The Partial Cartoon Central Vision Compensation Technique

Introduction and Evaluation

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***Abstract*—Non-costly, non-invasive, safe, and reliable electronic vision enhancement systems (EVES) and their methods have presented a huge medical and industrial demand in the early 21st century. Two vision compensation and enhancement algorithms are first presented, qualitatively optimizing the view of a truncated image, the "convex", and the "cartoon superimposition" techniques. The author compares these to a novel technique, motivated by the characterization of quality vision parameters in an attempt to account for and compensate reported viewing difficulties and low image quality measures associated with these two existing methods.**

This "partial cartoon" technique is based on introducing the invisible image to the immediate left and right of the truncated image as a superimposed cartoon into respective sides of the truncated image, yet only on a partial basis as not to distract the central view of the image. Warped images are quantitatively compared by evaluating the Root-Mean-Square Error (RMSE) and the Universal Image Quality Index (UIQI), both representing image distortion and quality measures of warped, as compared to original images for five different scenes. It is concluded that the presented partial cartoon method exhibits superior image quality for all objective measures.

Keywords- image, compensation, enhancement, warping, eye, vision

I. INTRODUCTION

The growing field of Electronic Vision Enhancement Systems (EVES) requires development in such areas as vision optimization and image enhancement [1]. EVES carry out image warping, in order to achieve correction (such as in low-vision applications), or to magnify a section(s) of the image (such as in surveillance) [2]. EVES technologies strive to achieve an application-dependent optimization between the factors governing geometric warping (or compensation) to produce the desired shape, versus the realistic appearance and minimized distortions in the output image.

Such image optimization involves dealing with both geometric and physiological aspects of the human perception to images. A geometric optimization is achieved through ensuring that the image warping is carried out with a "good" match and minimal distortion between the original (or source) and final (or target) images. More specifically, central vision optimization involves achieving both these factors as well as maximum visibility within the region of the highest spatial resolution.

This paper highlights research done regarding central vision optimization through applying and evaluating techniques used to maximize the viewing of an image by introducing as much of the peripheral sections into the central portions of an image. First two such techniques present in the literature are considered, named here (1) the "convex" image warping scheme [3],[4], and (2) the cartoon superimposition scheme, or "Peli" technique, after the leading author for this research [5],[6]. A third technique, presented by the author, is the partial cartoon superimposition technique [7],[8],[9]. Each of these methods is first briefly described; then objective evaluation techniques are applied and used to analytically compare each method.

A. *Convex Image Warping Scheme [3],[4]*

The convex scheme is an analytical warping technique that is created by projecting the 2-D image onto a convex 3-D surface, and projecting the surface back to a smaller 2-D plane. The analytical formulation is based on the spatial retinal distribution. In doing so, the target image is smaller in size, its central portion is almost conserved in size (with minimal distortion), while the peripheral image (of less visual significance) has a gradually diminishing shape.

B. *Cartoon Superimposition "Peli" Technique [5],[6]*

The cartoon superimposition technique involves two images, the source image, truncated down solely to its central, undeformed portion, as well as a contour superimposition of the image periphery onto the truncated image. Thus, the basic idea regarding both methods is that of fitting a larger size image into a reduced size (either for low-vision purposes or for offering selective area magnification). Although the convex scheme involves warping the entire image, the "Peli" technique retains much of the source image while offering a hint of the surrounding.

C. *Partial Cartoon Superimposition Technique [7],[8],[9]*

In the partial cartoon technique only the invisible image to the left and right of the truncated image is superimposed on the

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