Krzysztof Chmielnicki, Konrad Eckes: **Testing the Suitability of Spatial Printing Technology for Engineering Applications (for Presentation of Topographic Surface)** • Geomatics and Environmental Engineering 2014, Vol. 8, No. 3

The final result of the architect's designing work is the visualization of the project in the form of a drawing or a picture on the screen. Such screen images have many advantages, there are, however, some flaws of this method (of visualization), which makes it necessary to build physical models of the projected objects. The observation of physical models requires no hardware, the observed model is seen using the principles of everyday experience of the observer – as a realistic three-dimensional object and – it can be observed in real time from any site. Moreover, one can directly determine the spatial relationship between its component parts.

Physical models can be elaborated manually or using modern printing technology – 3D. Three-dimensional printing technology involves building a model of layers. Subsequent layers are superimposed on each other, but their shape is given in numerical form – according to the programmed design model. The layers are bound together creating a stable physical spatial model.

The aim of this study was to use the 3D printing technology to visualize terrain objects. As the source object for testing the 3D printing technology four Kraków mounds have been used. These objects were a well selected experimental basis, both because of the shape of the surface topography, and the associated engineering structures (paths and walls).

The source data was obtained from the GNSS measurements and from airborne and terrestrial laser scanning.

For the models prepared on the basis of GNSS measurements some inaccuracies of mapping were observed, due to the insufficient number of the source points. The models based on the clouds of points from laser scanning showed high accuracy in reproducing all terrain and engineering details.

In conclusion we list the temporary 3D printing flaws like: the time-consuming printing process and the high technology

cost. Advantages and possible applications lie in the creation of architectural models and in the renovation of monuments.

**Keywords**: visualization of the topographic surface, physical models, spatial printing, 3D printing, airborne laser scanning (ALS), terrestrial laser scanning (TLS), interpolation of 3D surface

Janusz Dąbrowski: **Optimization of Setting out Controls in Aspect of Stakeout Accuracy of Engineering Objects** • Geomatics and Environmental Engineering 2014, Vol. 8, No. 3

This work presents the process of designing and measuring local controls for setting out whose coordinates of points should be determined with such accuracy that staked out engineering structures were determined within the taken limits of construction tolerances. To solve this problem a global inaccuracy index of determining coordinates of points of the setting out control has been proposed. Definition of the index is based on the covariance matrix of two orthogonal functions $F_d$ and $F_k$.This parameter is connected with equation of geodetic observation network, so it depends on network scale. Functions $F_d$ and $F_k$ describe distance and direction (angular) deformations of geodetic network. The function $F_d$ represents linear form (differential) of sum of distances between geodetic network points in all dual combinations. The function $F_d$ is the sum of projections of partial coordinates $dx$ and $dy$ of each point of the control on all directions determined in the relation to other points of the control. But the function $F_k$ is orthogonal to the function $F_d$, hence, it represents the sum of projections of partial coordinates $dx$ and $dy$ of each point of considered control on directions being orthogonal to all directions considered for the function $F_d$.

On the basis of such defined functions and a covariance matrix for the coordinates of points of a setting out control a covariance matrix cov[$F_d$,$F_k$] is determined. Transformed out matrix onto parameters of the constant probability density ellipse illustrates the global inaccuracy of the considered control. The covariance matrix cov[$F_d$,$F_k$] illustrates linear and angular deformation of geodetic network (realisation network), resulting from its survey inaccuracy. The ellipse mean error illustrates extreme directions of these deformations. That means it does not depend on geodetic network orientation.

The invariant of this matrix, defined in this work, constitutes the base for the selection of optimal variant for measuring the designed setting out control with connection to the permissible value of the construction tolerance. All considerations were carried

out with an assumption that the global interval inaccuracy of determination of coordinates of all considered points within the control should be less than the limited construction tolerance multiplied by a quantile of the Student's t distribution.

**Keywords:** setting out control, optimization, construction tolerances

Janusz Dąbrowski: **Accuracy Standards of Tying the Horizontal and Vertical Control Network to the National Geodetic Control Network** • Geomatics and Environmental Engineering 2014, Vol. 8, No. 3

The thesis proposes the specific task of the least squares method basing on estimation algorithm of point coordinates of horizontal and vertical control network and with different conditions of connecting to National Geodetic Control Network, included in the tie construction. Classification and properties of different types of reference systems for realization network has been formulated on the basis of Gauss–Markow model with random parameters, using block matrix algebra. Formulas for differentials estimates to approximate coordinates have been derived, along with covariance matrix, seperately for the national geodetic control points and horizontal and vertical control points. On the basis of these values three criteria were formulated in relation to tying horizontal and vertical control network to the national coordinate system.

