A NEW APPROACH TO ONLINE 3D MEASUREMENT

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KEYWORDS close range, mobile, industrial application, 3D point measurement

KURZFASSUNG

Der Bedarf an mobilen 3D Messsystemen für Industrieanwendungen hat sich in den letzten Jahren enorm gesteigert. Einige photogrammetrische 3D Messsysteme stehen bereits zur Verfügung und stehen im täglichen Einsatz. In dieser Veröffentlichung wird ein neuer Ansatz beschrieben, bei dem mechanische und optische Antastung durch inverse Photogrammetrie kombiniert werden. Der Ansatz und die praktischen Einsatzmöglichkeiten werden im Folgenden beschrieben.

ABSTRACT

The demand for mobile 3D measurement systems for industrial applications has increased rapidly in the past years. Some optical photogrammetry based 3D systems are available and in the daily use. In this paper a new approach is described which shows a combination of optical and tactile techniques using inverse photogrammetry. The approach and the practical applications are described in the following.

1 INTRODUCTION

The mobile 3D measuring technology is gaining more and more importance in industry. The transportation of objects to coordinate measurement machines is time-consuming and leads to delays and interruptions of production and to extended set-up times. A mobile 3D measuring system offers a quick and flexible control on the shop floor, avoids expensive production interruptions and reduces set-up times to a minimum. These advantages offers the new approach to online 3D measurement, realized in AICON's mobile 3D probe **ProCam**③.

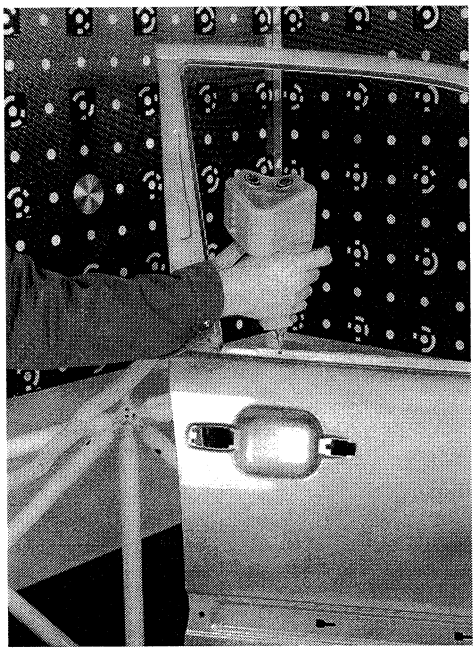


Figure 1: 3D Probe ProCam③

2 Operation Principle

The mobile measuring device **ProCam**③ consists of an active probe with three integrated CCD cameras and a portable PC for the system control. The probe is equipped with a measuring tip to touch object points. During measurement the cameras are facing a field of control points that is located nearby on portable or fixed panels. Pushing a button at the probe releases the measurement after the tip has contacted the object. The result is immediately shown on the computer. The resulting 3D coordinates can be analysed either with an integrated tool or linked with third party analysing software. So it is possible to represent the measured points in comparison with CAD data.

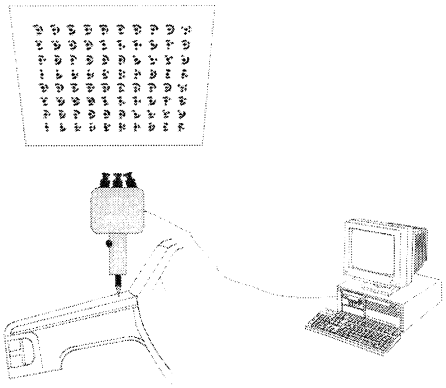


Figure 2: System Configuration

3. SYSTEM CONFIGURATION

3.1 Active Probe

The probe that is designed according to ergonomic aspects incorporates three micro-CCD cameras. The measurement is released by pushing a button at the handle. The measuring points are illuminated by an integrated flashlight enabling the system to be operated independently from any surrounding light. The T-box to be carried at the belt includes the control electronics, display and control panel with which the complete software is controlled.

