

REVIEW

on a dissertation for the acquisition of the educational and scientific degree
"doctor"

Author: Eng. Ali Abdulkarim Gitan

Topic: "Optimizing the set up of workpieces during mechanical processing in a CAD environment"

Reviewer: Assoc. Prof. Eng. Angel Dimitrov Lengerov, Phd., Technical University of Sofia, branch Plovdiv

1. Relevance

The development of mechanical engineering production is closely related to the modernization of production facilities based on the application of the latest achievements of science and technology. An important stage of technological preparation is the design of the necessary devices, as well as the creation of constructive and technological documentation. Studies show that the costs of technological preparation in a number of cases reach up to 70% of the value of the final product. The improvement of technological preparation, through the creation of systems for automated design of technological equipment, allows to shorten the production cycle and significantly reduce the cost, to increase the quality of the designed structures and the resulting technological documentation. A number of objective difficulties currently limit the automated design of devices, with the help of computer technology, individual tasks of the design, which is carried out in the traditional way, are solved. Many existing automated design systems have specialized modules for the development of technological equipment, but they mainly include the design of casting molds, dies, molds, and the design of fixtures for fixing the blanks is carried out according to the design scheme of a simple product. This approach is not rational, since fixtures are specialized structures to which special requirements are placed during design. Therefore, it is necessary to supplement the design modules with specialized blocks for the development of fixtures.

One of the most complex and laborious tasks in the automated design of fixtures is the selection of an optimal scheme for setting up the workpieces. The quality of the designed technological process depends on the solution of this problem - processing accuracy, time for setting up and removing the workpieces, the service life of the fixture and the costs of its manufacture. Therefore, it is necessary to supplement the CAD modules with specialized blocks for selecting optimal schemes for setting up the workpieces, the development of which is of particular relevance when using integrated CAD systems that are well integrated with CAM modules of technological production.

In this regard, the work aimed at the automated selection of an optimal scheme for setting up the workpieces in mechanical processing is relevant for solving the

entire complex of problems related to the automation of technological preparation of production.

2. Review of the cited literature

Analyzing the bibliography to the dissertation work, it may be concluded that the doctoral student has entered with understanding into the scientific problem. A total of 103 literary sources were used, of which 17 are in Latin. The doctoral student has reviewed a sufficient number of publications, which allowed him to become familiar with the many statements, with some unsolved problems and, as a result, to accurately formulate the goal of the dissertation work and the tasks that have to be solved to achieve it.

3. Research methodology

In developing the dissertation, the systems approach, object-oriented design and analysis, as well as the fundamentals of the scientific specialties "Mechanical Engineering Technology" and "Automation of Engineering Work and Automated Design Systems" were used. Overall, I assess the conducted research as significant, and the obtained results as reliable.

4. Characterization of the nature and assessment of the credibility of the material on which the contributions of the dissertation are built

4.1. Structure

The dissertation work contains: table of contents, abbreviations used, introduction, 4 chapters, classification of contributions, publications on the dissertation, literature, declaration of authorship in a total volume of 119 pages, which includes text, formulas, 40 figures, 17 tables, as well as appendices in a total volume of 44 pages.

4.2. Извършена работа

Chapter 1 analyzes the existing methods and stages for designing fixtures for locating workpieces. The shortcomings of the traditional (manual) method and the need to use an automated method for designing fixtures are indicated, which should combine the known methods for structural and parametric synthesis of fixtures, based on unified model design.

As a result of the analysis, the most suitable systems for designing fixtures have been revealed, providing modeling capabilities at minimal costs, such as Solid Edge v. 6, Inventor, Solid Works, etc.

From the analysis of the stages of designing fixtures, it was found that the quality of design activities in terms of accuracy, reliability, manufacturing costs and auxiliary time for locating workpieces depends to a significant extent on the correct choice of a locating scheme and its constructive implementation.

It was found that the automated selection of an optimal locating scheme would allow significantly reducing the costs of materials and time, as well as increasing the quality of design activities.

The main criteria for choosing an optimal fixture scheme are substantiated - processing accuracy and reliability, as well as the fact that even at the design stage it is necessary to predict the repair interval, ensuring the design of fixtures with a guaranteed service life.

I generally consider the formulated goal and tasks of the dissertation work to be correct. I believe that it would be good if the tasks were set to correspond to the names of the chapters.

In **Chapter 2**, a methodology for choosing an optimal fixture scheme for blanks is developed.

A systematization of the possible schemes for basing blanks in fixture fixtures has been carried out with a view to their use in automated design.

An analysis has been carried out, with the help of which the criteria for: geometric compatibility have been defined, allowing the selection of a basing scheme that satisfies the geometric shape of the blank; selection of element basing structures.

For the selection of an optimal setup scheme based on the processing accuracy criterion, algorithms have been developed for determining the inaccuracies of basing, and for this purpose combinations of workpiece surfaces and basing elements presented as computational modules have been considered, for which dependencies have been derived and block diagrams have been developed.

