CONTROL MEASUREMENTS USING MOTORIZED TOTAL STATIONS AND FIELD COMPUTER

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ABSTRACT

In the area of measurements monitoring the position of checkpoints in space there are new instrumental solutions being developed: servo-motors, ATR (automatic target recognition), PR (power search), etc. These elements enable to accelerate the measuring process considerably, make the results more objective, help avoid target identification mistakes, introducing the possibility to conduct "continuous" measurements supervised by the operational system of an instrument or a field computer. The article presents the monitoring measurement results obtained by means of measuring systems built in the Institute of Applied Geodesy, under the author's supervision.

1. SYSTEM GEOSURVEY

The system developed by me to carry out measurements automatically by means of Leica instruments enables to control these instruments, collect measuring data, visualize intermediate results, change their graphic representation, analyze measuring data and react properly by using signaling and alarm procedures (the Internet, SMS, etc).

2. BEZMIECHOWA EXPERIMENT

During the tests of an air-shed structure at Bezmiechowa, measurements were made of a spatial control network (Fig.1) in a semi-automatic mode, by means of a motorized station TCM 1800 following the procedure of the system program TPS 1000 – MONITORING. The results of the measuring experiment confirmed high functional suitability and accuracy of the system for studying displacements in engineering space structures. The obtained results can constitute a set of data used to carry out static and dynamic analyses of structures.
Additionally, studies of geometry changes of selected structure elements were made by means of a laser distancer DISTO Pro, remotely controlled under the supervision of the GeoSurvey (Fig.2). Daily geodesic observations showed clear correlations between registered linear changes and those of the thermal structure (Fig.3). Due to the application of such a tracking system of changes the completion of this task was exceptionally easy and effective.

