

# DPS

## Digital Photogrammetric System

Advanced High Precision Digital Photogrammetric Metrology System

### System Features

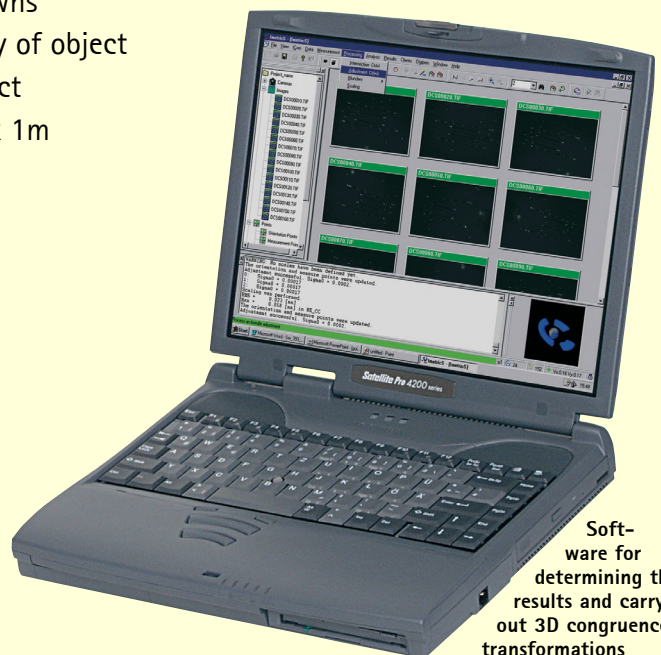
- Unaffected by surrounding conditions e.g. vibrations, dust etc.
- Short time of object occupation
- High degree of automated image processing
- Very flexible configuration via hand-held camera with only one operator
- Documentary evidence of an objects geometrical properties as part of quality management
- Restitution of object's 3D-geometry by bundle adjustment
- Intersection of lines of sight from camera centres to object points
- Resulting 3D co-ordinates of measurement points, camera positions and accuracy estimations of all unknowns
- Typical achieved accuracy of object points :  $\pm 0.1\text{mm}$  for object of dimensions 5m x 2m x 1m



High Resolution Digital Camera  
(3000 x 2000 Pixel)



Precision Equipment that is  
robust and easy to handle



Soft-  
ware for  
determining the  
results and carrying  
out 3D congruence  
transformations

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### Advanced High Precision Digital Photogrammetric Metrology System

#### Introduction

Industrial 3D measuring technology has become an elementary part in modern production processes. It is used both in production control and product development. Mobile 3D measuring technology provides the opportunity to carry out error analysis directly on site without lengthy interruptions of production or transport to the measuring instrument. The DPS mobile 3D industrial measuring system offers all of these advantages.

#### Range of application

The DPS offers a wide range of application, covering objects in sizes from a few centimetres up to many metres, e.g. in ship construction where object sizes may amount to 30 to 40 metres. The fact that the camera is hand-held and can be therefore highly flexible makes the DPS a much appreciated measuring instrument, especially with large

objects or objects that cannot be transported. The same is true for narrow places or areas with limited accessibility since the camera does not need to be mounted on a stable base. Equally convincing is the swiftness of use – results are there shortly after the picture has been taken.

The most typical measuring tasks for the DPS are:

- Measuring of large steel constructions and concrete segmental tunnel linings
- Inspection of circularity, e. g. in tunnelling
- Deformation analysis e.g. in crash measuring

camera as a recording sensor. The object to be measured is photographed from different angles so that all relevant object areas are covered. The digital images are processed afterwards (off line mode) or simultaneously (on line mode) in the evaluation PC, and the 3D coordinates of the relevant geometry points are calculated. This calculation is based on the principle of spatial triangulation of images (photogrammetry) and is carried out automatically by the evaluation software.

There is no need for elaborate pre-calibration of the system since the calibration dates are automatically determined during the measuring evaluation. The measuring itself can be carried out by the client's staff after a short period of training.

#### Operation

##### Signalization

The objects measured with the DPS 3D industrial measuring system are marked with measuring markers or adapters in places relevant for the geometry. There is a wide range of possibilities to signalize not only simple surface points but also hidden or hardly accessible points. Customized adapters for a speedy signalization of the object under test are individually developed in-house. Measurements conform to national and international standards due to the use of high precision and certified scales.

##### Measuring

The DPS is a mobile optical 3D measuring system using a digital

##### Evaluation

After the image data have been transferred to the evaluation PC, the calculation of the 3D coordinates is run largely automatically. Data analysis is done directly in the system or by external software packages.



Signalized Concrete Segment



Coded Marker

# DPS

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### System Components

#### Software

The core of the measuring system is a software package of bundle block adjustment and geometry verification. This software permits fully automated evaluation of digital images independent of the type of camera used. It can easily be adapted to different measuring tasks and therefore is optimally suited for all requirements. In addition to the 3D coordinates of the points relevant for the geometry, the software delivers an extensive statistical analysis of the results with specific details on the accuracy of each value. This enables the user to judge the quality of the measuring results directly. Further processing of the 3D coordinates determined is done by the program itself or by export into the usual CAD programs.

#### Camera

The current model used as recording sensor is the Kodak DCS 660 with a sensor size of 2000 x 3000 pixels. The DCS 660 offers the possibility to save the photographed images directly on a PCMCIA card of type I, II or III or via Firewire (IEEE 1394) directly on the PC. It is possible to use other digital cameras or several digital cameras at the same time (on line mode).

Another important accessory is the ring flash. Bright focal lighting from the direction of the recording axis guarantees that the retro-reflective targets stand out clearly from the background. With suitable lighting and exposure the background vanishes almost completely and the image only shows the reflecting target as the base for calculation.



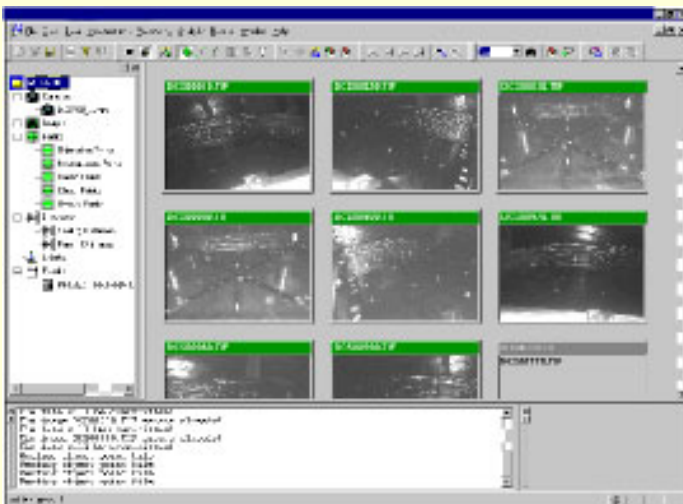
Camera Kodak DCS 660



Camera with ring flash

#### Accessories

Retro-reflective targets are used for signalization. They are made of circles cut from a reflecting foil. This foil consists of a tight arrangement of reflecting beads. A ring code is cut from black foil material and glued onto the circles. The ring code is unique to each retro-reflective target and enables automatic recognition of the pass points. To indicate scale in the picture taken, scalebars are used. They are made of non-warping glass-fibre reinforced plastic (GRP). Attached to them are coded retro-reflective targets in distances that are calibrated to 3/100 mm.



Photogrammetry Image Files