

Simulation of blur in stereoscopic image synthesis for virtual reality

Benoît Piranda

François de Sorbier

Didier Arquès

SISAR Team, University of Marne La Vallée
5, boulevard Descartes, Champs sur Marne
77454, Marne La Vallée, France

piranda@univ-mlv.fr

fdesorbi@univ-mlv.fr

arques@univ-mlv.fr

ABSTRACT

This paper proposes a method permitting to generate synthesized images including blurred area in real time in order to help stereoscopic perception in virtual reality systems. At any time of the process, the combined knowledge of the scenario and the position of the user in front of the screen allows to select automatically the important zone of the scene. The elements associated to the clear zone catch the attention of the user while the blurred areas avoid an excessive eyestrain.

First, we present several methods permitting to simulate blur effects produced by a thin lens in image synthesis. Then we develop our work on the adaptation of the previous methods in the stereoscopic images context, illustrated by results generated in our own virtual reality system. Finally, we propose different solutions for the treatment of the interdependence between scenario and interactivity in image synthesis animations.

Keywords

real time image synthesis, simulation of blur, virtual reality, scenario, interactivity, stereoscopic images.

1. INTRODUCTION

One of the fundamental characteristics of a virtual reality system [Fuc01] is the immersion of the user in a virtual environment. In a visualization context, the using of stereoscopic image synthesis permits to recreate three-dimensional environments by mentally fusing two images of a single scene.

On the one hand, when the two stereoscopic images are locally different (parallax), it implies an excessive eyestrain or even the impossibility for the user to reconstruct the 3D scene. On the other hand, all objets displayed on screen have potentially the same importance. The real time synthesized images produce a perfectly sharp image in all its surface : the user will cast a glance over the screen.

The main goal of our work consists in both

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WSCG 2005 POSTERS proceedings, ISBN 80-903 100-8-7
WSCG'2005, January 31-February 4, 2005
Plzen, Czech Republic.
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simulating, in real time, the perception of stereoscopic images including depth of field in order to catch the attention of the user in the important areas of the scene, and reducing excessive eyestrain.

In this paper, we first present the main methods permitting to generate stereoscopic images and to simulate the depth of field. Then we detail our new method adapting one of these existing algorithms to the context of the stereoscopic images production applied to virtual reality. Finally, we propose some rules permitting to select important elements in virtual scene.

2. STEREOSCOPY AND BLUR

2.1. Computation of stereoscopic images

The stereoscopic images principle consists in associating an image of the same scene with different points of view for each eye. Thanks to a pair of filter glasses, the user merges these two images in order to create the relief effect.

2.2. Adding blur

2.2.1 Notion of circle of confusion

A lens (simulating human eye) creates an image of an object whose position p is function of the lens' focal length. If we place a projection plane at the position p the image will be sharp else a stain will appear on this plane at the origin of the blur effects.

This stain will be defined as the circle of confusion [Pot82].

2.2.2 Blur calculation methods

We classify the methods of synthesized images production that take into account the depth of field into two categories. First the preprocessing methods that calculate a high resolution image [Coo84] [Woo99], and next the post-processing methods that locally degrade images in order to add blur [Pot82].

One of this methods, that we are using for our work and mainly used in video games, permits to add blur in real time synthesized images [Can01] [Eva01]. It consists in calculating a set of sub-resolutions images (mipmaps). They are all placed orthogonally and linearly in front of the point of view, completely covering the screen. The farther the images are from the original one (in the foreground), the lower their resolution is. Finally, for each pixel, the size of the circle of confusion deduced from the depth map permits to know which plane to display.

3. BLUR IN VIRTUAL REALITY

In the stereoscopic images context, with the addition of the notion of convergence plane that is different from the focus plane, we have to improve the method presented in the last paragraph. Our method consists in placing a set of blurred images before and behind the focus plane. The areas that may cause eyestrain, because of the shifting between two stereoscopic images, can become blurred and as a consequence reduce their interest for the user.

If the images are placed linearly, the transition between two images could be perceptible to the user. So we have organized our images with an exponential function first to reduce the distance between the images close to the focus plane and second to increase the space between remote images. An example of generated image is presented figure 1.

4. THE INTEREST AREA

4.1. Imposing the focus plane position

To direct the attention of the user we position the focus plane in a zone that we define as the interest area. If the user behind the virtual reality screen is inactive we use a scenario to automatically modify



Figure 1 : image with depth of field simulation



Figure 2 : Interactive positioning example

the position of the focus plane during the animation and highlight objects of our scene that have more importance than others. For a given time t , the scenario also modifies the geometrical and radiometrical characteristics of the objects to get the visual result we are looking for.

4.2. Interactive positioning

The degree of freedom of the user can be increased by using his position and orientation in the virtual scene to find the position of the focus plane. For example, the unblurred object is the biggest one in front of the user. So as to place the focus plane, we use morphological parameters of elements in the image, in this way the user will pay attention, for example, to the nearest object in the screen (figure 2).

5. CONCLUSION

In this paper we have presented a new solution for real time stereoscopic images synthesized in the context of virtual reality using blur. By highlighting areas that we have defined as important for the user and by reducing interest of areas where the parallax between two stereoscopic images is too high, this method permits to decrease the user's eyestrain.

The next part of this work will be to empirically validate this solution with sets of users in our virtual reality system.

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