A numerical example inserted at the end illustrates all stages of random parameters estimation as well as the way in which the analysed horizontal and vertical control network is tied to the national coordinate system.

**Keywords:** horizontal and vertical control network tying, point coordinates estimation

Judyta Książek: **Methods for Detection of Asbestos-Cement Roofing Sheets** • Geomatics and Environmental Engineering 2014, Vol. 8, No. 3

It is estimated that currently in the Republic of Poland there are about 14.5 mln tonnes of asbestos products, mainly eternit panels. The problem of detection and utilisation of asbestos-containing materials is extremely important due to their detrimental impact on human health. Pathogenic effects of asbestos are associated with the inhalation of its airborne fibres that can cause respiratory diseases, such as: asbestosis, lung cancer, mesothelioma

of pleura and peritoneum. Therefore, it is important to explore available methods to try to develop technology for detection and location of asbestos in the human environment.

The paper presents the previous experience in the field of remote sensing detection of asbestos roofs which have been described in the literature. Furthermore, it was described own experiment which checked the possibility of visual detection of asbestos roofing on high resolution orthophotomaps.

Results of this work suggest that the potential for automatic detection of roofing materials have hyperspectral aerial imaging methods. Research are worth continuing because public administration authorities are interested in introduction to GIS the location of asbestos roofs for the efficient management of their utilisation.

**Keywords:** asbestos, remote sensing, hyperspectral data, orthophotomap

Przemysław Kuras, Łukasz Ortyl: **Selected Geometric Aspects of Planning and Analysis of Measurement Results of Tall Building Structures Using Interferometric Radar** • Geomatics and Environmental Engineering 2014, Vol. 8, No. 3

Ground-based radar interferometry is a technique which has been used for several years to measure displacements. The IBIS-S system, which is the result of the practical implementation of this technique, allows us to measure position changes of the observed points, for example, on tall building structures.

This article presents practical issues associated with planning displacement measurements of tall building structures. The influence of the SNR coefficient on the efficiency and accuracy of the measurements has been discussed. A lot of attention was paid to the geometric parameters of the measurement, i.e. the range resolution, the projection factor and the characteristics of antennas, as well as to a need to take them into account at the observation planning stage. Also, interdependencies between the parameters of the radar operation in a dynamic mode were determined. The authors also highlight a necessity of converting radial displacements into the real ones, which are often occurring during the observation of tall structures, and the resulting problems.

**Keywords:** interferometric radar, tall building structures, displacements, measurement planning

Anita Kwartnik-Pruc: **Practical Problems of Delimitation of Real Estate under the Provisions of the Water Law** • Geomatics and Environmental Engineering 2014, Vol. 8, No. 3

Land covered by water is a special type of object entered into the register of land and buildings. It is a separate usable land which includes: land under the internal marine waters land under surface flowing waters and land under surface still waters. These types of usable land do not constitute an exhaustive list of all the areas covered by water. Land under ponds and land under ditches are registered as agricultural land as well.

The Water Law provides for a specific procedure for adjusting boundaries between the land under waters and the adjacent land, which is different from the procedures regulated by the Geodetic and Cartographic Law. However, in practice, the implementation of this procedure encounters numerous problems due to imprecise regulations.

This article analyzes the existing provisions of law on determining the boundaries of land under inland waters. Based on the author's own experiments and the available studies, the practical problems in the implementation of this procedure were emphasized. It was proposed to complement the Regulation so as to indicate clearly the successive stages of the proceedings and the persons responsible for their implementation.

**Keywords:** the Water Law, boundaries between the land under waters and the adjacent land

Wojciech T. Witkowski: **Implementation of the Least Squares Method in Determining the Parameters of Knothe's Theory** • Geomatics and Environmental Engineering 2014, Vol. 8, No. 3

The article presents the currently used method of forecasting the impacts of mining on the surface in Poland. Consideration has been given to the importance of the parameters of Knothe's theory and the need for the designation for various mining and geological conditions. The paper applied the strict method using the observational equations to determine the parameters of the theory. The proposed calculation algorithm has been implemented in the program Scilab 5.4.1 and the accuracy of the application has been analyzed. Finally, the program has been used to determine the parameters in different regions of mining.

**Keywords:** mining subsidence, parameters estimation, subsidence coefficient, the angle of influence range, subsidence prediction, the method of least squares