

## Report on the work of the dissertation Council

Dissertation Council on metallurgy and materials science the Kazakh national research technical University named after K.I.Satpayev on specialties (direction of training):

6D071600 – «Instrumentation»

8D07106 – «Robotics and Mechatronics»

8D07105 – «Biomedical Engineering»

1. Data on the number of meetings held– 5 meetings.
2. Full name of members of the dissertation Council who attended less than half of the sessions: none.
3. List of doctoral student indicating the organization of training:

- Fazylova Alina Rinatovna - Kazakh National Research Technical University named after K.I. Satpayev

- Ayazbay Abu-Alim Yerikuly - Almaty University of Energy and Communications named after G. Daukeev

Brief analysis of dissertations considered by the Council during their porting year

№	Full name of the Doctoral student	Topics of work	Code and title of specialty
1	Fazylova Alina Rinatovna	Development of control units for wind generators	8D07106 – «Robotics and Mechatronics»
2	Ayazbay Abu-Alim Yerikuly	Development of an automated manipulator control system using machine vision	8D07104 - "Instrumentation"

### **4.1 Analysis of the subject of the work of Fazylova Alina « Development of control units for wind generators», submitted for the degree of Doctor of Philosophy (PhD) on speciality 8D07106 – «Robotics and Mechatronics».**

Wind energy is a promising solution to the problems of unstable electricity prices and environmental pollution. It is becoming increasingly popular, competing with traditional sources. In Kazakhstan, wind energy has significant potential, capable of exceeding the country's needs by 15 times. Promising locations for wind turbines are highlighted in UN studies. There is a high demand for low-cost, low-power wind energy installations with a simplified control system. However, some systems, such as asynchronous generators, have a limited operating range and do not ensure continuous use of wind potential at high wind speeds. Kazakhstan follows international trends in energy development, planning to increase the share of renewable energy in total electricity production. At the same time, wind turbine control methods are developing, but existing approaches have their limitations and disadvantages. The dissertation considers the solution of the issues of designing control units for the vertical-axis multi-blade wind generator "WIND GENERATOR V-1000", based on mechatronic control of the blade position to achieve the goal of creating a comprehensive control and monitoring system for a wind generator for the efficient use of wind energy and ensuring the reliability and safety of its operation. The idea of the work is based on increasing the efficiency of vertical-axis wind generators by introducing the developed mechatronic blade control unit and a monitoring system for the main units of the vertical-axis multi-blade wind generator "WIND GENERATOR V-1000".

As a result of the research, the following new scientific results were developed and presented.

1. A software product for obtaining data on the wind speed forecast for the city of Almaty with the subsequent calculation of the output power of the wind generator, based on the exponential smoothing method to improve the accuracy of the forecast with a forecast error of no more than 0.54%.

2. A vertical-axis wind turbine blade control system that increases the efficiency of the wind turbine by 7.69%.

3. A diagnostic system for the main components of the wind turbine using IOT technologies that allows obtaining data to assess the condition of the wind turbine and identify problems.

**Connection of the dissertation topics with the directions of science development, which are formed by the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan in accordance with paragraph 3 of Article 18 of the Law "On Science" and (or) state programs.**

The topic of the dissertation corresponds to the scientific direction "Advanced production, digital and space technologies" of the National Scientific Council under the Government of the Republic of Kazakhstan.

The dissertation work was carried out jointly with the Angel Kynchev University of Ruse and part of the work on this dissertation was carried out within the framework of the funding program from the corporate fund "National Conservation Initiative" No. 03-14 dated June 8, 2021 within the framework of the sponsorship agreement dated April 24, 2020 No. 20-055354, concluded between the National Conservation Initiative fund and CHEVRON MUNAYGAS INC.

**Analysis of the level of implementation of the results of the dissertation in practice.**

According to the results of the dissertation research, 12 printed works were published. Of these, two were published in journals included in the 1st quartile according to the Scopus database, one in a journal included in the 3rd quartile according to the Scopus database, 3 were conference materials, and 4 were published in scientific journals of the Republic of Kazakhstan. The doctoral student made a worthy contribution to each published article, reflecting the provisions submitted for defense, the results obtained by the doctoral student in the course of the research. In addition, two patents of the Republic of Kazakhstan for a utility model were received.

**4.2 Analysis of the subject of the work of Ayazbay Abu-Alim Yerikuly « Development of an automated manipulator control system using machine vision» submitted for the degree of Doctor of Philosophy (PhD) on specialty 8D07104 - "Instrumentation".**

With the accelerated development of modern technology, the importance of automated systems and robotics is increasing. Automation of manipulator control using machine vision is an important research area that extends the scope of applications, from industrial production to medicine and security. In such a context, the development of low-cost, versatile and accessible robotic solutions is crucial. In this thesis, the development of a manipulator platform is a reflection of progress in this direction. Printing the robot elements on a 3D printer and using low-cost electronic components provide affordable and efficient solutions for small-scale manufacturing and research environments. The control system algorithms are designed so that the robot kinematics and trajectory planning can run on low-performance microcontrollers, extending the scope of the application. Thus, this work has great potential for automating small-scale manufacturing processes and creating experimental laboratory benches used in research work. The relevance of this thesis lies in increasing the availability of new technologies and stimulating innovative growth in the SME sectors.

This research also opens new possibilities for future developments of automated systems, especially in the area of complex data processing and improving the ability of machine vision to analyze information. The relevance of this topic is also due to the wide range of research in the

field of artificial intelligence and robotics, which play an important role in the development of modern innovative technologies.

As a result of the research, the following new scientific results were developed and presented. The work presents new software and hardware solutions in the realization of integrated control system of manipulator c machine vision. In the work a new hybrid method of planning the trajectory of the manipulator motion is developed. The hybrid method allows optimizing accuracy and efficiency due to trajectory planning both in the task space and in the space of kinematic pairs within one operation.

**Connection of the dissertation topics with the directions of science development, which are formed by the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan in accordance with paragraph 3 of Article 18 of the Law "On Science" and (or) state programs.**

The topic of the dissertation corresponds to the scientific direction "Advanced production, digital and space technologies" of the National Scientific Council under the Government of the Republic of Kazakhstan.

**Analysis of the level of implementation of the results of the dissertation in practice.**

The practical significance of the study is revealed by the integration of machine vision into the manipulator control system, a method that allows research and experimentation in scientific laboratories, as well as the automation of various sorting and assembly operations at small manufacturing enterprises. The main findings of the work are presented in 4 publications, including 1 article in a journal included in the SCOPUS database (percentile 36%), 3 articles in publications recommended by the Committee for Quality Assurance in Science and Higher Education of the Republic of Kazakhstan.

## 5 Analysis of the work of official reviewers (with examples of the most low-quality reviews)

№	Full name of the doctoral student	Review ers	
		Full name of the first reviewer (position, academic degree, title, number of publications in the Specialty for the last 3 years)	Full name of the second reviewer (position, academic degree, title, number of publications in the specialty for the last 3 years)
1	Fazylova Alina Rinatovna	Zhankeldi Adilet Zhankeldiuly - PhD, Associate Professor, A. Burkitbayev Institute of Energy and Mechanical Engineering, Department of Standardization, Certification, and Metrology. Over the past 5 years, there have been more than 5 publications on the topic of the dissertation.	Almuratova Nurgul Kanaevna – Doctor Ph.D., Associate Professor of the Department of Renewable and Alternative Energy Sources, Almaty University of Energy and Communications named after G. Daukeev. Over the past 5 years, there have been more than 5 publications on the topic of the dissertation.
2	Ayazbay Abu-Alim Yerikuly	Baygunchekov Zhumadil Zhanabaevich – Doctor of Technical Sciences, Professor, and Professor of the Department of Mechanics of the Kazakh National University named after Al-Farabi. Over the past 5 years,	Mukhanov Samat Bakytzhanovich – PhD Doctor, Assistant professor, Head of the Department of Computer Engineering of the International University of Information

	there have been more than 5 publications on the topic of the dissertation.	Technologies. Over the past 5 years, there have been more than 5 publications on the topic of the dissertation.
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**Data on the considered dissertations for the degree of doctor of philosophy PhD, doctor of profile**

Dissertation Council	Code and title of specialty		
	6D071600 – «Instrumentation»	8D07106 – «Robotics and Mechatronics»	8D07105 – «Biomedical Engineering»
Dissertations accepted for defense	1	1	-
Including doctoral students from other universities	1	-	-
Dissertations withdrawn from consideration	-	-	-
Including doctoral students from other universities	-	-	-
Dissertations that received negative reviews from reviewers	-	-	-
Including doctoral students from other universities	-	-	-
Dissertations with a negative decision on the result of the defense	-	-	-
Including doctoral students from other universities	-	-	-
Dissertations aimed at completion	-	-	-
Including doctoral students from other universities	-	-	-
Dissertations aimed at repeated defense	-	-	-
Including doctoral students from other universities	-	-	-

**Chairman of the dissertation Council**



*[Handwritten signature of K. Ozhikenov]*

**K. Ozhikenov**

**Scientific Secretary of the dissertation Council**

*[Handwritten signature of Ye. Altay]*

**Ye. Altay**