2006년도 대한전자공학회 하계종합학술대회 제29권 제1호

바다영상에서의 CG/실사 합성

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CG and Photo-Realistic Image Composition in Ocean Scenes

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Abstract

CG and Photo-realistic image composition in the ocean scenes is frequently used in movies and TV advertisement. But it is very difficult task because it's impossible to use calibration tool in outdoor environment or to use auto-calibration algorithm using natural features like KLT(Kanade Lucas Tomasi feature tracker) from the ocean scene. We propose a simple, effective method for solving camera motion using previous knowledge about background structure. We applied our method to the production of a commercial movie, 'Hanbando' and the result was satisfactory.

I. Introduction

These days, CG and Photo-realistic image composition is used widely in making movies, advertisements and various video contents. For good image composition, exact camera motion tracking is necessary. Auto Calibration method [2] is not proper for deformable background like ocean scenes because it' s not possible to extract reliable feature points in the sequence. Our strategy is to use the previous knowledge about the background structure that the sea surface is a plane. We applied proposed method to the production of a commercial movie, ' Hanbando' which will be released to the public at July, 2006. The result was as excellent as none can find the mismatch between CG objects and the real background.

II. Proposed Method

In our method, we premise that focal length is known and we calculate camera rotation using the horizon information and a few feature points. We start with finding the horizon edges using Canny Edge Operator and Radon Transform [1]. At step 2, we calculate camera tilt and roll from intrinsic camera parameter matrix K and the horizon using eq.(1),(2). At step 3 we track a few Track Points and acquire a Vanishing Point in Figure 1. Track Points were extracted from ships or islands on the real background images and Points which were located parallel to the sea surface were chosen. By using the direction of the Vanishing Point (vector $\mathbf{u}$ in Figure 1) as a reference direction, we can calculated pan angle.

$$\begin{pmatrix} n_x \\ n_y \\ n_z \end{pmatrix} = \mathbf{n} = K^T \mathbf{l} = \begin{pmatrix} f & 0 & 0 \\ 0 & f & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} a \\ b \\ c \end{pmatrix} \quad (1)$$

$$\theta_x(tilt) = arcsin\left(-\frac{n_z}{\sqrt{n_y^2 + n_z^2}} \right) \quad (2)$$

$$\theta_z(yaw) = acrsin\left(\frac{n_x}{\sqrt{n_x^2 + n_y^2 + n_z^2}} \right)$$

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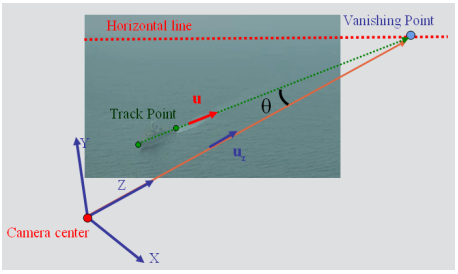

Figure 1. Pan from a Vanishing Point

Finally translation is estimated. Once rotation is acquired in step 2,3, translation can be estimated easily with some feature points of ships or buoys. Acquired camera motion is relative to Ground Plane in Maya working space (refer Figure 2) and we can composite CG objects with the ocean background simply by putting the objects on the Ground Plane and rendering the Moving Camera.

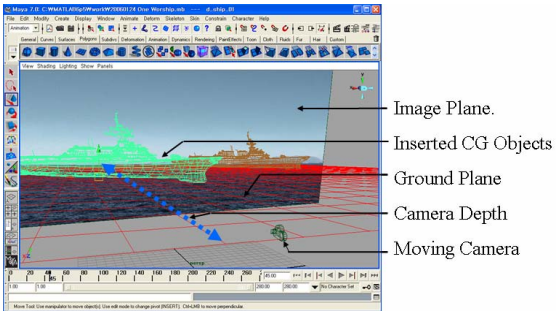

Figure 2. Maya Working Space

Ⅲ. Experiment

We applied proposed method to 11 sequences for the commercial movie, Hanbando' . Some of the sequences are shown in Figure 3 and one rendering result with CG warships is shown in Figure 4. Our tracker is simulated in Matlab environment and composition was done in Maya software. Processing time for calculation of camera motion was very short and it was less than 1 second if we except for the processing time of Canny Edge Operator and Radon Transform. Because we used Matlab function for Canny Edge Operator and Radon Transform, it required long processing time and this is a problem that we should solve by complementing the algorithm in C code.

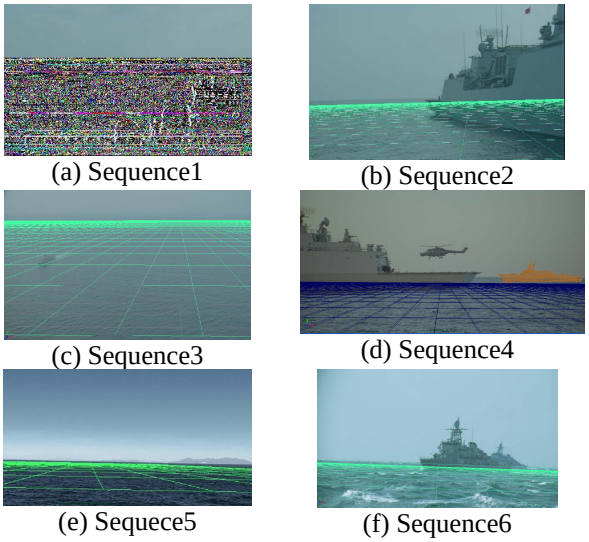

Figure 3. Camera Tracking Result

Figure 4. Rendering Result

IV . Conclusion

Our proposed method is simple but it was very useful for CG artists working for image composition. A lesson that Computer Vision technology can be used for solving important problems in the movie production may be the worth of our research.

References

[1] DEANS, S. R., "The Radon Transform and Some of Its Applications", John Wiley & Sons, 1983.

[2] HARTLEY, R., "Multiple View Geometry in Computer Vision" Cambridge University press, 2003