

REVIEW

in regard to a competition for obtaining an academic position "Professor" in the area of higher education 5. Technical sciences, Professional field 5.1. Mechanical engineering and course "Programming of machines and systems with CAM", announced in the State Gazette number 67/04.08.2023, with candidate Assoc. Prof. PhD Eng. Stoyan Dimitrov Slavov from the department "Manufacturing Technologies and Machine Tools". The current review is prepared according to Order No 791/02.11.2023 of the Rector of the Technical University of Varna and the protocol of the first meeting of the Scientific Jury from 14.11.2023.

Reviewer: Prof. PhD Eng. Angel Antonov Dikov, from Technical University of Sofia

1. Background and biography

Associate Professor Dr. Eng. Stoyan Dimitrov Slavov was born in Varna, Bulgaria in 1973. He graduated his secondary education in 1993, majoring in "Robotic and flexible automated production systems" at the "A. Ivanov" secondary technical school in Varna, and after that higher education in 1998 at the Technical University (TU) of Varna, majoring in "Mechanical engineering and metal-cutting machines" at the department of Manufacturing Technologies and Machine Tools (MTMT). In 2004, he defended a PhD dissertation, entitled "Technological possibilities of flat vibratory burnishing for control some quality parameters and operational characteristics of flat surfaces" before the specialized scientific council of the higher attestation commission in Sofia. He began his academic career at the MTMT department of TU - Varna in the position of "Chief assistant" in November 2006, and from July 2012 to the present he held the academic position of "Associate Professor" in the scientific specialty "Technology of mechanical engineering" in the MTMT department. He participated in numerous research projects, both internal to TU of Varna and with national funding. He has been scientific leader in six of them. He is a member of the Scientific and Technical Society for Machine Building Equipment and Technologies at the Varna Scientific and Technical Unions, and the Union of Scientists in Bulgaria. He is the author and co-author of 14 study programs in disciplines in the field of mechanical engineering technologies, as well as two textbooks and three teaching guidance related to the field of the current competition. In addition to his teaching and research activities, the candidate has also performed numerous administrative functions at TU of Varna, such as university rating analysis expert, head of quality management and accreditation centers. He was also been Head of the MTMT department. He has carried out several specializations at various universities and institutes abroad.

2. Overall characteristic of the applicant's research, scientific and applied activity

The general characteristics of the candidate's research and applied activities are based on the references and evidentiary materials submitted by him. They are classified according to the requirements of Bulgarian legislation and internal regulations of TU of Varna.

The candidate participated in the competition with 29 works, as follows: one habilitation work - monograph; eleven scientific publications that are indexed in the world-known scientific information databases: SCOPUS, Tomson Reuters, Web of Science, as five of them were published in journals with an impact factor or impact rank; twelve scientific publications in non-indexed, but peer-reviewed journals or in reviewed collective volumes; two university textbooks and 3 university teaching guides.

Seven of the submitted scientific works, and all five textbooks and teaching guides are in Bulgarian, but the remaining 17 papers are published in English.

The materials provided under the competition correspond to the minimum national requirements for hold the academic position "Professor". They can be attributed to the individual groups of indicators, as follows:

Group of indicators - A: Dissertation work, entitled "Technological possibilities of flat vibratory burnishing for control some quality parameters and operational characteristics of flat surfac-

es" before the specialized scientific council of the higher attestation commission, Sofia in 2004. The author was awarded with PhD degree in the scientific specialty "Mechanical Engineering Technologies". This brings 50 points accordingly, which fulfills the minimum requirements for this group of indicators.

Group of indicators - Б. There are no submitted materials falling into this group, 0 points.

Group of indicators - В. A monograph, entitled "Formation of regular reliefs using CNC machines" is presented. The monograph applied consists of 219 pages, and it can be classified as a habilitation work. This is equivalent to 100 points, which fulfills the minimum requirements for this group.

Group of indicators - Г. A total sum of 23 publications are presented in this group, which are divided into two subgroups: Г7, which includes 11 publications indexed in the world-known databases SCOPUS, Tomson Reuters, and Web of Science. A total sum of 132.6 points are collected from them for that subgroup. Another subgroup Г8, which refers to 12 publications issued in non-indexed, but peer-reviewed journals and reviewed collective volumes is also present. A total sum of 156.7 points are formed from this sub-group of publications. Therefore, the applicant's total score is 289.3 points, which exceeds the minimum requirement of 200 points in this group Г.

