Embedded Motion: Generating the Perception of Motion in Peripheral Vision

Yu Okano[*1] Shogo Fukushima[*1] Masahiro Furukawa[*1,2] Hiroyuki Kajimoto[*1,3]

*1 The University of Electro-Communications,

*2 JSPS Research Fellow, *3 Japan Science and Technology Agency

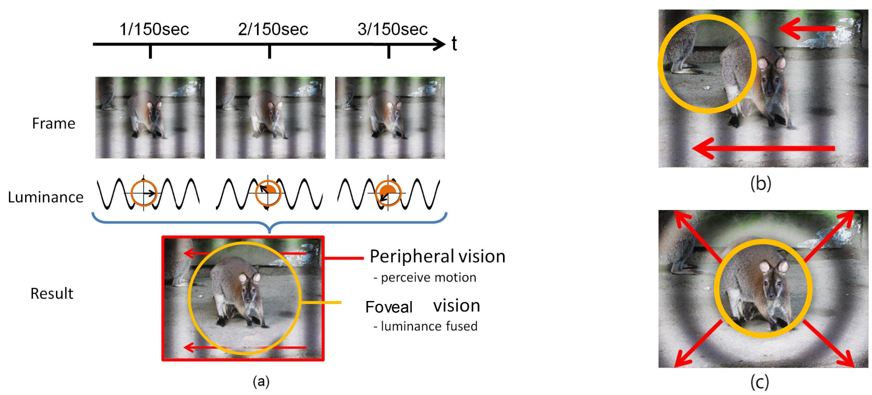

Figure 1: *(a) Video frames consist of one image with three luminance wave patterns. 150fps make 50Hz traveling wave. (b) Perceived image when users watch upper-left of the image. (c) Perceived image when radial motion is added to original image.*

1 Introduction

We aimed to generate a visual sensation of motion in any direction, with both video and still images. In drawings such as comics, radial or parallel patterns are often used to represent the direction of motion and velocity of objects. In recent years, another approach has been developed, using characteristics of the human visual system to induce the perception of motion. One such example is the Fraser illusion [Chi et al. 2008]. In all these approaches, the background is hidden, which decreases the realism of the image. We propose a new method of conveying motion, utilizing characteristics of foveal and peripheral vision. Our method recognizes that users can perceive motion without image distortion.

2 Proposed method

Generating the perception of motion without image distortion involves two key points. First, optical flow must be superimposed on the original image. Second, a method must be developed that allows observers to see the image clearly while also perceiving motion. The simplest approach is to superimpose optical flow with moving luminance wave patterns. However, this method involves deterioration of the image.

Our proposal involves the use of characteristics of foveal and peripheral vision. It has been established that the spatial resolution of peripheral vision is inferior to that of foveal vision but that peripheral temporal resolution is superior [Fukuda 1979] [Hylkema 1942]. Consequently, visual flicker at a high temporal frequency (around 50 Hz) is detected only by peripheral vision. To generate a flicker stimulus of this frequency, we prepared three luminance wave patterns as video frames, each of which had a different phase lag (0, 120, or 240 deg; Fig.1(a)). We repeatedly flipped these patterns at 150 frames per second, producing a 50 Hz traveling wave.

With this type of stimulus, users were able to perceive motion only in peripheral vision, while a clear static image was perceived in foveal vision. This was also true if users moved their eyes to another point in the image (Fig. 1(b)). We found that a radial motion pattern could also be used to produce a similar effect (Fig. 1(c)).

Other studies examining the generation of perceived motion have been reported previously [Okabe et al. 2009], but our study is novel in not changing the quality of the image perceived by foveal vision, while simultaneously generating the perception of motion selectively in peripheral vision. Moreover, compared with traditional visual effects, our stimuli do not lose visual realism, allowing observers to understand motion while simultaneously see the background clearly.

References

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