Object’s Optical Geometry Measurements Based on EDoF Approach

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Machine vision applications are getting more popular in many manufacturing applications. Although vision techniques have many advantages there are still numerous problems related with those methods. One of the drawbacks is that when measuring or performing an inspection task the image resolution must be as high as possible. When inspecting an object of complicated geometry, with a specific lens and camera to achieve a given accuracy, the field of view, or the depth of field might be insufficient for the task. Using cameras placed on manipulators, or on moving stages leads to solving the problem, but it also causes various implementation issues.

During the measurement process when the camera or the inspected object is moving, images are acquired and need to be processed separately. If the inspection task is a simple feature extraction might be sufficient. On the other hand if the image processing is more complex it might take time to process each image separately. For example when a feature is located on the border of a image, to measure it or properly assess, two or more images with the feature need to be combined. When it comes to field of view limitations, there are known methods of image stitching, and combining [1,2].

When the depth of field is narrow, for example when using fixed telecentric lenses the problem is more complex. The Extended Depth of Field (EDoF) is an approach known in microscopy imagining. It allows to stitch images taken form a range of distances that are minimum spaced. Acquiring images of the same object with differently placed depth of field reveals elements otherwise hidden (due to shallow depth of field). The methods of extracting information form a set of images taken with different depths of field is known in microscopy and wildly used [3,4]. On the other hand using EDoF in non-microscopic inspections is not utilized because of the fact of changing the focal distance from the inspected object leads to resizing the object in the frame. The longer the focal length the higher is the compression rate of the imagining.

The authors propose a method of using EDoF in macro inspections using bi-telecentric lenses and a specially designed experimental machine setup, allowing accurate focal distance changing. Also a software method is presented allowing EDoF image reconstruction using the continuous wavelet transform (CWT). Exploited method results are additionally compared with measurements performed with Keyence’s LJ-V Series in-line Profilometer for reference matters.

References: