Disturbing Moiré effects in photogrammetric setups using passive structured light

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1.) 3D measurement methods using structured light

Methods, which are using structured light, are encoding the object's surface with a sequence of projection patterns in order to prepare it for a good data analysis of the aquired images. Assuming a perfect encoding of the surface, it would be possible to find a correspondence pixel for every image point, thus yielding a 3D-point for every image point. As it is necessary to analyse two different views both discrete view-grids overlap on the object. If these grids are geomtrically similar there will be an areal modulation of the pixel to pixel overlap on the object, which may have negative side-effects on methods using structured light. We are showing this effect with a technique using statistical patterns to encode the objects surface.

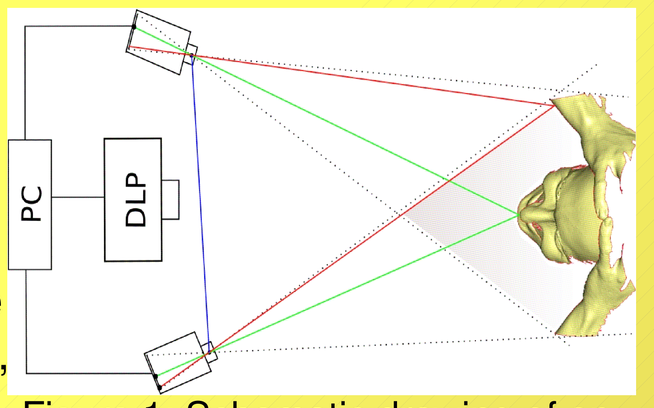

Figure 1: Schematic drawing of an structured light setup

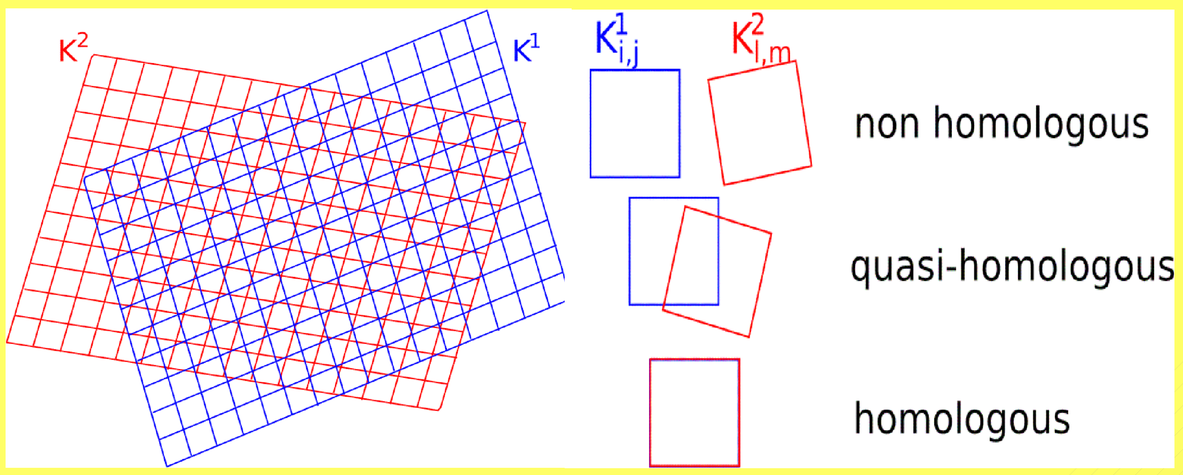

Figure 2: Drawing of an overlapp of two CCD-Grids on an object, as well as an overview of the classification scheme.

2.) Classification of two pixels of different views

A classification of two image points originating from different views can be acomplished by looking at the overlap of said pixels on the object. Image points which overlap perfectly are classified as **homologous points**. As figure 2 shows this case is not realised even for simple setups. If there is a partial overlapp of two image points they will be classified as **quasi-homologous points** as they are supposed to be aligned to each other as correspondence points. If there is no overlap a pair of image points will be called **non-homologous points**.

3.) Structured light using statistical patterns

A sequence of statistical bright-dark patterns [1], [2] is projected onto an object. A stereoview is synchronously captured for every pattern of the sequence. After the measurement is finished the gray-value sequence of every pixel is correlated with the correpondent sequence of every pixel of the second view. The homologous pair according to this method is the pixel-pair which correlates best.

4.) Experimental results

In figure 3 two 3D reconstructions of a plane are presented, which differ only by the relative rotations of the used cameras. The first reconstruction shows a structure of holes in the point cloud. As the cameras were not rotated to each other the structure of both CCD-grids on the object were similar, which creates a moiré like areal modulation of the pixel overlap. The holes are a result of areas where **quasi-homologous points** overlap poorly. The second reconstruction shows the identical scene captured by cameras rotated to each other by 30°. The holes have disappeared. Both grids are rotated to each other on the object so that the moiré disturbance has decreased in size.

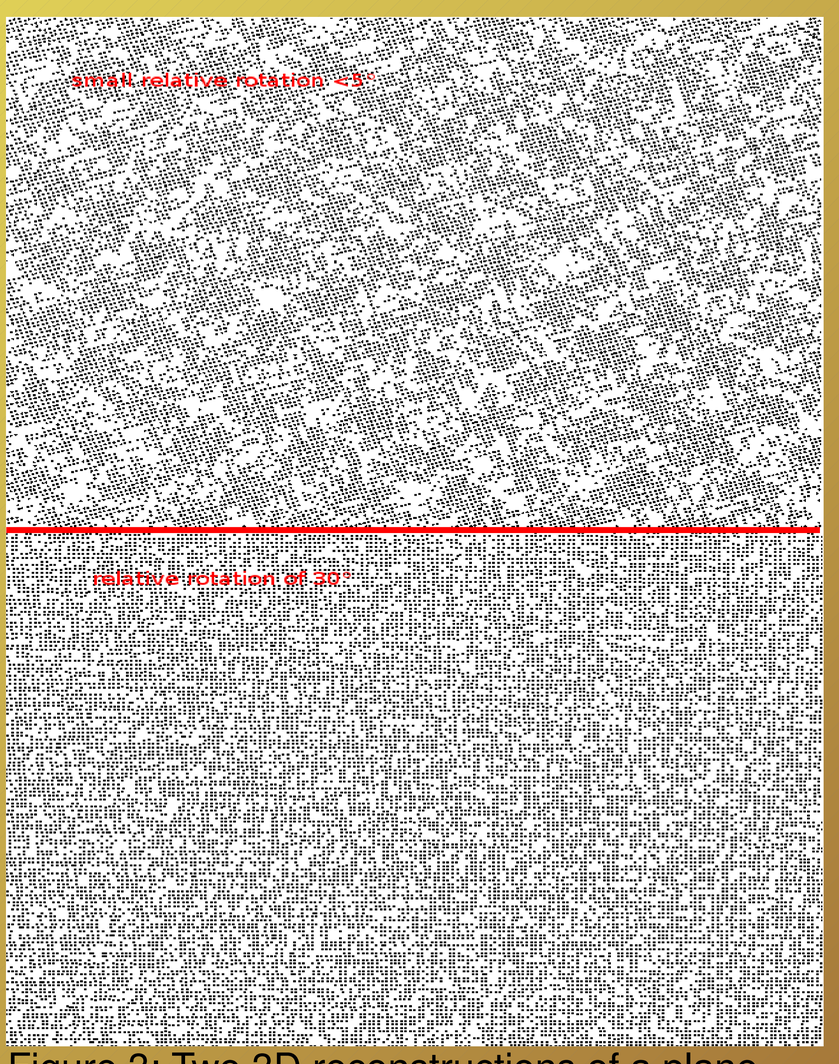

Figure 3: Two 3D reconstructions of a plane, which only differs by the relative rotations of the two cameras

5.) Conclusion

Depending on the used CCD, capture-geometry and object-geoemtry there may be holes in the reconstruction of an object.By slightly rotating both cameras to each other the moiré-like holes were surpressed. By using different CCD cameras for the two views it is possible to avoid the holes without a relative rotation of the cameras. In [3] the results and it's interpretation are supported by using a general illumination model to show the effects of overlapping grids.

Literatur

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2. P. Albrecht, M. Michaelis: Proc. 14th Int. Conf. On Pattern Recognition, Volume I, Brisbane, Australia, pp. 845-849 (1998)
3. M. Große: Untersuchungen zur korrelationsbasierten Punktzuordnung in einem Stereophotogrammetriesystem, Diplomarbeit 2009

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