

REVIEW

about the Ph.D. thesis for acquisition of the scientific degree “doctor” in the professional field 4.6 Informatics and computer sciences, scientific specialty Computer sciences – distributed systems

Author of the Ph.D. thesis: Ivailo Todorov Andonov

Topic of the Ph.D. thesis: DISTRIBUTED CONTROL OF CONVEYER SYSTEMS

Reviewer: prof. D.Sc. eng. Todor Atanasov Stoilov , Institute of information and communication technologies – Bulgarian Academy of Sciences, Sofia, Acad.G.Bontchev str., BL.2

General notes

The Ph.D. thesis has 96 pages and it contains Introduction, 4 chapters, list of contributions, and list of references. The reference list contains 27 positions including 14 information sources from Internet (in a late edition of the thesis the list is extended to 51 positions).

1. Actuality of the problems in the Ph.D. thesis

The added value of this research concerns development of program modules in a specialized software environment for the simulation of conveyer operations. The complexity and the content of the control influences towards conveyer systems concern the management of the sequence of the packets, which are transported by the conveyer system. The sequence of packet transportation is defined by the distances between the packets. The system performance is controlled by increasing the speed of feeding and transportation on the conveyer.

The Ph.D. thesis makes analysis for needs to be installed appropriate sensors, which will transmit data about the control process for keeping distance between the packets on the conveyer.

The Ph.D thesis makes an attempt to present in formal way the operation of the conveyer system by recording the sequence of transportation of the different packets on the conveyer.

I appreciate positively the topical content of the Ph.D. thesis. I find that these researches, included in the thesis has pragmatically and useful nature, because they address profitable cases of control of technological and engineering systems for transportation and triaging goods on conveyer systems.

The reviewer assesses positively the developments in the Ph.D. thesis. The defined topic is worked out by simulations and programming modeling in a specialized software environment FlexSim. I find that the importance of the researches in the thesis is evident, the received results are useful and they give positive assessment about the qualification of the Ph.D. student.

2. Degree of knowledge acquired by the student

The Ph.D. thesis presents an analysis in chapter 1 for the peculiarities of the control of conveyer systems. Resulting from this analysis is the definition of the

research approach of the thesis, defined as decomposition of the conveyor system to a set of independent and separate subsystems, which influence each other's. The formal presentation of each subsystem is assumed to be as software agents. This research approach is defined as a result from the applied classification of the conveyers systems and the set of problems, concerning its management.

Chapter 1 finishes with the definition of the goal of the thesis, defined as implementation of integrated system for distributed control. The reviewer finds that the Ph.D. thesis doesn't implement something. The correct definition is design of control laws for the management of conveyor systems.

It has been defined 5 tasks, supporting the thesis goal. The reviewer finds that these tasks should be defined more precisely. The currently written sentences easily can raise questions, which will make troubles for their explanations by the student, concerning the research and application meaning for the thesis. Such research and application contribution are needed to be defined explicitly by the legislative requirements in our country. The reviewer doesn't accept declaration for "implementation" and probably the student has to motivate correctly the content and the definition of such task.

The reviewer assumes that appropriate research and application task for this Ph.D. work is the design of control algorithm for the chosen system of conveyers, which operate in decentralized way. The independent operation of set of conveyers needs coordination and this coordination contains research and application character.

The reviewer has critical opinion for the size and the content of the presented reference list. It is very short, 27 sources from which 14 are information sources from Internet (in a late submitted document there are increase to 51 sources). Such manner of presentation of the Ph.D problem doesn't give positive assessment for the knowledge of the student concerning the problems of control of conveyers systems.

3. Correspondence between the chosen research methodology and the goals and problems targeted in the thesis

The Ph.D. thesis targets the design a control algorithm for the management of decentralized conveyers (or parts of them). This algorithm is claimed to be formalized in terms of software agents, which operate independently. Then the algorithm is tested in a simulation specialized software environment FlexSim.

