Quality Evaluation of Surface Embedded Micro-Structures in Injection Moulded Parts

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Embedding certain patterns of micro-structures into a surface, it is possible to create regions that reflect light differently. This can be used to create binary patterns like QR- or Datamatrix codes directly in the molding process. It is of interest to measure the quality of these binary patterns in a functional way.

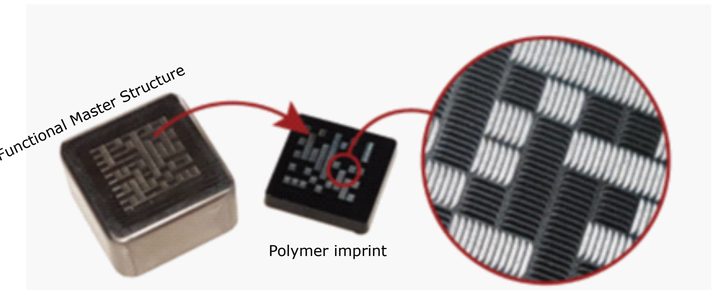

Figure 1

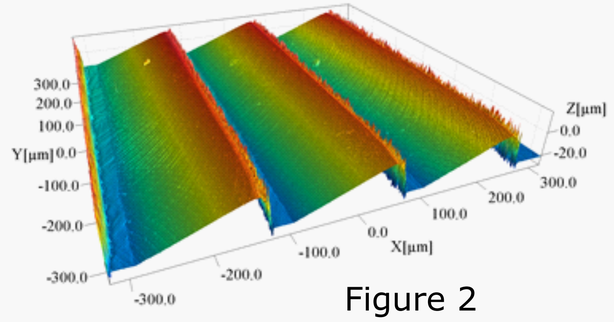

Figure 2

Microscope images like Figure 2 does not show the perceived functionality of the surface and thus we use cameras to observe the pattern under controlled and varying lighting conditions. We use a robotic setup, consisting of 2 robot arms one with a camera mounted on, the other with a lightsource, see Figure 3.

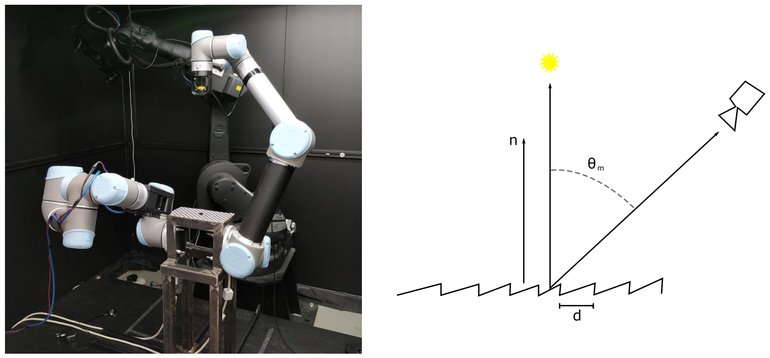

Figure 3

Using this system we can measure the contrast between black and white "pixels" of the pattern at multiple camera and light configurations. This allow us to find the optimal configuration to evaluate contrast for a system embedded in production.

We extract the surface from a High-Dynamic Range (HDR) image using a homography, see Figure 4. Then we can use the ideal pattern to extract black and white regions for contrast measurement.

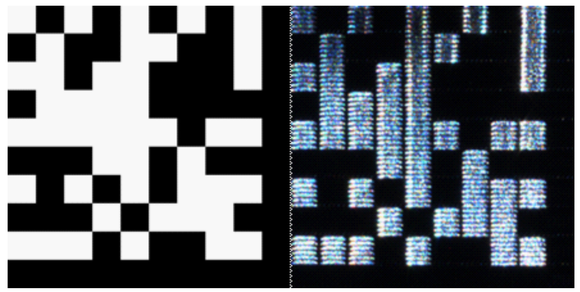

Figure 4

It is impractical to perform a precise calibration of the light source and thus the contrast is on an arbitrary scale. But the scale is constant for all measurements made by the system, this comparison of samples are still valid. Another option is to normalize measurements to highest light intensity. Figure 5 shows this relative contrast for the sample in Figure 4.

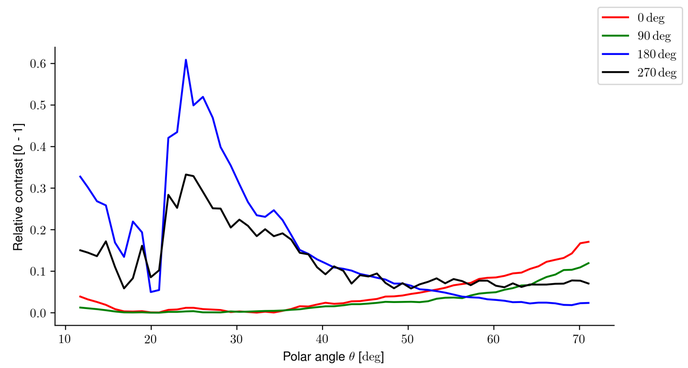

Figure 5