An approach and optimal solutions for selecting a setup scheme based on the reliability criterion have been proposed, and for several setup schemes that meet the accuracy and reliability conditions, a selection methodology has been proposed based on the criterion of minimum costs for the design and manufacture of the fixture.

In Chapter 3, the main approach to solving the task of automating the selection of an optimal setup scheme is the systematic approach, which allows breaking the entire task into separate stages, identifying the connections between them and the criteria for optimal search.

A general model of an automated system for selecting an optimal setup scheme for workpieces using CAD systems based on three-dimensional solid modeling is proposed.

Through a joint analysis of the theoretical setup scheme and the geometric shape of the workpiece, an algorithm has been developed for forming possible setup schemes and calculating the inaccuracy of the setup.

Algorithms have been developed for: selecting the design of the setup elements and determining their dimensions; determining the inaccuracy of fastening; determining the dimensional wear of the setup elements and checking reliability.

For the final selection of a setup scheme according to the criterion of minimal costs for the design and manufacture of the fixture, an algorithm and automated tables given in the appendix have been developed.

In Chapter 4, models for the operation of the automated system for selecting the optimal setup scheme in the form of class and state diagrams, as well as a structural diagram of the software package that can be used to develop a software product, have been developed.

For the program implementation of the automated system, a database of solid-state models of BE in the SolidWorks environment and tables for automated selection of their parameters in the MSExcel environment have been developed.

A methodology has been developed for the practical implementation of the automated system for selecting an optimal detection scheme, which has been verified with an example given in the appendix to the dissertation work.

5. Contributions

The contributions in the dissertation are of a scientific-applied and applied nature and are the result of research aimed at improving the technological preparation of production by creating a methodology and algorithms for selecting an optimal scheme for establishing the blanks during mechanical processing in the CAD environment. In general, I accept the contributions as formulated in the dissertation work.

Scientific and applied contributions:

- Systematization of possible schemes of basing of blanks in fixtures for setting with a view to their use in automated design.
- The defined criteria for: geometric compatibility, allowing the selection of a basing scheme that satisfies the geometric shape of the blank; selection of BE structures when using different technological bases.
- The developed methodology, models, algorithms and diagrams of classes and states that can be used to develop a software product for selecting an optimal setting scheme.

Applied contributions:

- *The developed structural diagram of the program package for selecting an optimal setting scheme.*
- *The developed database with solid-state models of basing elements.*
- *Automated tables for: selection of basing element models; preliminary assessment of the economic efficiency of the designed fixtures.*

6. Authorship

The presentation of the dissertation, the publications on it, as well as my personal impressions, give me reason to assume that the contributions are primarily the personal work of the doctoral student.

7. Publications related to the work

The main results of the dissertation have been published, sufficiently well publicized and discussed. The requirement that 2/3 of the dissertation material be published has been met, and the works have been printed and are distributed as follows

- articles in scientific journals – 2 pcs.
- reports at scientific conferences – 3 pcs.

Of the publications, 1 is independent, and 4 are co-authored with the doctoral student's supervisors.

There is a lack of data on the citations of the scientific publications and the practical implementation of the results obtained.

Based on the above data, it can be concluded that the results of the dissertation of Eng. Ali Abdulkarim Gitan have been sufficiently publicized and discussed.

8. Using the results of the dissertation in scientific and social practice

No documents have been provided regarding the direct economic effect achieved.

9. Abstract

The abstract of the dissertation is 43 pages long and is prepared in accordance with the requirements of the Regulations for the Admission and Training of Doctoral Students at the Technical University of Gabrovo. It reflects the results achieved from the research conducted to optimize the process of establishing blanks during mechanical processing in the CAD environment, as well as the achieved scientific and applied and applied contributions. A list of publications on the topic of the dissertation is also presented.

10. Opinions, recommendations and remarks on the dissertation

. The dissertation is structured and written at a very good scientific level. I have no significant comments on the dissertation. The recommendations and comments I made as a reviewer of the preliminary defense are generally reflected in the dissertation.

11. Other questions

I believe that the educational function of doctoral has achieved its goal. The doctoral student has significantly increased his knowledge of the problem studied in the dissertation.

12. Conclusion

I believe that the presented dissertation work “Optimization of the establishment of blanks during mechanical processing in the conditions of the CAD environment” meets the requirements of the Act on the Development of the Academic Staff in the Republic of Bulgaria. The achieved results give me reason to propose to the esteemed scientific jury to award Eng. Ali Abdukarim Gitan the educational and scientific degree “doctor” in the field of higher education - 5. Technical sciences, professional field - 5.1. Mechanical engineering, doctoral program “Technology of mechanical engineering”.

14.08.2025.

Reviewer:

(Assoc. Prof. Eng. Angel Lengerov, Phd)