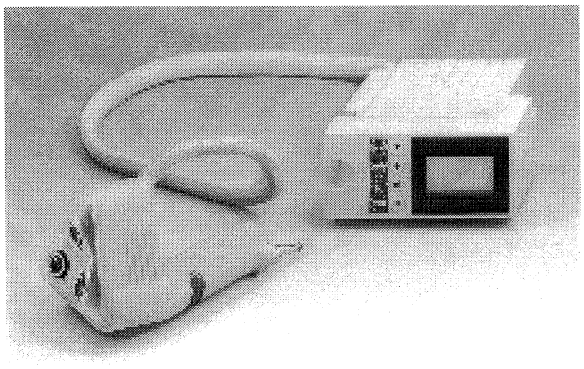
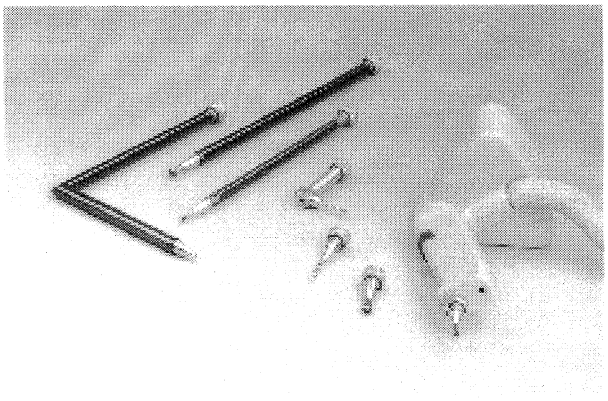


Figure 3: Active Probe and T-Box

3.2 Probe Tip



The probe tips are exchangeable and available in various shapes and lengths allowing the measurement of any point e.g. hidden points or holes. The probe tip is attached to the measuring probe with a standard bayonet joint and can be exchanged as often as desired requiring no calibration after the exchange.

Figure 4: Mobile Probe with Probe Tips

3.3 Target Panels

By using fixed or transportable target panels it is possible to install stationary or mobile measurement stations.

The transportable target panels are made of carbon fibre plates with a size of 600 mm x 800 mm, 800 mm x 1,200 mm or any individual size. Each panel is equipped with reference targets which are optically coded for identification. The target panels are measured with high precision and can be placed near the object with fixtures like tripods or clamps.

For the stationary operation of ProCam, reference targets are fixed to a wall or ceiling, and the coordinates of the reference points are once determined with high precision. The measuring volume may have any size so that objects of any size can be measured.

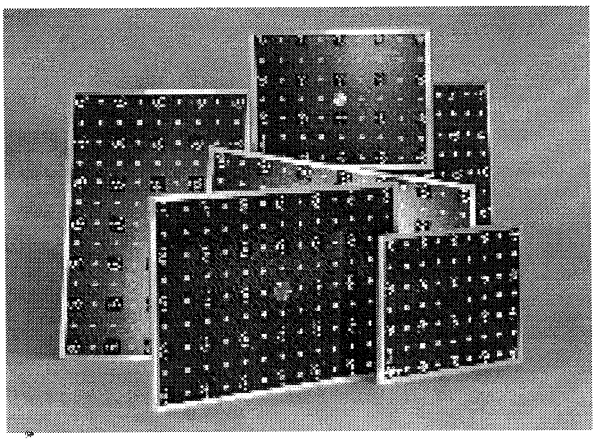


Figure 5: Target-Panels

3.4 Analysing Software

The **ProCam**® software offers interfaces to several measuring software packages as Metro***soft CM.*** These software packages allow the definition of the coordinate system, the measurement of geometry elements as well as a CAD comparison. The results can be analysed statistically with a graphic output. The database structure offers the possibility to define measurement routines as batch jobs and integrated tools for measurement according ISO standards are available.

