



C58 The Use of 3D Acquisition Techniques of Surfaces for Forensic Image Databases

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After attending this presentation, attendees will understand the possibilities of 3D scanning methods in forensic science

This presentation will impact the forensic community and/or humanity by demonstrating the use of 3D acquisition techniques of surfaces for forensic image databases. 3D techniques for scanning can result in higher recall rates when comparing to an 2D image database.

Techniques for three dimensional acquisition of surfaces are developing rapidly, and are becoming cheaper and faster to use. However, most forensic image databases are still based on two dimensional (digital) photographs. Known examples are databases for tool marks, bullets and cartridge cases. For this reason, a research project has been started on the feasibility of using the third dimension in forensic image databases.

It is important that the surfaces are not damaged by the techniques. For this reason, we have limited our research to techniques that work contactless. Many products have been developed in the manufacturing industry for contactless scanning of 3D surfaces. These products are based on:

- Stereo Photogrammetry
- Laser Scanning Triangulation
- Moiré Fringe Contouring
- Structured light

Stereo Photogrammetry is combining two (or more) images from cameras with a different viewpoint. This is also similar in the way that we see depth with two eyes. A computer can exploit this offset to perform the same operation. If presented with two photographs of an object taken from cameras set slightly apart, it can use the differences between the two pictures to retrieve 3D information from the image. The trick is to let the software firstly identify the correlation between the image pair.

The technique of laser scanning triangulation involves projecting a stripe of laser light onto the object of interest and viewing it from a camera. Deformations in the image of the light stripe correspond to the topography of the object under the stripe and are measured. The stripe is then scanned across (or around) the scene to produce 3D data for the rest of the object.

The essence of the Moiré fringe contouring is that a grating is projected onto an object and an image is formed in the plane of some reference grating. The image then interferes with the reference grating to form Moiré fringe contour patterns which appear as dark and light stripes. Then, analysis of the patterns gives accurate descriptions of changes in depth and shape.

In the structured light approach, patterns of light (grids, stripes, elliptical patterns, etc.) are projected onto an object. Surface shapes are then deduced from the distortions of the patterns that are produced on surface of the object. With knowledge of relevant camera and projector geometry, depth can be calculated by triangulation.

In the literature approaches are known in forensic science with laser triangulation and structured light. Approaches for using laser triangulation are known for crossing ink lines, cartridge cases and faces. The advantage of structured light is that it captures images very fast (less than ten second per scan), the technique is not expensive and it is possible to work with small objects.

We have used structured light for toolmarks and logo's of a drug tablet. With this technique, heights of 5 micron can be measured. One disadvantage of this technique is that, depending on the depth and on the surface that is scanned, occlusions are possible. By measuring the surface under different angles, and averaging the result, it is possible to avoid occlusions. The matching of the different positions is committed with the Fourier Mellin algorithm. The system could be improved by using a stepping motor when turning the tablet. From this research it is recommended to develop a 3D image database in which pattern recognition method are based on the 3D structure instead of the 2D side light image.

Three-dimensional techniques for scanning surfaces are now in the research and development stage in forensic science. As soon as the techniques will become faster, more sensitive, less expensive and more experience with the techniques is obtained, it is expected that they will be introduced routinely in forensic science.

3D, Structured Light, Image Databases