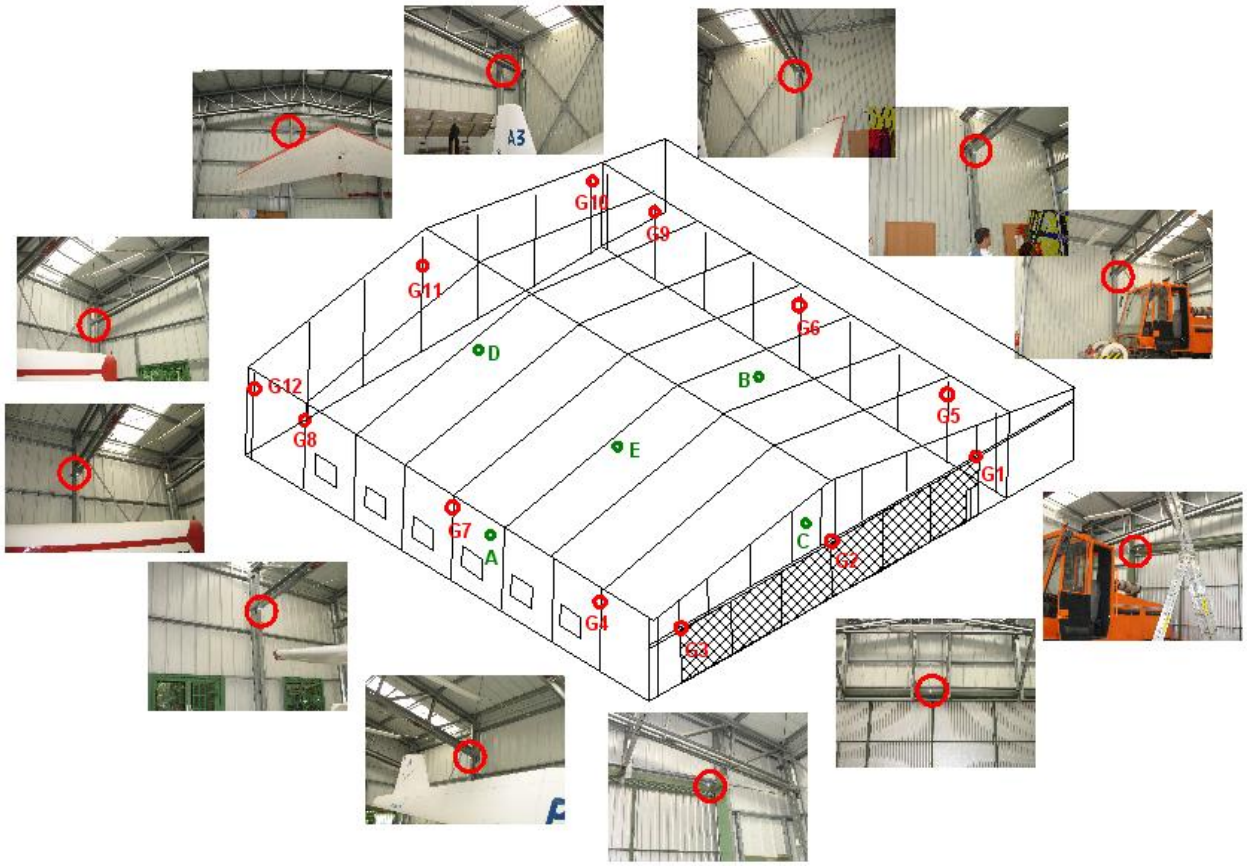

Fig. 1. Diagram of locating the checkpoints.

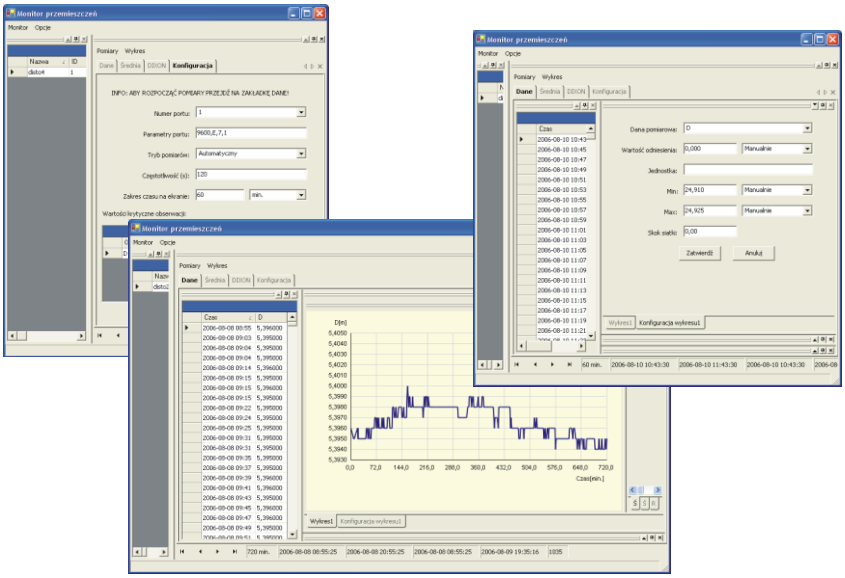

Fig. 2. System of communication windows in the program.

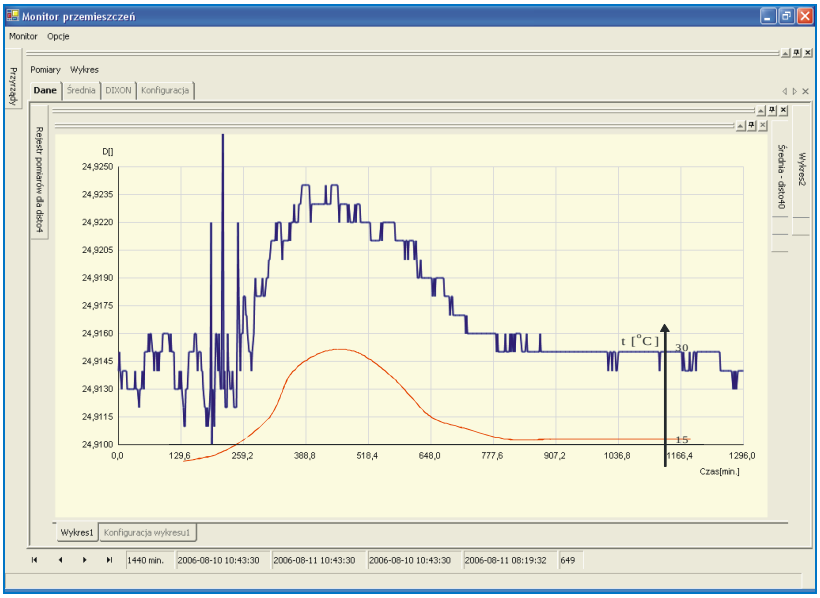

Fig. 3. Presentation window of the diagram.

