

REVIEW

by Prof. Dr. Atanas Vasilev Palazov

Member of the Scientific Jury for the award of the "Doctor of Philosophy" (PhD) degree,
approved by Order No. 301 / December 9, 2019 of the Director of the Institute of Oceanology at
the Bulgarian Academy of Sciences (IO - BAS),
on a Doctoral thesis on " Remotely Operated Vehicle for a
continental shelf research ",
presented by PhD student, engineer Konstantin Iliev Shterev
for the acquisition of the educational and scientific degree "Doctor of Philosophy" (PhD) in
Higher education area: 4. Natural sciences, mathematics and informatics,
Professional area: 4.4. Earth Sciences,
Doctoral Program in Oceanology,
with scientific consultant Assoc. Prof. Dr. Dimitar Petkov Dimitrov

Introduction

The documents presented to me (dissertation, abstract, list of publications, etc.) meet the requirements of the Academic Staff Development Law (ASDL), the Rules for the implementation of the ASDL, the Rules for the conditions and procedures for acquiring academic degrees and occupying academic positions at the BAS and the Rules for the conditions and procedure for acquiring educational and scientific degrees and occupying academic positions at IO-BAS - Varna, as well as the minimum requirements of IO-BAS for the scientific and teaching activity of the candidates for acquiring a scientific degree PhD. This gave me reason to review the dissertation.

General characteristics of the thesis

The dissertation submitted to me for review in form, volume and content corresponds to the specific requirements of IO-BAS. Its total volume is 184 pages, structured in 10 chapters, a list of used literature and six annexes, which presents technical data and results obtained and used in the development of the dissertation. The bibliography contains 123 titles, 90 of which have been published since 2005. This shows the PhD student has a good understanding of current state of research related to the topic of the dissertation. The graphic material (157 figures in total) is of very good quality.

The dissertation is devoted to solving a specific engineering problem - designing and manufacturing an Remotly operated vehicle (ROV) for exploration of the continental shelf, for this purpose three general project requirements are defined, which concern: the capabilities of the apparatus; its price; and project implementation time. Some of the main features of the device are set to be equal to or better than an existing equivalent device.

In general, the content of the dissertation meets the requirements of IO-BAS, but I believe that it would be better presented if the instructions of Appendix 8 of IO-BAS Rules have been more strictly followed.

Chapter 1 is a very broad introduction to the subject of the dissertation, incorporating the research objectives and the tasks to be solved, as well as the contributions of the PhD student. Chapter 2 is entitled Literature Review, which is extremely short (half a page). Some of the texts in Chapter 1 would be more logical in Chapter 2, as well as some of the texts in Chapters 3 to 8. Chapters 3 to 8 describe the materials and methods used in the design of the vehicle. There the basic theoretical assumptions and detailed studies of the components of the apparatus are presented. Chapter 9 describes the design of the apparatus, component by component, and Chapter 10 presents the results obtained by the PhD student and the conclusions drawn. The tasks set out in the Doctoral thesis are formulated by the doctoral student at the end of Chapter 1, and are summarized as:

- Research the existing ROV state of the art
- Create a requirement list for the project
- Split the ROV system into a manageable subsystems
- Create the overall system architecture
- Design, manufacture and test all the subsystem
- Test and review the results of the whole ROV system

I would note here that the list of requirements for the project has already been described before the tasks assigned, and the tasks themselves are more logical to be defined on the basis of the analysis of the current state of the problem made during the literature review. Moreover, nowhere in the dissertation does the decomposition of ROV into subsystems, although it is clearly done.

Topicality of the topic

In recent years, the use of ROVs has been increasingly expanded to explore the ocean floor. They established themselves and began to be widely used as an effective research tool only after relatively low-cost ROVs were created, mainly for the purposes of underwater surveillance. In this sense, the topicality of the PhD student work aimed at creating low-budgeted ROV is beyond doubt.

Basic scientific and applied scientific contributions

The main achievements in the dissertation of engineer Konstantin Iliev Shterev are expressed in the design and development of the systems of remotely operated apparatus and prototype of ROV. The PhD student formulated them in nine contributions as follows:

1. A power model of a ROV system is created. An equation for power transfer is devised.
2. Transfer function of a distributed power supply system is derived. The system is analysed and verified for stability.

3. A network model of a ROV is created. A novel communication protocol is developed in order to reduce components and increase reliability.
4. A tether, based on a Power Twisted Pair (PTP) network channel using Frequency Division Multiplexing (FDM) is developed and analysed.
5. Novel motor control algorithm is designed and implemented.
6. Dedicated ROV propeller is designed, suitable for the high Kv brushless DC motors.
7. Various LED lights are analysed for performance in water. The most suitable colour temperature is found.
8. IP camera is tested for lag and performance. Bandwidth requirements are devised.
9. A ROV system is built, based on the theoretical research. The system is tested in year 2016 on board RV Akademik in the Black Sea.

The contributions of the dissertation are expressed in the application of scientific achievements in practice and realized economic benefits. The results obtained can be directly applied to future research.

Abstract

The abstract of the PhD thesis, set out on 33 pages, correctly reflects its content and includes the main graphic material. The formulated contributions and publications on the topic are consistent with those listed in the dissertation.

It is noteworthy that the numbering of Chapters in the Abstract does not correspond to those in the dissertation, which causes confusion in the reader of both papers.

Scientific publications on the topic of the thesis

The results of the research on the topic of the dissertation of Eng. Konstantin Iliev Shterev have

been published in three scientific publications, one of which is a book chapter and two have been published in conference proceedings. As for the PhD student's personal contributions, the two publications are self-contained and the third is co-authored. This fulfills the minimum requirements for the candidates for the PhD degree in IO-BAS.

Critical notes

I have the following notes about the work:

- The dissertation practically lacks of a literary review as a result of which the outstanding scientific and practical problems are identified, on the basis of which the PhD student can formulate the goals and objectives of the dissertation;
- The presented results of testing the developed ROV are extremely insufficient to prove its reliable operation in the marine environment under different operating modes and in this sense the development can be considered as a prototype;
- From the point of view of its application, ROV should be considered as an vehicle-tether system. From the presented results it is not clear whether the design consider the influence of the tether on the behavior and controllability of the apparatus, which is of utmost importance for its practical application;
- Results of the impact of the tether on the behavior and controllability of the vehicle have not been checked in the testing of the developed ROV.

Plagiarism

Partial examination of the dissertation with specialized software showed the absence of plagiarism.

The doctoral student declared that the research and the results presented in the dissertation were his personal matter, and where the work was done in collaboration with other persons, this was explicitly stated in the text.

Considering the characteristic style and the details in the texts of the dissertation and the other presented materials, I believe that the presented dissertation is the work of PhD engineer Konstantin Iliev Shterev.

Personal impressions

I know the doctoral student hurriedly and have no direct impressions of his work. My impressions of the dissertation and the other materials presented are that Eng. Konstantin Iliev Shterev has a good theoretical background and practical skills that enabled him to successfully complete the tasks set in the dissertation. The shortcomings of the PhD work, which I have pointed out, I attribute to the fact that the doctoral student works in the industry bussines and does not have much experience in the field of research

Overall conclusion

The above facts discussed allow me to give a positive assessment of the dissertation of the PhD student and to suggest to the distinguished scientific jury to award to engineer Konstantin Iliev Shterev the educational and scientific degree "Philosophy doctor" (PhD) in the field of higher education: 4. Natural sciences, mathematics and informatics , Professional area: 4.4. Earth Sciences, Doctoral Program in Oceanology.

20/02/2020

Reviewer: .

/ prof. Dr. A. Palazov/