

## Improvement of 3-D Reconstruction by Deformal Stereo Matching Using a Set of Linear Spatial Filters

Sherif El-Etriby, Ayoub Al-Hamadi, Bernd Michaelis  
*Institute for Electronics, Signal Processing and Communications (IESK),  
 Otto-von-Guericke-University Magdeburg  
 D-39016 Magdeburg, P.O. Box 4210 Germany,  
 sherif@iesk.et.uni-magdeburg.de*

### Abstract

This paper presents a stereo matching algorithm to calculate the three-dimensional (3-D) reconstruction. In view of the fact that, stereo images are obtained from the different perspective position, so that each image can have the effect of projective distortion region (foreshortening effects, occlusion region). These effects cause problems because most stereo method compares similarly-size regions (using the same size windows in both images). An alternative approach is presented, which based on the output of linear spatial filters turned to a range of orientations and scales to make the correspondence analysis more reliable and robust. The responses of these filters at a given point constitute a vector called the filter response vector is correlated instead of correlating area in the two images. In addition, an automatic procedure is used to evaluate and optimise the filters set by using the steering theorem and the singular value decomposition (SVD). The projective distortion region are detected to improve the quality of the disparity by adaptive the size of filter kernel, and a 3-D information is recovered. The real stereo images and the reference (true) disparity map are used to benchmark the performance.

**Keywords:** *Stereovision, Structured light, linear spatial filters, correspondence analysis, Steering theorem.*

### 1. Introduction

Recently, stereovision and 3-D reconstruction have received a considerable attention in the field of computer vision. The quest about reliable methods for determining the 3-D surface reconstruction and increasing reliance on the stereovision methods has attended out to find a solution of the correspondence problem (CP).

In the experimental set-up, the surface of a real object is projected on the right and left cameras (Fig. 1). However each projected-image have different viewing characteristics. So, each projected image can have the effect of projective distortion regions. For instant, the differing amount of foreshortening in the two views whenever a

surface is not strictly front-parallel, then the image of the surface is more compressed and occupies a smaller area in one view. Other distortion is the occluded region, which is visible to one camera and not visible to the other when the scene have a depth discontinuities.

Numerous stereovision approaches can be classified into two classes: *feature-based* [5, 6, 7] and *area based* [16, 17, 18] (sometimes also referred to as intensity or correlation-based) correspondence analysis.

A central problem in many existing stereo matching approaches lies in selecting an appropriate window size. However, same window size, reference window and searching window, does not appropriate for projective distortion region. This leads to poor results from area-based techniques.

In this paper, instead of correlating a fixed windows size, the filter response vector obtained from the output of linear spatial filters is correlated.

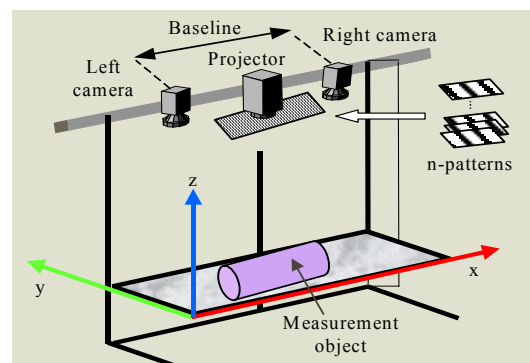


Figure 1: Experimental set-up for the 3-D analysis with active vision.

The method reviewed here use a set of linear spatial filters approach [1], which provides a rich description of the image, with little chance of false matching. This approach is based on convolve the left and right images with a bank of linear filters tuned to a number of different orientations and scales. The responses of these filters at a given point constitute a vector called the *filter response vector* (FRV) that characterizes the local structure of the image patch. The correspondence problem can be solved









