Photogrammetry Manfred Hennecke

There are many variants of photogrammetry, because with increasing computer power today more possibilities are given, eg. 3D-realisation. Firstly, it became developed by the Prussian architect Albrecht Meydenbauer, who published his basic article "Die Photometrographie" in 1867, for architecture purposes. Then the method was transmitted to aerial (or orbital) and satelite photogrammetry. Slowly it became developed towards close-range photogrammetry. Unlike in aerial photogrammetry, close-range photogrammetry deals with objects in a size range from a few centimeters up to more than 100 meters.

The most common fields of application of close-range photogrammetry are industry, medicine ("virtopsy") and biomechanics, plant science (phenotyping) as well as accident recording and forensic. In architecture and archeology, close-range photogrammetry is used for building surveys, eg. for documentation as a basis for alterations and monument preservation measures, recorded as a 360° panorama picture. More over in agriculture crop fields can be easily observed, and in ecology close-range photogrammetry can document habitats, even caves, for further investigation.

Due to technical progress, close-range photogrammetry is not complicated anymore. The company Dr. Clauß Bild- und Datentechnik GmbH, located in the Saxonian oremountain, Germany, developes such systems since 1996. Today this company offers systems to record spherical images at the push of a button. The user has to have no experience with this kind of technology, since the software of the system processes everything automatically to the final picture.

2008: Guinness World Record - Dresden recorded in 26 gigapixels!
2012: Guinness World Record - From the British Telecom radio tower, the largest 320-megapixel panorama is recorded. At the same time, three RODEON VR Head ST record London in thousands of individual recordings.
2015: Guinness World Record - The panorama head RODEON piXpert produces the world's largest panorama with 365 gigapixels from the Mont Blanc.
2016: Guinness World Record - Kuala Lumpur in 846 Gigapixels, the current world record for gigapixel photography.

Photogrammetry with area sensor cameras

Principle & unique features of piXplorer 5oo
Cameras with area sensors are in general DSLR cameras. But such cameras became modified in different ways to be applicable in close-range photogrammetry. Second, to take a 3D-picture the camera has to be turned 360° on the x-axis and moved 180° on the y-axis. The integrated photo lighting brightens dark areas and allows shooting in absolute darkness up to about 10 m distance. Light shape and color ensure a shadow-free illumination with natural color rendering. Interiors often have very light passages and poorly lit areas. Both are best photographed by a so-called HDR process. Windows are no longer bright spots, but open the view to the outside.

Fig. 1: piXplorer 5oo

Three simple steps to the virtual copy of any scene
Without any prior photographic knowledge each event location is captured at the push of a button and at the highest resolution due to the automation of the photographic process. A special "processor software" stitches fully automatic the captured crime scene images to spherical 360° panorama pictures in a very high resolution (512 megapixel) and optimal illumination.

1 Automatic Spherical Photography
2 Automatic "Stitching"
3 Virtual Copy of the Crime Scene

Such technological edge instrument like pıXplorer 5oo comprises quite a bit of advantages:
- fast photographic documentation in highest resolution (4.5 minutes per location)
- battery runtime about 75 locations at working temperatures between -5°C till +40°C
- different lighting conditions are balanced automatically (dynamic range: 26 aperture stops)
- time and cost savings by automatic photo recording and stitching process
- well suited for field operations due to its solid, robust and weather proofed design
- optimal image quality without any prior photographic knowledge
- excellent price-performance-ratio.

Therefore, the piXplorer 5oo is ideal for accident recording and forensic investigations.

Fig. 2: Crime scene documentation with piXplorer CSD model. In all cases, an additional heavy duty tripod has to be used, see picture.

Fig. 3: A built-in LED-ringlight guarantees best results even in dark rooms like cellars.

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Fig. 4: Location scene documentation with piXplorer LSD model. It was absolutly no problem to determinate the plant in the foreground based on the picture due to excellent sharpness. The full 3D-image can be viewed at https://pix500.net/samples/hintersee_1/tour.html. An additional heavy duty tripod is needed for such kind of photo documentation. We recommend ash wood tripods manufactured by Berlebach, Germany, see technology chapter "Vibration damping of wooden tripods".

Close-range photometry is also ideal for phenotyping, because the set of photografic conditions is always constant. This is most important to compare images captured in time-studies.

Photogrammetry with single-line sensor cameras

Principle & unique features of RODEON ForensiScan

Close-up photography becomes extremly complicated on a round object using area sensor cameras. The reason is depth of field, which becomes very small in close-up photography. One solution to overcome this problem would be z- or focus-stacking. But, a round object photographed by an area sensor camera is never distortion-free. To overcome both problems in a very elegant way is the use of a single-line sensor camera. Using such a camera, the object has to be turned regarding to the width of the line-sensor. Additionaly, if a fingerprint is placed on the surface of a mirror, it is very difficult to capture it by area sensor cameras, as the image is mirrored on the backside of that mirror, giving an over-layed doubleimage. As the RODEON ForensiScan always captures perpendicular to the surface, double images can effectively avoided.