Group of indicators - Д. The candidate has submitted a reference and evidence for 60 citations of his publications, in which there are no common co-authors between the cited and citing publications. These publications were not used in previous procedures for the acquisition of "Doctor" and "Associate Professor". The publication citations are classified into three subgroups: Д.12, which includes 49 citations by works, which are published in indexed in world-known scientific information databases SCOPUS, Tomson Reuters, and Web of Science (490 points); Д.13, in which there are two citations from monographs (6 points); and Д.14, in which there are 9 citations in non-indexed, but peer-reviewed journals or reviewed collective volumes (18 points). The total result of citations of the candidate's works forms score of 514 points. This significantly exceeds the minimum requirements of 100 points for this group of indicators.

Group of indicators - Е. The candidate has one doctoral student who successfully defended his dissertation in 2019, which topic is related to the theme of the current competition (40 points), and three more doctoral students who are in the process of training yet. During the period from the acquisition of academic position "Docent" in 2012 to the moment, Assoc. Professor Stoyan Slavov participated in eight national scientific research and educational projects (80 points) and was head of 6 projects (120 points). He has attracted external funding for the university for BGN 119,902 as the Head of a scientific project under a contract with the Bulgarian Scientific Research Fund (24 points). He wrote and published two university textbooks by himself (80 points) and three university study guides by himself or co-authored (50 points). The candidate's total score for this indicator is 394 points, and the minimum number of points required for this group of indicators is 150.

Group of indicators - Ж. For the last three academic years, Assoc. Prof. Stoyan Slavov has conducted more than 750 academic hours of lectures on disciplines, which are related to the competition's subject. They are equal to 768.2 hours of study, after applying reduction coefficients, according to the academic rules in the TU of Varna. This result forms 768.2 points in the current category, which is also a significant excess of the required minimum of 120 points.

The submitted documents show that the minimum national requirements for occupying the academic position of "Professor" in the field of higher education 5. Technical sciences, according to the state legislation, as well as the additional requirements of the internal regulations at the TU of Varna, are covered by the applicant.

3. General characteristics of the applicant's scientific research and applied activities.

The scientific research of Assoc. Prof. Stoyan Slavov can be categorized in the following thematic areas:

- Development of new technological schemes for ball burnishing (BB) operations for different types of surfaces using Computer Numerical Controlled (CNC) metal-cutting machines.

- Development of new methodologies and algorithms for the automated generation of numerical codes to realize the complex trajectories of the deforming tool when using the BB process;
- Investigation of the influence of the BB process regime parameters on the various topographical and operational characteristics of the functional surfaces of parts processed according to the developed new kinematical schemes.
- Development of contemporary designs of tools for processing through BB, suitable for CNC machines, which, in addition to processing the relevant surfaces, also allow measurement of some parameters of the operation.

All presented scientific publications have been peer-reviewed and reported in authoritative scientific forums and/or published in internationally recognized scientific journals. Some of them are in English. This makes them accessible not only to the Bulgarian, but also to the international scientific community. Proof of their significance is the significant number of citations by scientists from all over the world.

The presented results of the scientific research and scientific-applied activity fully correspond to the subject of the announced competition in the area of higher education 5. Technical sciences, Professional field 5.1. Mechanical engineering, and course "Programming of machines and systems with CAM".

4. Evaluation of the applicant's pedagogical training and activities.

The candidate's pedagogical training and his work as an academic Professor can be positively evaluated, taking into account the large number of the developed study programs, as well as lectures and exercises in the following study disciplines for the educational degree "Bachelor", which refer to the subject of the current competition:

- Programming of machines and systems by using CAM;
- Computer aided programming of machines and systems with CNC;
- Computer integrated technologies;
- Production systems;
- Manually programming of machines and systems with CNC;
- Material processing machines and systems –part two.

The candidate has written and published by himself and in co-authorship two university textbooks and three study guides, the subject of which is very close to those of the competition. Under his supervision, 53 students have graduated in degree "Bachelor" and "Master", by successfully defended their diploma thesis. He is the supervisor of four doctoral students, one of whom has successfully defended his dissertation, and the other three persons are still in the process of training.