3. GEOROBOT SYSTEM

This system is geared to Leica instruments (TCM 1800) used for radio or wire control of the measuring process. The system enables to register observations manually and sequentially in the automatic or semi-automatic mode. It has a very well developed user's interface. It is perfect for registering periodically repetitive measurements. Its communication interface is exceptionally well developed.

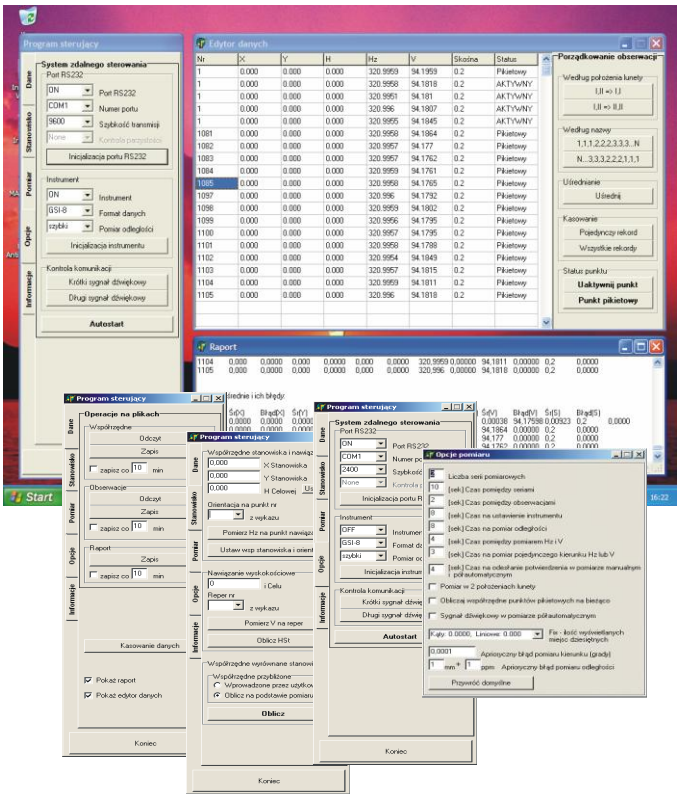

Fig. 4. System of editing windows in the GeoRobot program.

4. SERVO-TC SYSTEM

It has been geared towards monitoring measurements, repetitive in their character and enabling on_ and off_ line operation. It can be operated both in the passive and active mode. The job of the former is to "define" the set of targets for predicted cyclic measurements and to determine their current positions. The job of the latter is to repeat observation sequences according to an established schedule. Data from all measuring stages are collected and can be post-processed.

