST LIMITED ADAPTIVE HISTOGRAM EQUALIZATION

sección del clahe

3. MÉTRICAS DE EVALUACIÓN

4. FORMULACIÓN

Dadas la imagen de entrada I y el algoritmo *CLAHE*, se desea calcular el conjunto de soluciones $\mathscr{X}$ que maximice de manera simultánea los objetivos $\mathscr{H}$ y $\mathscr{C}$, como se muestra abajo:

$$f(\overrightarrow{x}) = \{f_1(\overrightarrow{x}), f_2(\overrightarrow{x})\} \tag{1}$$

donde:

- $\overrightarrow{x} = (\mathscr{R}_x, \mathscr{R}_y, \mathscr{C})$, donde $\mathscr{R}_x$ y $\mathscr{R}_y$ conforman la región contextual y $\mathscr{C}$ es el Clip Limit.

- $f_1(\overrightarrow{x}) = \frac{\mathscr{H}(T)}{log_2 L}$ es la Entropía normalizada de la imagen T, siendo T la imagen mejorada por *CLAHE* con los parámetros dados por $\overrightarrow{x}$, y L la cantidad de grises disponibles.

- $f_2(\overrightarrow{x}) = SSIM(I,T)$ es el Índice de Similitud Estructural.

sujeto a:

- $\mathscr{R}_x \in [2,..,M]$ en los números $\mathbb{N}$.

- $\mathscr{R}_y \in [2,..,N]$ en los números $\mathbb{N}$.

- $\mathscr{C} \in (0,1]$ en los números $\mathbb{R}$.

Ésto significa que los valores de $\mathscr{R}$ solamente pueden tomar valores enteros positivos entre $(2,2)$ y (M,N) y que $\mathscr{C}$ puede tomar un valor mayor a cero y menor o igual a 1.

5. OPTIMIZACIÓN DE ENJAMBRE DE PARTÍCULAS MULTIOBJETIVO

The paper title (on the first page) should begin 35 mm (1.38 in.) from the top edge of the page, centered, completely capitalized, and in Times 12-point, boldface type. The

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Subheadings should appear in lower case (initial word capitalized) in boldface. They should start at the left margin on a separate line.

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Format you paper for US letter, $8,5 \times 11$-in. paper. A4 paper is also acceptable, but please leave the extra 0.5 inch (12 mm) empty at the BOTTOM of the page and follow the top and left margins as specified. If the last page of your paper is only partially filled, arrange the columns so that they are evenly balanced if possible, rather than having one long column.

In LaTeX, to start a new column (but not a new page) and help balance the last-page column lengths, you can use the command "\pagebreak" as demonstrated on this page (see the LaTeX source below).
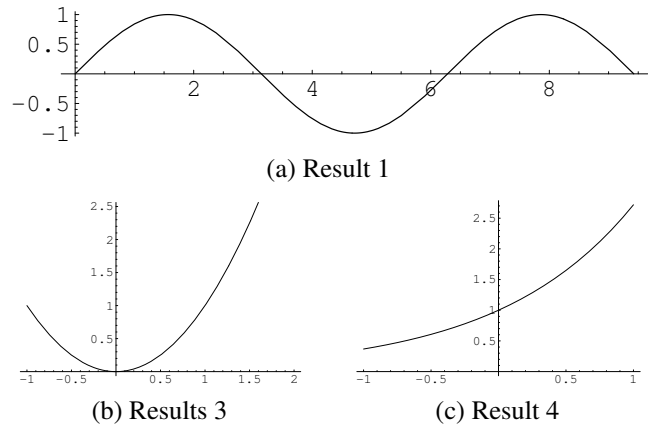

(a) Result 1

(b) Results 3   (c) Result 4

Fig. 1. Example of placing a figure with experimental results.

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Since there are many ways, often incompatible, of including images (e.g., with experimental results) in a LaTeX document, below is an example of how to do this [1].

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Use footnotes sparingly (or not at all!) and place them at the bottom of the column on the page on which they are referenced. Use Times 9-point type, single-spaced. To help your readers, avoid using footnotes altogether and include necessary peripheral observations in the text (within parentheses, if you prefer, as in this sentence).

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List and number all bibliographical references at the end of the paper. The references can be numbered in alphabetic order or in order of appearance in the document. When referring to them in the text, type the corresponding reference number in square brackets as shown at the end of this sentence [2]. An additional final page (the fifth page, in most cases) is allowed, but must contain only references to the prior literature.

14. REFERENCES

[1] A.B. Smith, C.D. Jones, and E.F. Roberts, "Article title," *Journal*, vol. 62, pp. 291–294, January 1920.

[2] C.D. Jones, A.B. Smith, and E.F. Roberts, "Article title," in *Proceedings Title*. IEEE, 2003, vol. II, pp. 803–806.