Capture of Omni-Directional Stereoscopic Panoramic Images

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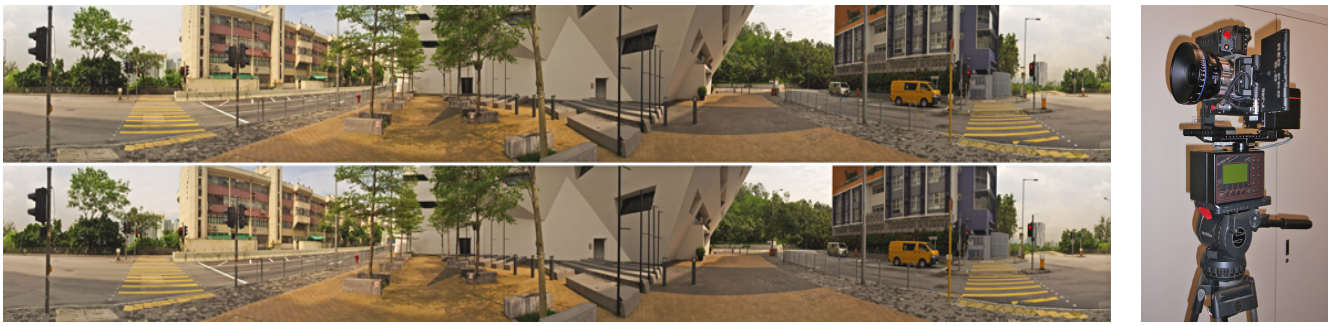

Figure 1. *(Left) Stereoscopic panoramic pair derived using this this technique, potential resolution approximately 32K x 4K pixels. (Right) Red Scarlet video camera offset from the center of rotation mounted on a motorized base.*

1. Introduction

A number of stereoscopic cylindrical displays have been developed over the years, the most recent being the CAVE2. Some of these, unlike the traditional CAVE environments, provide a seamless 360 stereoscopic image without corners [AVIE] and thus can support a heightened sense of immersion. Most immersive displays that consist of discrete walls rely on head tracking and are thus only intended to be a single person experience. For cylindrical displays a method is well known by which stereoscopic panoramas can be presented without the need for head tracking, these stereoscopic pairs are generally referred to as omni-directional [Ishiguro et al, 1992][Bourke 2006]. This allows large cylindrical displays to be constructed that support multiple person audiences with each person potentially looking in a different direction.

As projector and display resolutions improve one of the challenges is how to generate sufficiently high resolution omni-directional stereoscopic content for such displays. This can be achieved for CG and realtime graphics by either a discrete multipass approach or a continuous algorithm usually implemented with a vertex shader. Capturing sufficient resolution omni-directional stereoscopic photographs is more challenging.

One option that mimics the continuous algorithm for CG has been the construction of a rotating slit camera, one such camera is known as the RoundShot. These consist of twin cameras offset horizontally from the axis of rotation. Two long rolls of film are exposed continuously as the camera pair is rotated through 360 degrees. Unfortunately, since these use film in order to acquire the required resolution, their future is uncertain. Additionally they require not insignificant costs for drum scanning as well as image processing and alignment in post-production.

The poster presents a digital method of capturing high resolution stereoscopic panoramic images. Furthermore, perhaps surprisingly, it achieves this by employing a single camera.

2. Implementation

A digital alternative for the film based rotating slit camera has been developed, figure 1 (right). It is based upon a motorized rotating head and employs either a digital video camera (Red Scarlet) or a SLR camera (Canon 5D MKIII). Only a single camera is required, two vertical stripes are extracted from each frame, these are each arranged consecutively to form the stereoscopic panoramic pairs. This technique has a significant advantage in that the inter-ocular separation can be adjusted in post-production.

Historically one of the issues of using a video camera had been the limited vertical resolution. While this improved with HD video where one can acquire a vertical resolution of 1920 pixels (mounted sideways), the recent releases of 4K video cameras such as the RED enables one to capture stereoscopic panoramic pairs that match the resolution of many cylindrical displays.

The problem until recently with the use of still cameras, while they may provide superior resolution they have been limited in their frame rate for full resolution photographs. The Canon 5D MKIII was tested because it can record full frame stills at 6 frames per second. This has allowed stereoscopic panoramas to be captured at 5K vertical resolution and in less than one minute.

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References

MCGINITY, M., SHAW, J., KUCHELMEISTER, V., HARDJONO, A., FAVERO, D.D. AVIE: A Versatile Multi-User Stereo 360 degree Interactive VR Theatre. Proceedings of the 2007 workshop on Emerging displays technologies: images and beyond: the future of displays and interaction. San Diego, California. Article No. 2. 2007. ISBN:978-1-59593-669-1., 2007.

BEN-EZRA, M., PRITCH. Y., PELEG, S. 2001. *Omnistereo: Panoramic Stereo Imaging. IEEE Transactions on Pattern Analysis and Machine Intelligence*. Vol. 23, No. 3, pp. 279-290, March.

BOURKE, P.D. 2006. *Synthetic Stereoscopic Panoramic Images*. Lecture Notes in Computer Science (LNCS), Springer, ISBN 978-3-540-46304-7, Volume 4270, pp 147-155

ISHIGURO, H., YAMAMOTO, M., TSUJI, S. 1992. *OmniDirectional Stereo*. IEEE Transactions on Pattern Analysis Machine Intelligence 14 (2), pp 257- 26.

PELEG, S., Ben-Ezra, M. 1999. *Stereo panorama with a single camera.* IEEE Conference on Computer Vision and Pattern Recognition, pp 395-401, Ft. Collins, Colorado, June.