5. Main scientific and applied contributions

The contributions contained in the candidate's scientific papers can be attributed to the following categories:

5.1. Scientific contributions (proved by new means of substantial new aspects of already existing scientific fields, problems, theories, hypotheses)

1. A modern concept to achieve the necessary complex planar and spatial trajectories of the deforming tool in order to form different types of regular reliefs (RR) through the BB process using CNC machines on the surfaces of parts with different shape and contour profile is proposed - B 3-1, Г 7-2.

2. The artificially induced reciprocating movements of the deforming element in the classical process of vibrational BB is avoided by using the interpolation of the axes of the contemporary CNC equipment, which simplifies significantly the design and dimensions of the tools used for this type of operations. This allows the finishing operation for BB to be performed on the same machine immediately after the preceding shape forming operations - B 3-1, Г 7-2.

3. On the basis of the obtained mathematical models for calculating the coordinates of characteristic points of the deforming element toolpath, the possibility of automatically creating corresponding control programs for turning, turning-milling and milling multi-axis machining centers with CNC for performing BB operations for forming partially and fully regular reliefs, suitable for machine parts that have:

- a) planar surfaces - B 3-1, Γ 7-2, Γ 7-4, Γ 7-5, Γ 8-2, Γ 8-9;
- b) cylindrical and tapered outer surfaces - B 3-1, Γ 7-1, Γ 7-2, Γ 8-2, Γ 8-11;
- c) nonplanar (or so called "sculptured") surfaces - B 3-1, Γ 7-2, Γ 8-1, Γ 8-6.

4. Three original approaches have been developed for the automated identification of the number of cells of completely regular reliefs (Γ 8-12) and determination of their topographic characteristics, based on standardized (ISO 21920-2 and ISO 25178-2) criteria with the use of parallel measured profilograms by the contact method and a combination of them and obtained digital images of reliefs by using an optical microscope - B 3-1, Γ 7-9, Γ 7-11;

5. A group of uncorrelated three-dimensional criteria has been identified according to the ISO 25179-2 standard, describing the complex topographic characteristics of the regular reliefs obtained by BB operations using CNC machines - B 3-1, Γ 8-7.

5.2. Applied scientific contributions (obtaining and proving new facts and creating new classifications, methods, constructions, technologies, schemes).

1. Computer models have been developed and applied practically for calculating toolpaths when performing BB operation on different types of surfaces, depending on the contour of the processing domain - B 3-1, Γ 7-1, Γ 7-2, Γ 7-4, Γ 7-5, Γ 8-1, Γ 8-2, Γ 8-6, Γ 8-9.

2. An algorithm was created to optimize the length of the toolpath of the deforming tool during BB, so that it is obtained with the minimum necessary unfolded length, depending on the shape and dimensions of the processed surface - B 3-1, Γ 7-2, Γ 7-10

3. An algorithm for direct generation of numerical control programs (or so-called "ISO-code") for CNC turning centers for forming RR by BB operation on cylindrical and tapered external surfaces was developed - B 3-1.

4. An algorithm for obtaining polylines in DXF format (Autodesk) has been developed, which describes the deforming element toolpath, in order to import the toolpath into appropriate CAM software and use it for automated programming of the BB operation and output of NC-code for the suitable CNC system – B 3-1.

5. An algorithm for filtering the high-frequency components of the measured profilograms, by means of a "finite impulse response" filter and a resampling algorithm, allowing an adequate spatial representation of the RR's topography in 3D roughness or waviness has been developed - B 3-1.

6. A generalized algorithm for analysis of the degree of significance of the effects and the nature of influence of the regime parameters of the BB process, as well as the toolpath of the deforming tool has been developed, over :

- the characteristics of the topography of the RR through two-dimensional criteria according to the standard ISO 21920-2 – Γ 7-9;

- the characteristics of the resulting three-dimensional topography of the RR based on the identified topographic criteria according to ISO 25178-2 – B 3-1, Γ 8-7;

- the variability of the deforming force during processing of flat surfaces and those with a complex spatial shape - Γ 8-1, Γ 8-6.

5.3. Applied contributions (classifications, designs and technologies)

1. Based on an overview and analysis of existing designs of tools for vibration assisted BB

operations, new, simpler and compact designs of tools for forming RR, intended for work with lathe and milling centers with CNC have been created. They are equipped with some sensors for measuring the deforming force during the processing by BB operation- Г 7-7, Г 8-4, Г 8-8.

