

OPINION

of a doctoral dissertation for the acquisition of the educational and scientific degree "Doctor" (PhD) in the field of higher education 5. Technical Sciences, professional field 5.1. Mechanical Engineering, Scientific specialty Mechanical Engineering Technology

Author of the PhD thesis: Mag. Eng. Nikolay Penkov Kolev

Dissertation title: Optimization of Technological Processes for Part Processing on CNC Machines with Robotic Feeding

Prepared the opinion:: Assoc. Prof. Svetlana Koleva, PhD, Eng., University of Ruse "Angel Kanchev" – Ruse, field of higher education 5. Technical Sciences, professional field 5.1. Mechanical Engineering, Scientific specialty Mechanical Engineering Technology

1. General Description of the Dissertation and the Submitted Materials

The PhD thesis consists of 113 pages, structured into 4 chapters: Chapter One: Robotization of CNC Machines – Current Status and Prospects; Chapter Two: Investigation and Modeling of Technological Parameters of the Turning Process on CNC Machines with Robotic Feeding; Chapter Three: Multi-objective Optimization of the Turning Process on CNC Machines with Robotic Feeding; Chapter Four: Determination of the Number of Cutting Tools Ensuring a Continuous Working Cycle in CNC Turning Machines with Robotic Feeding. Analyses and conclusions are presented at the end of each chapter, and general conclusions and contributions are formulated at the end of the PhD thesis. The text integrates 41 figures and diagrams, and 27 tables. An appendix with a volume of 41 pages is provided. Seven publications have been submitted in full text.

2. Relevance of the Problem

The PhD thesis addresses problems related to the robotization of workpiece blank positioning on CNC turning machines – an activity usually performed by an operator. These are monotonous actions, often associated with the need for physical effort, inconvenience during execution, and sometimes carried out in a dusty or contaminated environment. Taking into account the fact that the striving of modern mechanical engineering is towards automation and robotization of a large part of the activities in the sector, the topic of the PhD thesis is highly relevant and possesses potential for industrial application.

3. Knowing the State of the Problem

The doctoral student has reviewed 126 literary sources, 34 of which are internet websites. Over 70% of the literature used is from the last 15 years, with foreign language publications prevailing. Thematically, they are directly related to the topic of the dissertation, focusing on the optimization of the turning process, mathematical modeling, production robotization, the influence of the physical and mechanical characteristics of the material on its machinability, etc. It is evident from the submitted documents that the doctoral student also possesses significant practical experience. This gives me reason to consider that a thorough knowledge of the problem is present.

4. Approach and Solution to the Problem

Experimental studies were conducted to obtain the necessary information regarding the influence of cutting speed and feed rate on the surface roughness of the machined surfaces using three types of indexable cutting inserts. The obtained data were processed

using software products, simulations were performed, and mathematical models were derived and statistically verified for adequacy. For the purpose of practical application, a methodology has been developed to determine the required number of cutting tools for operations performed on CNC turning machines with robotic feeding.

5. Credibility of the obtained Results

The reliability of the results obtained can be judged by: the presented appendices related to the software used for data analysis and processing; the results presented in graphical form; and the real parts used to conduct the experimental part under the production conditions of the company ADTECH LTD – Gabrovo.

6. Extended Summary (Abstract)

The extended summary consists of 42 pages and accurately reflects the significant aspects of the PhD thesis.

7. Main Contributions

I would formulate the contributions of the PhD thesis as follows:

A. Scientific and Applied Contributions

1. Experimental models have been obtained for the values of the roughness parameter Ra, productivity, and tool life during part machining on CNC turning machines with workpiece loading performed by two types of robotic feeding stations.

2. A methodology has been proposed for multi-objective compromise optimization of the CNC turning process with robotic feeding.

3. A methodology has been developed to determine the number of cutting tools required to ensure a continuous workflow during part machining on CNC turning machines, depending on their tool life, the capacity of the tool magazine and the feeding mechanism, and the volume of the production program.

B. Applied Contributions

1. An algorithm has been developed for a software product to manage the operation of CNC lathes with robotic feeding, ensuring a continuous production process for a given batch of parts.

8. Personal Contribution of the Author

I consider that the achieved results are the personal work of the doctoral student under the scientific and methodological guidance of his supervisors. My motives for this are that the doctoral student has a rich practical experience, which allows him to define technological problems, propose approaches for their resolution, and conduct the corresponding experiments in a real production environment.

9. Publications on the Subject of the PhD Thesis

Seven publications have been presented on the topic of the PhD thesis, one of which is single-authored, and six are co-authored with his scientific supervisors. In two of them, the doctoral student is the first author, and in four – the third author. Two of the publications are indexed in the Scopus scientific publication database.

10. Use on received Results in the Practice

I believe that the presented results, after adaptation to specific production conditions, would find real application in the machining of parts on CNC turning machines.

11. Critical Remarks and Recommendations on the Dissertation

I would like to make the following recommendations and comments:

The PhD thesis exhibits some incorrect terminology and phrasing: "assembled inserts" instead of indexable inserts; "high accuracy as a result of using a single coordinate system during dimension formation", whereas it is well known that machining accuracy is not influenced by the choice of the coordinate system; the influence of the cutting regime on roughness was investigated using a robotic station, but the influence of the cutting regime on roughness does not depend on the method of workpiece positioning (manual or robotic); "the influence of the number of machined parts on roughness", whereas the correct phrasing should be the influence of tool wear during the machining of a certain number of parts on roughness; the phrase "the tool is changed when it starts cutting poorly" was used instead of the tool is changed when wear exceeds the permissible threshold for achieving the required roughness. Important technological information has been omitted: roughness requirements (one of the investigated parameters), how the positioning/clamping is implemented, what technological steps (passes) are used for machining, what is the number of tools used, by what criteria the type and grade of the cutting inserts were selected, etc. I believe that the conducted studies should also take into account the hardness scattering of the machined workpieces, which directly affects tool wear. It is stated several times in the text that "Based on preliminary information, a model type was adopted...", but it is not specified what this information consists of. The analysis of the results for the utility function requires a deeper interpretation rather than just a factual presentation.

12. Critical Remarks and Recommendations on the Extended Summary (Abstract)

Designations and symbols whose meaning is not explained are used in the extended abstract, which complicates its independent review and comprehension.

13. Conclusion

I consider that the presented PhD thesis meets the requirements of the Development of Academic Staff in the Republic of Bulgaria Act and I give it an overall positive evaluation. I propose that the doctoral student Mag. Eng. Nikolay Penkov Kolev be awarded the educational and scientific degree "Doctor" (PhD) in the Scientific specialty Mechanical Engineering Technology, professional field 5.1. Mechanical Engineering in the field of higher education 5. Technical Sciences.

Date: 27.05.2026
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