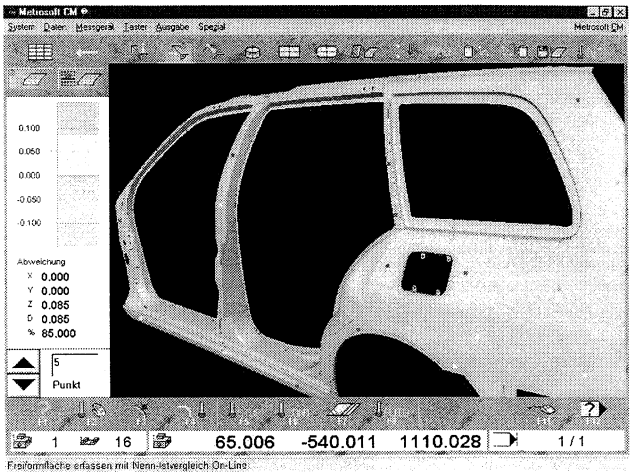


Figure 6: User Interface Metro*soft CM*

4 APPLICATIONS

4.1 Mobile Application

The mobile 3D probe **ProCam**③ is a mobile measurement system. This allows quick and flexible onside testing of single values or complete objects. The setup time of the system is very short. Before the measuring starts, one or more panels are placed beside the object in a distance between 1 or 2 meters. The panels are fixed on tripods or with other fixing devices at larger frame works or profiles. Afterwards the relative position of the panels will be derived using the probe itself. Therefore the images are captured from the panels from different directions which are processed by the system software using photogrammetric algorithms to define the relative orientation of the panels. This procedure takes about 2 or 3 minutes. The number of panels to be used is not limited, so theoretically an unlimited measurement volume can be achieved.

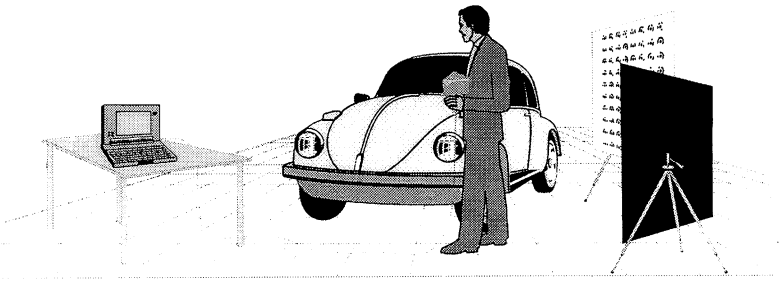


Figure 3: Mobile Application

4.2 Stationary Application

For a stationary application of **ProCam**③ one or more panels are fixed installed. An alternative is to stick the reference target directly on surrounding walls or frames. This reference field will be surveyed once with a higher accuracy using digital photogrammetric systems or laser trackers. The size of a reference point field controls the measurement volume, so that also in stationary applications theoretically unlimited measurement volume can be realised. If a stationary measurement place is once installed, the measurement of an object can directly started without any additional setup time.

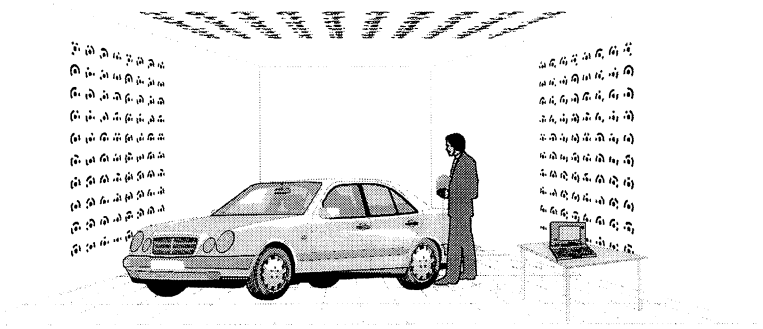


Figure 4: Stationary Application

5 ACCURACY

The accuracy of ProCam is independent from the size of the object. Only the distance between probe and reference targets is relevant. The accuracy is approx. 5 x 10^{-5} of the distance (e.g. distance 2 meter, accuracy ± 0.1 mm). This offers a very high accuracy potential for small and especially large objects.

6 PRACTICAL EXAMPLES

The field of application of ProCam regarding both the stationary and mobile use is nearly unlimited.

In a manufacturing hall, it is for example possible to easily install measurement stations at various places so that only one probe can be flexibly used for measurements at different places. It is not necessary to consider erection or set-up times, since the system is ready for operation within a few minutes.

The mobile application allows a fast check on site. The component no longer has to be transported to a measuring device so that a decision can be made directly on site on the basis of the measuring results. This reduces set-up and testing times and thus shortens product development and production start-up.

Figure 5: Stationary Application for Car Body Measurement

The following measuring tasks are typical for the use of ProCam:

- Deformation analysis in the crash measurement
- Measurement of large welded constructions
- Final component check and variance comparison with CAD data
- 3D measurement directly at testing stands
- Tool measurement
- Setting up and positioning of subassemblies

7 References

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