2. On the basis of conducted experimental studies, the potential for increasing the number of cycles to fatigue failure of samples of austenitic steels AISI 304L and AISI 316, having regular reliefs formed by BB, in comparison with none burnished samples was experimentally determined - Г 7-3, Г 8-5.

3. The optimal values of the BB regime parameters have been established experimentally to obtain the maximum number of cycles until fatigue failure of austenitic steels AISI 304L and AISI 316 with a formed regular relief in the specimens' stress concentrator - Г 7-3, Г 8-5.

4. The influence of the deforming force magnitude and the feed rate during BB of samples made of aluminum alloy, brand 2024 on the topographic characteristics of the resulting RR on cylindrical samples - Г 7-1 was experimentally determined.

5.4. Methodical Contributions

1. Two methodologies for obtaining a three-dimensional topographical representation of the PP by BB on flat surfaces have been created and tested, using the capabilities of a micrometer table or a three-axis CNC milling machine to obtain parallel profilograms (B 3-10), and digital images and profilograms measured in optimal sections using a roughness meter - Г 7-11, Г 8-7.

2. A methodology for modeling the characteristics of PP was created, which is based on three-dimensional physical prototypes of RR, obtained by using 3D printer - Г 8-3, Г 8-10.

3. A methodology for measuring the deforming force and transmitting the measurements, both via cable connection and wirelessly to computerized devices for collecting and processing the measured data have been developed, in order to control and/or monitor the most significant regime parameter of the BB process during the operation – Г 7-7, Г 8-4.

4. A methodology for establishment the influence of the main BB's regime parameters and the sinusoidal trajectory of the deforming tool has been developed on the parameters of the topography (B 3-1, Г 8-7) and the number of cycles until fatigue failure for flat surfaces having RR (Г 7-3, Г 8-5), with a minimum number of experimental trials, using so-called "Bayesian statistics" and Taguchi's experimental designs.

6. Significance of the contributions to the science and practice.

There are significant scientific, scientific-applied and applied contributions, which significantly enriching the theory, teaching material and practice in the field of the announced competition in the discipline "Programming of machines and systems with CAM".

Because of the candidate's work, a solid base of knowledge has been formed on the peculiarities of the process to form regular reliefs on various surfaces of machine parts with using modern technological approaches, as well as on measuring and determining their topographical characteristics according to standardized criteria. A significant part of his methodical and analytical scientific activities is also implemented in the educational process.

The information given in sections 2, 3 and 4 speaks of the wide recognition of the candidate's work and gives me reason to claim that the majority of the contributions are his personal achievement or were obtained with his decisive participation. The numerous citations of the candidate's works speak convincingly for the recognition of Assoc. Prof. Stoyan Slavov's long-term work on the subject of the current competition by the scientific community at home and abroad.

7. Critical remarks and recommendation

In the applied documents of the candidate, I did not find any mistakes of a principle or debatable nature, such as literary ignorance, wrong statements, incorrect methodology, incomplete analysis or incorrect summary of the results. There are some notes of a secondary nature that I have communicated verbally to him that should be accepted as recommendations for the future work of the candi-

date and the team of doctoral students supervised by him. The next recommendation to the candidate is to integrate more widely the results of long-term research on the problems of forming regular reliefs by using BB process in the disciplines he teaches.

8. Personal impressions and opinion

I know Assoc. Prof. Stoyan Slavov from the procedures for defending the educational and scientific degree PhD before specialized scientific council of the higher attestation commission in 2004 and after that for occupying the academic position "Associate Professor" in 2012. I have good impressions of his competence and information from personal meetings and his publications in scientific journals and other sources.

I believe that he is formed as a highly qualified specialist and can be characterized as a recognized researcher and educator in the field of machine-building technology, programming and setting up machines with digital program control in the conditions of modern automated production.

9. CONCLUSION

Based on my impressions, after reviewing the submitted scientific works and materials for the competition, their significance and the scientific, scientific-applied, applied and methodical contributions contained in them, I find sufficient reasons to propose Assoc. Prof. Stoyan Dimitrov Slavov to occupy the academic position "Professor" in the area of higher education 5. Technical sciences, Professional field 5.1. Mechanical engineering, and course "Programming of machines and systems with CAM" for the needs of the department " Manufacturing Technologies and Machine Tools" from the Faculty of Manufacturing Engineering and Technologies of the Technical University of Varna.

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Sofia

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