In such logical sequence are presented the next chapters of the thesis.

The chapter 2 is titled with words like "solutions for adding intelligence in.....". The reviewer finds that this chapter contains an attempt to derive formal, quantitative relations, which present the dynamical operation of a conveyor system. An important control parameter is the distance between the packets and binding the packet position with its situation on the conveyor, using information from a set of sensors. It has been estimated density of the packets flow, the error from the measurements of the packet length. It has been discussed the need for additional data from sensors, based on visual cameras.

In this chapter is discussed also the possibility for energy saving by appropriate management of the drivers of the conveyor. This control opportunity is not formalized in an analytically given problem. The explanations are given in textual form and its possible rules of operations are explained.

The reviewer couldn't understand the terms "invitation for topographic of power supply". This term is defined as special operation of the control process. This part of the thesis applies formal records for the operation of the conveyor. It is not clear if

these formal records implements efficient control policy or their roles are only for presentation of records. The paragraphs, which describe the content about “methods for coding the signals for the rotor” and “security of the devices from cloning”, have character of description of constructive features of the control system. The term “cloning” was used for the opportunity the control software to be copied without permission. I find that in this part of the thesis research and application contributions are not presented and proved and such lack is not acceptable for the thesis.

This chapter finishes with comments about the operations in a neural network. But developments with such formal methods for the control system are not presented in the thesis. Thus it is not understandable why such paragraph is included in chapter 2 of the thesis. The overall chapter lacks of final conclusions about the results and contributions, which is not acceptable for the Ph.D. thesis.

The chapter 3 has a title for “implementation of the derived solutions”. The reviewer doesn’t accept the term “implementation” for the thesis. The descriptions in chapter 2 don’t give explicitly what from the conveyer system is used as available technological and control solution and what new and additional is added to this system. From the content of the chapter 3 it is understandable that the operation of a conveyer system was modeling and simulated in a special software environment. Thus under the term “implementation” the reviewer understands the design of software programs, which simulate the works of a conveyer system. On fig.41 is illustrated the code of such a program, despite that the explanations say that it generates codes of Hamming (there is a remark about the Bulgarian pronunciation of this name). It has been declared that these codes were used for data transmissions, but there is a lack of explanations how the usage of these codes is related with the conveyer operations.

In this chapter it has been commented the problem of energy savings. A program code illustrates the changes in the distances between the packets. Photographs are included for different technological components of the conveyer: moving table, drivers by belts, electrical drivers. It is seen that these object are not implemented by the Ph.D. thesis. The student must correctly define what was existed and what is developed in the conveyer system. Respectively he has to assess the new developments with existing solutions for the control of conveyer systems. The reviewer finds that it is not define clearly the result from the Ph.D. thesis: algorithm(s) or method(s). In chapter 2 it was written about algorithm, but in chapter 3 it was “implemented” methods. This is not a good way for definition of the proper results of the thesis.

In chapter 4 there are presentations of experimental results. The included file with operation rules is not explained and it doesn’t prove usefulness of the researches in the thesis. Respectively the result from improvement in the power supply is not presented appropriately. These both results are presented very shortly with few sentences. In paragraph IV.3 the expected results are illustrated only by photos of a conveyer system. There are no data about quantitative results, concerning the developed algorithm and its acceleration in speed, performance, energy savings etc. The lack of such data and their comparisons with current states don’t prove that the Ph.D. thesis gives beneficial results. The conclusion of chapter 4 has meaning of declaration, which is not proved in the content of this chapter. This is not in favor of the Ph.D. thesis.

The reviewer considers that it was necessary to be precised what will be content of the researches in the thesis. It is obvious that it has been made simulation of conveyer system. As a result from the simulation it is targeted better quality in the

operation of existing conveyer system. The Ph.D. thesis doesn't give comparisons of results with other systems, which will prove usefulness and correctness of claims and contributions. Without proves and comparisons the claims are declarative but not proved.

