Omnistereo images from ground based Lidar

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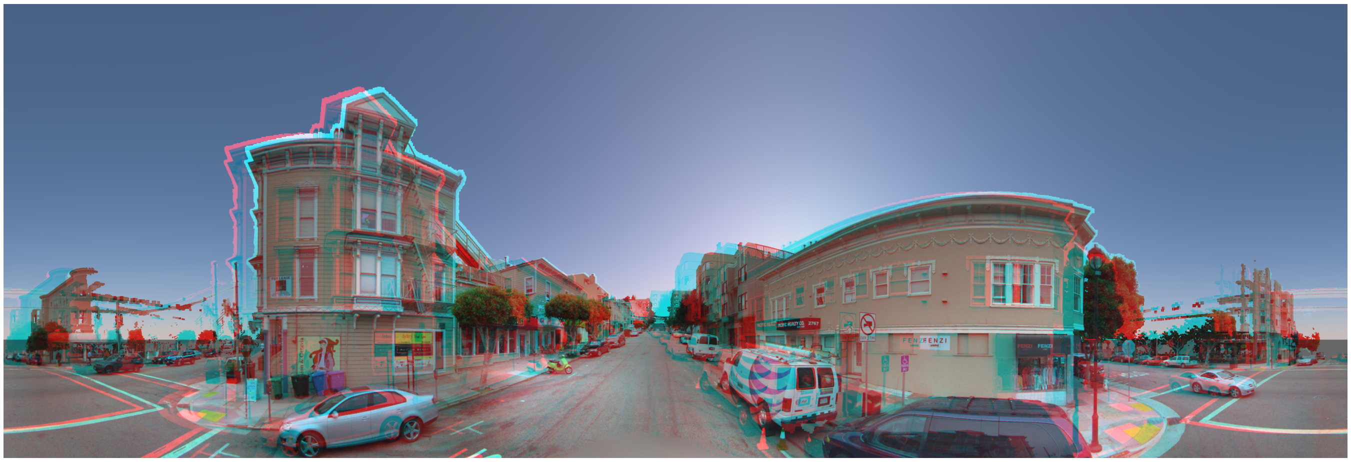

Figure 1: *Red/Blue analygraph of a generated omnistereo image using texture splatting of very dense Lidar and calibrated images.*

1 Introduction

Street level panoramic images provide users with an immersive means to remotely explore street level features. Stereoscopic panoramic images, also referred to as omnistereo panoramics provide an even more compelling view. As 3D display technology becomes less expensive and more ubiquitous; the ability to view these types of images is far easier. In addition to providing a *wow* factor, 3D stereo enhances the sense of scale and distance, factors which are useful when planing a visit a new location. Omnistereo panoramas cannot be photographed by a pair of full 360 $^\circ$ panoramic cameras as each would capture the other when the panoramic image is taken. Typically they are taken by a pair of cameras mounted on either end of a bracket which is then rotated [Peleg et al. 2001]. Each image is broken into a set of successive strips. These strips are then mosaiced together to form the left and right panoramic image. This, however, requires the camera remains stationary while the pictures are taken, and unless the rotation rate and shutter speeds are quite high, that the scene remain static as well. These two restrictions prevent the live capture of panoramic data from a vehicle driving down a busy street. The technique described here uses very dense Lidar and calibrated panoramic images captured by a ground mobile collection vehicle equipped with a Lidar unit and a single panoramic camera, driven at posed speed limits, to automatically create street level omnistereo panoramas. These stereo images are higher quality and therefore more realistic than any other method which uses mobile collection.

2 Process and Results

The basis for this method is textured point splatting [Yang and Wang 2006], which uses point cloud data along with calibrated panoramic images to texture map point splats. This generates much richer imagery than that achieved by point cloud colorization. In textured point splatting, each point is expanded into a small texture mapped camera facing billboard called a splat. A 2D panoramic image is used to texture each splat using spherical texture projection. This is done by projecting the vertices of every splat onto a unit sphere centered at the panoramic image's origin. The resulting spherical coordinates are mapped to the corresponding image coordinate which is used to texture each splat. As this can be done using the GPU the scene cane be rendered about 25 - 30 frame/second depending on the point density. When rendered from the panoramic image's location the result of the splatting is a recreation of the original image for all areas where Lidar data exists.

This technique also provides viewpoint interpolation which allows the the scene to be viewed from a different viewpoint other than the one collected. Like standard stereoscopic images this is the key to creating omnistereo panoramic with street level panoramic images. Each omnistereo image is created by offsetting the camera by a displacement value $\frac{eyeSep}{2}$. Next the full 360 $^\circ$ around the center of the rotation axis (i.e center of the panoramic image) is sub-divided into N slices. This becomes the horizontal field of view. For each slice, the camera is rotated by $\frac{360^\circ}{N}$. When all N slices have been rendered each slice is concatenated together to product a full 360 $^\circ$ panoramic image. This process is repeated for the other eye with the camera displaced by $-\frac{eyeSep}{2}$. The results of these steps is a pair of panoramic images, one for each eye, which can be processed to produce the red/blue analygraph shown in the figure above.

It should be noted that areas without point data can be addressed by merging multiple point clouds from separate drives which would fill in areas not sampled by a single drive, such as areas behind the collection vehicle and parked cars.

References

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YANG, R., AND WANG, L. 2006. View-Dependent Textured Splatting. *Environment 22*, 7, 456–467.

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