narized as follows:

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g segments in motion images is much techniques -HT and variations, or uously updated from the input points taking advantage of the previously expressing the problem of locating a for a *mixture*, where each elemental of the adaptive nature of the EM put edge image smoothly changes.

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DYNAMIC 3D MEASUREMENT BY USING CODED STRUCTURED LIGHT

J. Salvi, J. Batlle, P. Ridao, J. Freixenet
Computer Vision and Robotics Group
Institute of Informatics and Applications
University of Girona
Avda. Lluis Santaló s/n. 17071 Girona (Spain)
{qsalvi, jbatlle, pere, jordif}@eia.udg.es

Abstract

This paper presents a new coded structured light pattern which permits to solve the correspondence problem by a single shot and without using geometrical constraints. The pattern is composed by the projection of a grid made by coloured slits in such a way that each slit with its two neighbours appears only once in the pattern. The technique proposed permits a rapid and robust 3D scene measurement, even with moving objects.

Keywords: Coded pattern projection, Correspondence problem, Structured light, 3D Scene Measurement.

1 Introduction

There are some essential problems in stereo vision which difficult to solve the correspondence problem by using singular points. Some geometrical constraints can be used to reduce the problem of matching as the epipolar constraint and the disparity gradient. However, the first one does not solve the problem of points without matching and the disparity gradient can not be used at depth discontinuities.

It is known that the correspondence problem can be alleviated leaving off stereo vision, and going to the structured light concept [4]. Most of the proposed structured light techniques obtain 3D information from the geometric constraint propagation, and some of them are rather limited. In recent years the coded structured light technique has increased in importance. This technique is based on an unique codification of each token of light projected on the scene [2] [5]. When the token is imaged by the camera, this codification allows us to obtain the correspondence i.e. to know where it comes from [1].

2 Pattern Presentation

Our goal is to propose a new coded structured light pattern. The technique is based on obtaining 3D scene information from a single pattern shot projection, so that it could be used to measure static and dynamic scenes. The projecting pattern has been designed as such that it could be easily and robustly segmented, allowing us to efficiently solve the correspondence problem without spending a lot of computing time. We propose to project a grid made by coloured slits. Six different colours have been used. As an example we have chosen red, green and blue to code the horizontal slits; and magenta, cyan and yellow to code the vertical ones. But, what is important is that we must chose well spaced colours in the HSI cone, through which they can be well segmented using their hue and saturation components. Moreover, the slits have been coloured with the aim that each slit with its two neighbours froms a unique triplet in the whole pattern [3].

The pattern has been calibrated. We have computed intrinsic and extrinsic parameters using the method proposed by Toscani [7]. Then, we have modelled the lens deformation. We start the iterative algorithm from the parameters obtained by Toscani and a null radial distortion.

Hereafter, a example of 3D measurement is shown. The example shows a real hand illuminated by the pattern and its 3D reconstruction. In order to measure the efficiency of the system, we have measured the $3D$ real point, and we have inferred the $3D$ object point from both projective $2D$ points. The (X, Y, Z) error measured is the discrepancy between real co-ordinates and the inferred ones. We have measured

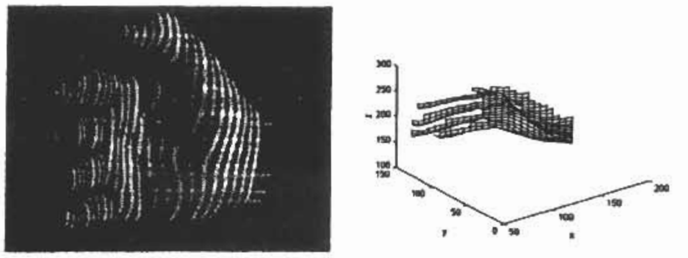

Figure 1: Reconstruction of the human palm.

the error in approximately 100 points. The average values of the error deviate 0.728 *mm.* (0.31%) from the X axe, 0.624 *mm.* (0.27%) from the Y axe, and 0.465 *mm.* (0.20%) from the Z axe.

3 Conclusions

In order to obtain a 3D measurement of either static or dynamic scenes, we propose to project a new coloured grid pattern on the measuring objects. The columns and rows of the grid are codified using six well-defined colours of the HSI cone. Such a codification permits that the pattern could be used to obtain 3D information of the illuminated scene from a single shot projection. Then, an easy and quick decoding step allows the pattern to be used in dynamic 3D measurements.

The results are quite interesting if we take into account that the deviation degree is highly influenced by the segmentation process, i.e. by the image noise and the problem of grabbing the projected lines of the pattern with different thickness. Moreover, the pattern identification is completely constrained by the kind of scene to be measured and the light conditions. Then, when the light conditions decrease, the projection of colour weaks considerably the use of such a kind of pattern. Of course, the utilisation of a digital light projector with a higher resolution, or even a more powerful lamp, will increase the efficiency of the system.

Some applications of the sensor could, in particular, be used within the scope of scene interpretation in mobile robot navigation and tracking of moving objects, and, in general, in any 3D scene measurement where a single shot is allowed and a quick response of the system is required [6].

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MWS: A NEW

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