I find that the topics of control of conveyer system have research and application character. It has been made an overview about the manner of operation and potential ways of increase its performance. I find that it was not presented in a good way how to improve the system performance with a new control algorithm, which is developed by the Ph.D. thesis.

4. Scientific and practical achievements in the Ph.D. thesis

The Ph.D. thesis makes an analysis of the parameters, which can be applied for the control of a conveyer system. These parameters relate to the technological characteristics of a conveyer system. It has been designed programs for control and turning of a conveyer system in a software simulation environment.

I find that the topics of the thesis have scientific and application character. It has been analyzed a complex process of control of distributed systems of conveyers.

My assessment is positive for the applied efforts and works for the experimental works in the thesis.

I find that the thesis contains scientific and application results in its part for modeling and formalization of processes for the control of the distances between the packets and loads on the conveyer.

The application contribution is proved by design of programs in special simulation environment for the works of conveyers.

My assessment of these researches and application contributions is that they are sufficient for this Ph.D. thesis. They prove that the student can make by himself research activities, to apply formal tools for development of control algorithms for the management of specialized transportation conveyers.

Reading the Ph.d. thesis I find that the results are obtained mainly by the activities of the student.

5. Correspondence with the minimal national legislative requirements

The reviewer finds that the presented publications correspond with the topics and the content of the Ph.D. thesis. It has been presented 4 publications. There are not data that these publications have SJR rank. Two of the publications are presented on conferences, organized by IEEE association, which are published in the electronic database IEEXPLORE and the last are refer by SCOPUS. There are not evidences that citations are available.

According to the National legislative documents, which give the minimal requirements for awarding of the educational end scientific degree Ph.D. for the domain 4.6 "Informatics and computer sciences", the student must have at least 30 points for the criteria of category "G". The applied documents to this procedure illustrates that the student achieved 36 points for this criteria, which satisfies that legislative requirements.

6. Significance of the research and application achievements in the Ph.D. thesis

he Ph.D. student Ivailo Andonov demonstrates ability to use methods and tools for simulation of complex system of the domain of transportation conveyers. It has been demonstrated knowledge about the peculiarities of this type of technological systems and to identify possibilities for achieving better quality in their control.

The reviewer finds that the researches in the thesis are useful and they had led to pragmatic results as programming modules in simulation software environment for conveyer systems.

The presented documents don't contain proves for separating the author's contributions in the presented papers.

7. Few assessments, recommendations and remarks

My assessment for the presented Ph.D. thesis is positive.

The reviewer expresses an opinion that the thesis doesn't give clearly the difference between what has been assumed as given in the control system and what is changed. Thus it is not seen what has been done additionally.

Respectively the experimental results don't contain comparisons and assessment material, which can prove the relative benefits of the new control algorithm.

The reviewer has critical remarks towards the presentation of the content of the thesis: is it implemented a conveyer system, correspondence between the define tasks and presented contributions, the usage of terms, which are not understandable. The reviewer recommends correct and precise presentation of the proper results by the student.

In chapter 4 it is needed to be presented comparisons between different control algorithms of the conveyer system. Thus the comparison of results allows easily to be assessed the advantages of the different manner of development of control algorithms for complex system with distributed structure. The presented results currently are very poor discussed and they are not informative.

The reviewer finds that the student Ivailo Andonov demonstrates abilities for independent developments and conducting researches.

8. Conclusions

I give positive assessment for the presented research and application results in the Ph.D. thesis of Ivailo Andonov. My estimation is that the legislative requirements of the Law for academic growth in Bulgaria, the Regulations for its application and the specific requirements of the Sofia University are satisfied. This give me reasons to recommend to the honorable Scientific Jury **Ivailo Todorov Andonov to be awarded** with the Educational scientific degree "**doctor**" in the professional field 4.6 "Informatics and computer sciences", scientific specialty "Computer sciences - distributed systems".

20.04.2021

Reviewer:

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