

Automatic texture mapping on real 3D model

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Abstract

We propose a full automatic technique to project virtual texture on a real textureless 3D object. Our system is composed of cameras and projector and are used to determine the pose of the object in the real world with the projector as reference and then estimate the image seen by the projector if it would be a camera.

1 Introduction

Improved reality consists on adding information, the texture, on a object. In virtual world it is more easier as all parameters can be well controlled. Lack of texture is the key point in the today's reproduction, as stereography. Our propose is to cancel this lack, by adding texture with a projector onto a 3D textureless object, a full blank model which represents garfield. Actually we must synthesize the view seen by the projector as been a camera with the same intrinsic and extrinsic parameters.

The structure of this paper is as follows. First we describe each step of our method, our results are explained and finally the conclusion.

2 Method

Our method, which we want to be fully automatic, can be divided into four parts : calibration, finding point of correspondence, fusion of the views and synthesis view. Only the first part, calibration step, need our intervention to use the grid data to calibrate the system.

2.1 Calibration

The calibration step can be divided into two parts :

- Firstly we use the Bouget Toolbox [1] to stereo calibrate our system.
- The projector projects a known pattern and the now calibrated cameras can triangulate the projected points to give a set of correspondence between 2D and 3D points. Using the Toscani-Faugeras Algorithm [3], the calibration of the projector is done.

Once the system is calibrated, we need to know where to project the texture.

2.2 Point of correspondence

We must determine the pose of the object, but classic algorithm do not work enough well with such a blank object. We cancel this problem by projecting a coded pattern on the object with the projector. The coded pattern is based on the structured light, which means the active use of the projector by projecting a pattern with known points through code, like the Bruijn sequence. In our case we use a binary pattern because we aim to use technique like Cotting [2], who by projecting a pattern and its contrary at high frequency manages to make both invisible at human sight. Each cell of our pattern (see Figure 1), actually each cell of five by five binary pixel, is unique.



Figure 1: Coded pattern



Figure 2: View Synthesis

The epipolar geometry of the system is known, so we only search these points along a search zone centered on the epipolar line. The criteria of correspondence is a threshold on the maximum correlation value (see 1) and we are looking for points of correspondence between either cameras and camera projector.

$$r = \frac{\sum_m \sum_n (A_{mn} - \bar{A})(B_{mn} - \bar{B})}{\sqrt{(\sum_m (A_{mn} - \bar{A})^2)(\sum_n (B_{mn} - \bar{B})^2)}} \quad (1)$$

2.3 Fusion

Once the points of correspondence are found and the 3D points triangulated, we see that the errors due to the calibration can not be ignored. The calibration of the projector is actually depending of this of the cameras, so we register all the views onto the 3D points from the couple camera-camera and we obtain one set of 3D points.

2.4 Synthesis View

The 3D reconstruction of the model can not be completed, so we add a scanned 3D model at our method. The registration of the scanned model with our reconstruction is possible with a few hypothesis : even if we do not know where the real model is , at least we know approximately its orientation. A coarse registration, like the PCA method, is then followed with a fine registration, like an ICP. The last step consists on the retroprojection of the scanned model on the view of the projector and finally estimates the view of the projector (see figure 2).

3 Results

The figure 3 shows the result, the real model without texture and the model with the projected texture.



Figure 3: Real model: Projector off and on

4 Conclusion

Our method, without human intervention or the use of any type of marker, has been presented. We can estimate the pose of a real model in the virtual world and then estimate the view seen by the projector.

References

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