Use of Local Surface Curvature Estimation for Adaptive Vision System Based on Active Light Projection

Wanjing Li[1,2], Martin Böhler[2], Rainer Schütze[2],
Franck. S. Marzani[1], Yvon Voisin[3], and Frank Boochs[2]

[1] Laboratory Le2i, Building Mirande, UFR Sc. & Tech, BP 47870,
21078 Dijon Cedex, France
{wanjing.li,franck.marzani}@u-bourgogne.Fr
[2] Laboratory i3Mainz, University of Applied Sciences,
55116 Mainz, Germany
{martin.boehler,schuetze,boochs}@geoinform.fh-mainz.de
[3] Laboratory Le2i, Route des Plaines de l'Yonne, BP 16,
89010 Auxerre Cedex, France
yvon.voisin@u-bourgogne.Fr

Abstract. In this paper, we present a new 3D reconstruction approach based on local surface curvature analysis. Its integration can make a normal active stereoscopic system intelligent, and capable to produce directly optimized 3D model. The iterative 3D reconstruction process begins with a sparse and regular point pattern. Based on the reconstructed 3D point cloud, the local surface curvature around each 3D point is estimated. Those 3D points located in flat areas are removed from the 3D model, and a new pattern is created to project more points onto the object where there is high surface curvature. The 3D model is thus refined progressively during the acquisition process, and finally an optimized 3D model is obtained. Our numerous experiments showed that compared to the 3D models generated by commercial system, the loss of morphological quality is negligible, and the gain by the simplification of the model is considerable.

1 Introduction

In computer vision field, 3D surface reconstruction is one of the most important research topics. It can be applied in a wide range of fields: architecture and civil engineering, industrial quality control, archaeology, etc.

Among all the 3D reconstruction techniques, stereovision has attracted a lot of attention of researchers and developers in recent years because of its flexibility, high precision, and relatively low cost. It consists of imaging the object from two or more different points of view and then finding the same surface elements among the different images. If the cameras are previously calibrated, the corresponding 3D positions of the elements can be calculated with high precision.

Stereovision technique can be classified into two categories: passive and active. In passive stereovision, the difficulties of resolving the correspondence problem (i.e., to find out the same surface element in several images) arise if the object does not have strong texture. In active stereovision, as shown in figure 1, structured light technique

J. Blanc-Talon et al. (Eds.): ACIVS 2008, LNCS 5259, pp. 530–541, 2008.