

Simulating Eye Movement in Reading Using Short-term Memory

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Abstract

We propose the computation model of the eye movement based on the short-term memory. We also applied this model to simulating the human eye movement in reading. We use the foveated vision that the resolution is high in the center of the retina and is low in the periphery of it to simulate human eye movement. It is reported that the viewpoint moves to the first word of next line from the end of line in a moment. But we cannot identify the first word of the next line in the end of line, because the resolution is too low in the periphery of the retina. It is reported that only four characters can be identified in the case of using the foveated vision. We introduce the short-term memory to identify the first word of the next line in the end of line. The viewpoint can be moved to the first character of next line using the image which is integrated the foveated images saved from the first word identified in the line. We call it the short-term memory image in this paper. These mechanism is also used the eye movement that we see a word more than two times. If the edge features derived from the short-term memory image in the current word is over the threshold, the viewpoint moves to next word. If not, the viewpoint is in the current word once again. The human eye movement that the viewpoint moves to next word, moves the viewpoint to the first word of next line and sees a word more than two times is simulated using this model.

keywords: Short-term memory, Foveated Vision, Reading

1 Introduction

The pixel density is high around the center of the retina and low in the peripheral of it. The vision such as this is called the foveated vision. The CCD devices are developed to generate foveated vision[1][2][3]. Some researchers propose the model of the eye movement based on foveated vision[4]. We uses the foveated vision to simulate the human vision. When human feels the movement of an object, the viewpoint moves to the next viewpoint reflectively. It is difficult to real-

ize the eye movement in wide region using the computation model, as the eye based on the foveated vision is controlled in the region of a foveated vision[4]. The short-term memory and task model are not discussed in the model of these eye movements.

In the other hand, the macro model consisted of the sensory register, the short-term memory, and the long-term memory is proposed in the psychological field [5]. The information derived from the sensory register is saved in the short-term memory. We introduce the short-term memory to the eye movement to realize the eye movement in wide region using the computation model. While the viewpoint moves quickly, we do not have the feeling that eye moves quickly. We show that the viewpoint moves to wide region by moving the viewpoint based on the short-term memory image generated using low level features. It is reported that the viewpoint moves to the first word of next line from the end of line in a moment. But we cannot identify the first word of the next line in the end of line, because the resolution is too low in the periphery of the retina. We introduce the short-term memory to identify the first word of the next line in the end of line. The viewpoint can be moved to the first character of next line using the image which is integrated the foveated images saved from the first word identified in the line. We call the image the short-term memory image in this paper. These mechanism is also used the eye movement that we see a word more than two times. If the edge features derived from the short-term memory image in the current word is over the threshold, the viewpoint moves to next word. If not, the viewpoint is in the current word once again.

It is difficult to realize the eye movement in the computation model because eye movement depends on tasks, while the psychological aspects in the eye movement is studied[6]. In the computer vision, the problem that defines the next viewpoint according to tasks is discussed [7][8][9][10][11]. In these studies, the viewpoint is defined according to tasks. But the eye movement based on the images received in the receptive field is not discussed. On the other hand, the

