



A New Sensor for Surface Process Quantification in the Geosciences - Image-Assisted Tacheometers

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ABSTRACT:

The quantification of earth surface processes in the geosciences requires precise measurement tools. Typical applications for precise measurement systems involve deformation monitoring for geo-risk management, detection of erosion rates, etc. Often employed for such applications are laser scanners, photogrammetric sensors and image-assisted tacheometers.

Image-assisted tacheometers offer the user (metrology expert) an image capturing system (CCD/CMOS camera) in addition to 3D point measurements. The images of the telescope's visual field are projected onto the camera's chip. The camera is capable of capturing panoramic image mosaics through camera rotation if the axes of the measurement system are driven by computer controlled motors. With appropriate calibration, these images are accurately geo-referenced and oriented since the horizontal and vertical angles of rotation are continuously measured and fed into the computer. The oriented images can then directly be used for direction measurements with no need for control points in object space or further photogrammetric orientation processes. In such a system, viewing angles must be addressed to chip pixels inside the optical field of view. Hence dedicated calibration methods have to be applied, an autofocus unit has to be added to the optical path, and special digital image processing procedures have to be used to detect the points of interest on the objects to be measured.

We present such a new optical measurement system for measuring and describing 3D surfaces for geosciences. Besides the technique and methods some practical examples will be shown. The system was developed at the Vienna University of Technology (Institute of Geodesy and Geophysics) – two interdisciplinary research project, i-MeAS and SedyMONT, have been launched with the purpose of measuring and interpreting 3D surfaces and surface processes.

For the in situ measurement of bed rock erosion the level of surveying accuracy required for recurring sub-millimeter to millimeter measurements of the same area in the field is demanding. To measure for example current day erosion rates point probing techniques require a rock anchor as reference point disturbing the vicinity of the sampling area and such measurements are only valid for a very limited part of the object. A precise method for quantification of areas larger than 1 m² with sub-millimeter accuracy is “badly needed”, but not available off the shelf. The method should be non-contacting as well as non-disturbing and suitable for field use even in remote areas. Image assisted measurement techniques combine the pointing precision of a theodolite with the ability of mass point measurement from stereo imagery. A high-precision contactless detection of changes of surfaces is possible.

In comparison with laser scanners, image-assisted tacheometer measure objects with higher accuracy; compared to photogrammetric systems, they can be easier used for on-line measurement processes (e.g. object monitoring) – this will especially be the case if the measurements can be performed with a high degree of automation.

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