Topic: "Optimization of the establishment of blanks during machining in the conditions of CAD environment"

Member of the scientific jury: Assoc. Prof. Eng. Georgi Georgiev Komitov, PhD

1. Topic and relevance of the dissertation

Machining is a process in which the shape, size or surface qualities of a workpiece are changed by removing material using tools and machines. The main goals of machining are to achieve accurate geometric dimensions, ensure the necessary surface roughness and quality, prepare the part for assembly or coating and eliminate defects from pre-treatments.

Basing or establishing is the process of selecting support surfaces, securing the workpiece in the correct position and orientation, and ensuring accuracy and repeatability in the processing of parts. Optimizing the establishment of blanks in machining in a CAD environment is a key step in modern manufacturing that has a direct impact on machining accuracy, preparation time, material consumption and production process efficiency. Machining requires accurate positioning and fastening of the workpiece. CAD environments allow for preliminary simulation and analysis, which reduces errors in actual setup. The result of the application of CAD systems is an improvement in accuracy and a reduction in time and resources through the intelligent use of virtual tools.

The topic chosen by the author is relevant in view of the application of modern methods in the production of details. CAD is used not only for designing, but also for simulating the fixation and positioning of workpieces, allowing for more precise toolpaths and control. On the other hand, CAPP acts as a bridge between CAD and CAM, and installation planning remains complex and often experience-based, despite significant technological advances. CAD/CAM systems are increasingly using automation, artificial intelligence, digital twins, cloud computing and machine learning to optimize parameters, processes, analytics and simulation – part of the overall digitalization and industrial transformation related to the Industry 4.0 era and Industry 5.0 concepts.

2. Research methodology

A methodology has been developed for selecting the optimal scheme for establishing the blanks in the fixtures and its constructive implementation. A systematization of the possible schemes of basing the blanks in the fixtures for installation during mechanical processing has been carried out with a view to its use in computer-aided design. An analysis of the BE structures in the special devices has been carried out.

A choice of a computational module is made to determine the inaccuracy from the basing. An algorithm has been developed and dependencies have been proposed for determining the dimensions of the base elements depending on the basing scheme.

An algorithm for automated design of an optimal establishment scheme has been developed, according to which the optimization of the given scheme is carried out through modules for selection of SU according to the criteria for accuracy, reliability and cost.

A structural diagram of the classes and their logical relationships with the CAD product SOLIDWORKS is created. The model of the object of design is represented as a set of bodies consisting of a set of surfaces and a table with the geometric and dimensional parameters of the given body.

I believe that the presented methodology of the study is up-to-date and leads to the solution of the set goal and tasks for implementation.

3. Dissertation Contributions

The contributions in the abstract are divided into scientific-applied and applied. Scientific and applied contributions are the results of the research activities of the PhD student, which have not only theoretical value, but also applicability in practice. They combine scientific knowledge with practical benefits. Applied contributions are the results of the research and professional activities of the PhD student, which have direct practical significance. They solve real cases by improving existing processes, methods, tools.

I accept the contributions in the abstract as presented by the author. They represent an original contribution of the author and the team with whom he worked. They relate to obtaining new scientific knowledge, to enriching existing ones and to the practical applicability of the results obtained, and I define them as relevant and significant.

4. Publications and citations of publications on the dissertation

Five publications were presented on the dissertation, which reflected the main results. Two of the publications are in English and the others are in Bulgarian. One of the publications is independent, and the others are developed in a team. One of the publications is visible in the Scopus bibliographic database.

This gives me reason to assume that the participation of the candidate is equivalent to that of the other members of the authors' team in the respective publications.

5. Authorship of the results obtained

Original results have been obtained from the systematization of the possible schemes of basing the blanks in the fixtures for detection in mechanical processing with a view to its use in computer-aided design. During the analysis, the criteria for geometric compatibility have been developed, allowing the selection of the SB to be carried out. It satisfies the geometric shape of the workpiece, the choice of BE structures when using different technological bases in terms of their purpose and their maintainability.

A general model of an automated system for selection of the optimal scheme of settling in the fixtures for fixing blanks using CAD systems based on three-dimensional solid modeling has

been obtained. Authentic databases were obtained for the selection of a base element for various supports such as "permanent", "spherical" and "special".

Models have been developed for the operation of an automated system for designing devices for establishing blanks during machining. A structural diagram of the program package necessary for the selection of an optimal establishment scheme has been developed. A methodology has been developed for practical implementation of the automated system for selecting an optimal detection scheme.

All these results give me reason to assume that the results of the dissertation of Eng. Ali Gitan are credible.

6. Opinions, recommendations and remarks on the dissertation

The dissertation is a completed development in terms of problems and solutions, which fully meets the requirements for the scientific degree of "Doctor".

Some technical inconsistencies were made in the design of the abstract. This remark does not diminish the merits of the dissertation.

I have no comments on the abstract.

7. Conclusion

I believe that the dissertation of Eng. Ali Gitan meets the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria and I give him an overall positive assessment.

The results achieved give me grounds to propose the acquisition of the educational and scientific degree of "Doctor" by Master. Ing. Ali Abdulkarim Gitan in the field of higher education - 5 "Technical Sciences", professional field - 5.1 "Mechanical Engineering", doctoral program - "Technology of Mechanical Engineering".

14.07.2025   **Signature:**

                                                        /Assoc. Prof. Eng. Georgi Komitov, PhD /