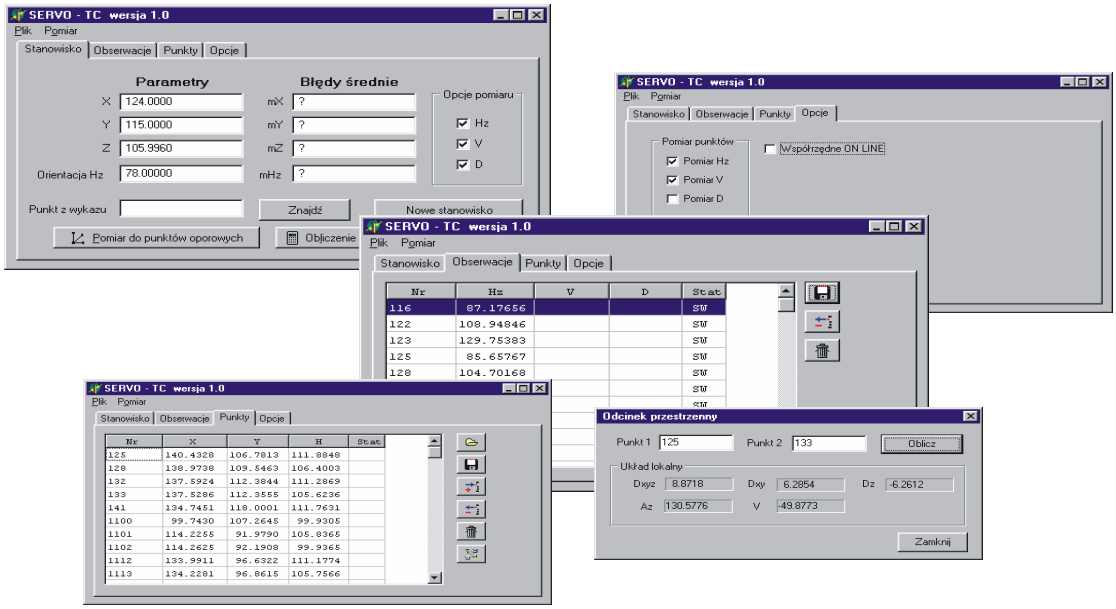

Fig. 5. System of data management windows of the Servo-TC.

5. MECHANISMS OF AIDED AIMING (ATR)

Very favorable elements of automatic monitoring systems are mechanisms supporting automatic aiming. These systems are not free from mistakes. Their malfunctioning depends, i.a., on target length, reflector type and its direction orienting.
The best reflector for angle-line measurements is the CCR type (corner cube reflector). However, due to high costs involved, the application of such a solution is justified only in very special cases. The amount of result disturbances of a distance measurement due to orientation changes of the telemeter aiming system has been illustrated below (Fig.6). The size of the changes is significant solely in the case of measurements of the highest accuracy.

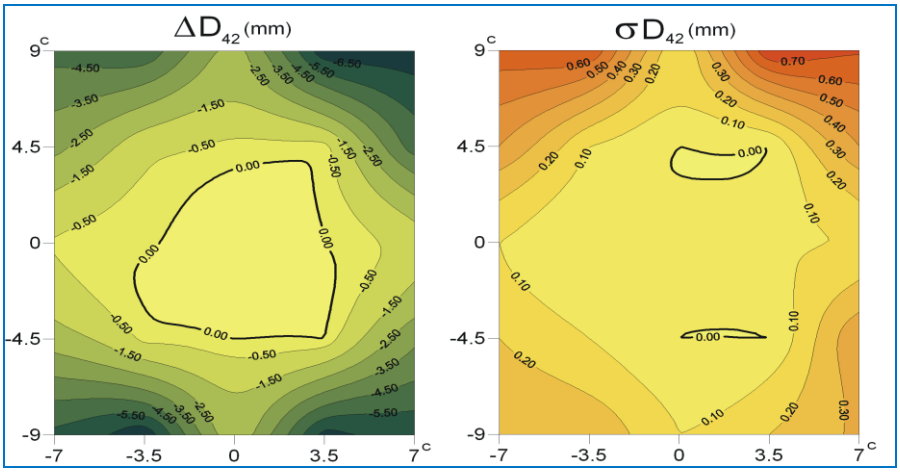

Fig. 6. Graphic representation of distance measurement deformation and its incorrectness.

6. ŻAR MEASURING EXPERIMENT

One of the experiment elements was to determine the movement characteristics of selected points in the crest of the upper Żar reservoir, both horizontally and for its tilts while the upper reservoir of the Żar pumped storage power station was filled and emptied. (Fig.7).
Geometrical changes were registered with a TDA5005 instrument and lengthwise and crosswise deflections - with a T2002 teodolite. Measurement results provided many valuable data about the behavior of the studied structure and enabled to assess the advantages and disadvantages of the automatic monitoring system without an "observer's" involvement in the daily observations of changes in the geometrical characteristics of elements of the reservoir structure.

Fig. 7. Dam of the upper Żar reservoir

Fig. 8. TDA 5005 on its position during the round-the-clock monitoring.

7. FINAL CONCLUSIONS

• Measuring systems involving motorized stations, additionally equipped with essential aiming aids are the main structural elements of the displacement monitoring system.
• The only limit in this respect is the need to provide appropriate stability for targets by means of prism reflectors.
• It is possible to use as measuring units "permanent" stations placed in "cages" or to carry
out observations from temporary, non-stabilized stations.
• An important element of the system defining the real position of checkpoints is appropriate
integration of all measurements into a uniform "stable" system of coordinates.
• The results of monitoring measurements, in their final form, should be stored and made available by means of an appropriate data storage and distribution system.

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