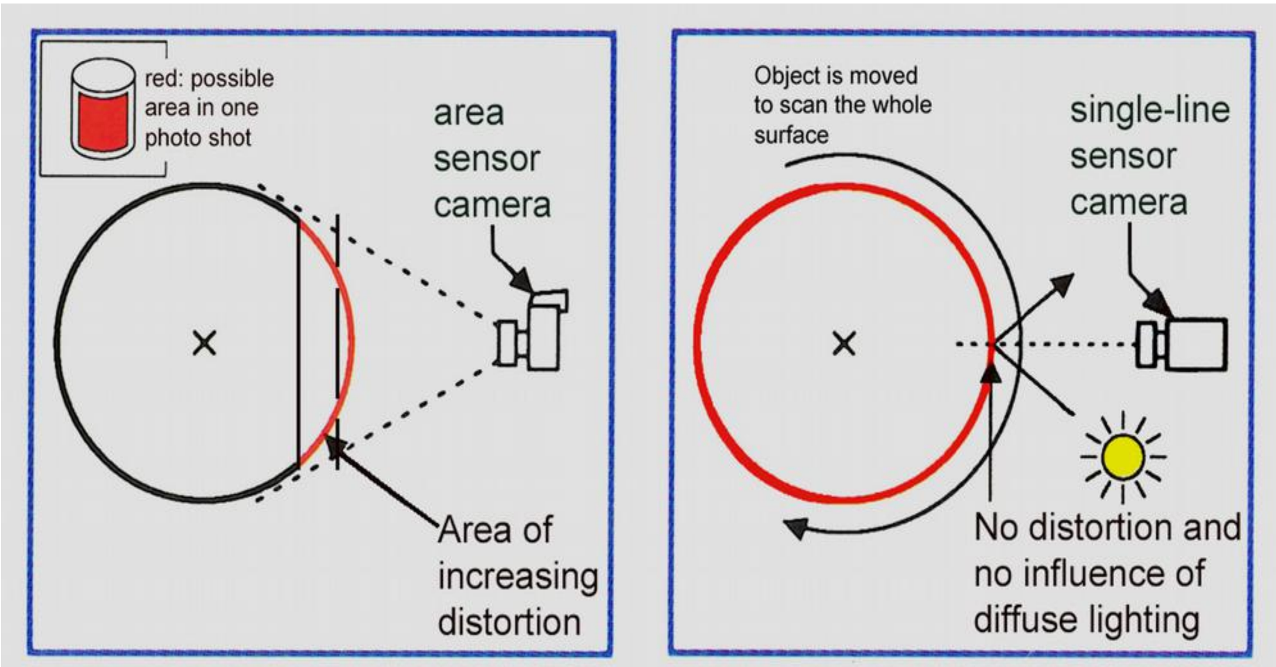

Fig. 5: Differences between the photo capture of area sensor cameras and single-line sensor cameras. in the last case a turntable has to be used.

Fig. 6: RODEON ForensiScan uses a single-line sensor camera. In front is the moving table, where round objects are fixed. In the background is the single-line sensor camera.

Fig 7: Cuck-jaws to fix round samples

Fig. 8: Linear moving device to fix mirrors

Fig. 9: Linear light for best illumination

Typical round items for RODEON ForensiScan are projectiles, bullet casings, ampoules, bottles, lighting fixtures, syringes or cans, fixed on the turn table. Highly reflective items that are eligible for RODEON ForensiScan processing include mirrors, CDs, credit or debit cards, knife blades or transparencies, fixed on the linear moving device. Such investigation with the RODEON ForensiScan does not change the evidence holder or the trace, so that they can be further evaluated (eg examined for DNA traces) or stored. At the same time, RODEON ForensiScan's innovative measurement process reduces effectivly the investigation time as well as the process costs of forensic trace documentation.

At the same time, RODEON ForensiScan's new recording concept also opens up new ways in which "complex" forensic traces can be evaluated and recorded. Thus, the RODEON ForensiScan offers not only the flat illumination of evidence but also the ability to selectively use a linear, parallel to the recording direction lighting variant. By recording directly in or directly next to the reflection plane of the illumination, the surface of an object can be selectively scanned (registered) and a new recording quality can be achieved. Disturbing double reflections, as often occur on specular objects, or artifacts in transparent objects can be effectively hidden.

Fig. 10: Finger print from a glass surface