# PERSPECTIVES FOR THE APPLICATION OF THE PHOTOGRAPMETRIC METHOD FOR LARGE-SCALE DETAILS AND STRUCTURES.

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*Abstract:* This paper examines the practical applicability of the photogrammetric method for technical control of the quality indicators, tolerances of form, location and dimensions in the heavy machine industry, using widespread non-specialized software products.

*Key words:* photogrammetric measurement method, non-specialized software, heavy-duty machinery.

## 1. Introduction

Photogrammetric is a scientific discipline based on the geometric relation between objects in space and their photographic images. The characteristic of modern photogrammetric methods is that processes are largely mechanized and automated. For this purpose special photometric instruments and apparatuses have been designed, which are improved with the development of optics, mechanics, electronics and achievements in photogrammetric [4, 5, 8]. The present work is devoted to exploring the possibilities of implementing the so- photogrammetric for technical measurements using readily available and relatively inexpensive photographic equipment and software [1, 2, 3].

**1.) Current state of the method: (micro and small dimensions)**

In Bulgaria, photogrammetric penetrated in 1908, when the first photographic was made in the countryside of Sofia and was mapped by the designer Edward von Orell. Immediately after the First World War, several photos were taken in the Rhodopes and around Sofia, but a more substantial attempt to introduce terrestrial photogrammetric for topographic purposes was made in September 1928. The first introduction of monochrome photogrammetry in Bulgaria begins with the preparation of plans for the settlements and a plan in scale 1:2000 of the irrigation field of a dam called "Al Stamoliiski" at that time. This gives rise to the extensive use of the method and imposes a series of organizational and technical changes to photogrammetry in practice. The problem of controlling the accuracy of machine detail dimensions always lies in the focus of research as its importance in terms of quality assurance of the final products is substantial and the time required to carry out the control operations in relation to the total production time of the articles is significant [5]. The traditional contact methods for measuring the geometric dimensions of the objects are accompanied by significant measurement uncertainties, due to a number of factors, for example: wear of contact surfaces of measuring instruments, reading errors, temperature deformation errors, [6,9] For non-contact measurement methods, this type of error is minimal or absent, the measurement accuracy achieved is significantly higher. Typically, instruments used in non-contact measurement methods work on the principle of optical data conversion or laser scanning [7, 9]. The cost of these appliances is too high and the requirements to the environment in which they will work and the qualifications of the service staff are essential. The use of the principle of photogrammetric is widely applied in a number of areas such as ground mapping, geodesy, space research, geography, architecture, building, ecology, cadastre, medicine, forensic science, military engineering, artillery, geoinformation systems where objects have significant dimensions. The application of photogrammetric in the field of technical measurements as well as the determination of the accuracy of the dimensions of the machine parts, where the size of the objects is considerably smaller, is in a relatively early stage on a global scale. The basis of the method is the use of pre-coordinated photographic pictures and pre-coordinate orientation, which are handled by specialized software [2, 10]. In this processing, the so-called reference points are used, which serve as a reference for calculating the coordinates of multiple points of the object so as to obtain a digital image. In practice, there are many companies that develop and market software for such processing. In view of the rapid development of photographic and computer equipment, software

products and their ever-decreasing cost, the use of photogrammetric in the field of technical measurements would be an inexpensive, rapid and effective method for controlling the accuracy of geometric dimensions of machine parts.

**2.) Opportunities to apply the method to large dimensions.**

For a long time in the production of large structures in machine-building (welding constructions of power tools - tractors, load-bearing self-propelled machines - excavators, fadroms, etc.), there is an acute need for a method which involves low cost, and the equipment needed, is expedient enough not to violate the production plans in its application, also be sufficiently precise to satisfy the requirements of the customer and the relevant production, which makes it applicable. For the control of large-scale machine-building structures mainly roller blinds (universal and specialized), trackers and others are used. All these measuring devices are limited in practice with their range and instrument constant. All this makes photogrammetric promising to apply the method to large sizes. It is a fact that, in many cases, production in a finished construction is subject to minimal deviations from the structural documentation, which would not function properly to make the product unsuitable. Then there is a correspondence between the production unit and the author of the technical documentation, which correspondence includes a request to the author whether he would accept the article with that deviation. The question is what method is chosen for control, what the error of the method and the means is and whether it will be repeatable to the client. As a rule, measurement values are usually sent to the author of the documentation. But it is also necessary to explain the methodology, the means, etc. This is another reason for expanding the scope of the method to large sizes.

The deformations of engineering structures and large machine-building structures arise from structural changes in the particles of building material under the influence of external forces (the load). If the load does not exceed the limit for the durability of the material, after the load has ceased, the facility or structure (as a result of the interaction of the particulate material) acquires its original form. In heavy loads, residual deformations occur, and in very high loads, the bond between the particles of material is interrupted and destruction occurs. This can be done not only with buildings and facilities, but also with machines and details. In this field, the photogrammetric method also has its future application [5].

## 2. Conclusion

In conclusion, it can be said that the method has been developed for application in the field of small and medium sizes. It has been studied with sufficient accuracy and uncertainty and has been found to satisfy the requirements in these two areas of application in the technique.

It can be assumed that the method is also applicable to measuring dimensions and deformations and to large details and constructions, but this should be investigated with scientific methods to confirm or reject this hypothesis.

The accuracy of measurement in the photogrammetric method is evident from the mean square errors in the coordinates of the points of the perspective image obtained according to the Gaussian Law on Error Distribution [4,7]. For the measurement of small machine-building structures, hull details, etc. similar in general mechanical engineering, accuracy [7] can be considered normal. Considering the fact that the visual resolution of a person with normal vision from a distance of 20cm is 0.1mm / 100μm /, the error is found to fluctuate but the maximum is 100μm. This is the thickness of the stroke on the main caliper scale. In other words, this may be taken as a cumulative positioning error of the start or end marker in the process of defining the measurement distance on the monitor with randomly selected software.

Here again, the fundamental question arises whether this accuracy is achievable for the application of the method and for large dimensions of constructions from the field of heavy mechanical engineering, where other factors other than the factors studied have influenced?

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