

REVIEW

over dissertation for gaining educational and scientific degree “doctor”

Author: eng. Stefan Borisov Karastanev

Topic: “Reengineering of industrial robots”

Educational area: 5. Technical sciences,

Professional division: 5.2. Electrical engineering, Electronic and Automation

Discipline: Automated systems for information processing and management

Jury member: prof. dr. Tasho Tashev, TU-Sofia

Dissertation volume is 258 pages, divided in 6 chapters and conclusion. 87 literature sources are quoted including web addresses. Along with the dissertation are presented 7 publications incl. patent application with doctorant’s author participation (5 are single-write). 3 of them are presented in international conferences abroad (visible in SCOPUS, one of them is with SJR - № 1), 3 in local science conferences and 1 patent). There are not known quotations of publications with doctorant’s participation.

1. Accuracy of the dissertation’s problem in scientific and scientifically-applied matter

The topic of the dissertation is referred to actual and perspective field for recycling and second use in different industrial areas of industrial robots, dropped out from the automobile industry.

Over this topic are made a lot of researches, not only in the developed countries, but the whole world. The gathered knowledge and theory in the literature, patents, models and practices in the existing systems highlight the actual and perspective opportunities of the problem solved.

2. Problem and literature understanding degree

A wide and detailed material overview is made for observing kinds of mechatronic robotic systems.

87 sources are quoted, there are 7 authors publications. The analysis shows, that the author has researched and have a deep knowledge for the problems in this area.

The conclusion from the overview are well systematized. The task and the goals are correctly presented.

3. Congruence between the chosen methodology, goal and tasks and the achieved results

A theoretically researched and practically examined approach for solving a desired task (reengineering of industrial robots) is made in the dissertation, as the results demonstrate, that the methodology can be used successfully for creating new better results within the examination and implementation of real products. The conclusions from the overview and the analysis are well systematised and the task and goals are well motivated. It can be concluded that the author has chosen a well builded methodology for solving the desired goal and tasks.

4. Characteristic and evaluation of the dissertation

The dissertation makes a good impression with a thorough knowledge of the problems, the use of appropriate approaches to describe physical phenomena and processes in different methods for testing types of efficiency, formulation of original algorithms and tools for improving the quality of results. A rich experimental material for the results of the application is presented and there is a correspondence between the theoretical background and the results of the experiments.

The doctoral thesis objectives are formulated after a critical analysis and systematization of methods and tools for re-engineering industrial robots.

Dissertation goal:

„Second-hand Industrial Universal Robot Reengineering (IUR) by upgrading mechanics, building new electronics and software, testing the robotic system, and integrating it into new industrial applications”.

For completing the goal the following tasks are solved:

1. summary, analysis and systematisation of mechatron robotic systems
2. selection of IUR type for reengineering
3. development of methodologies for research of mechanics, electronics and software of IUR
4. development of methodologies for research of IUR
5. building a concept for IUR reengineering
6. building, research and verification of the reengineered IUR;

For proven the application of the research has been done the following:

A detailed overview, analysis and systematisation of mechatron robotic systems has been carried out.

A detailed research and engineering approach for the mechanic hardware and software system of the chosen type - robot KUKA KR 150 has been done.

An analysis of kinematic and dynamic models of the researched type has been carried out.

An analysis over the main parameters of the hardware and software is carried out.

Techniques for inspection of mechanical design, hardware and software have been developed.

The dynamic model of the selected robot is investigated.

A mathematical apparatus for solving the right and inverse task of the chosen IUR is presented.

Methodologies have been developed to study the mechanics, hardware and software of KUKA KR 150.

Mechanical design, hardware and software of the laboratory model have been investigated.

A study has been carried out of the developed hardware of the current laboratory model of IUR.

Research and verification of the results of the reengineering has been carried out.
Verification of the results of the research by the methods of reengineering has been carried out.

A study of the functionality of the developed management software was performed.
Verifying the updated mechanical design and the developed hardware and software for controlling the functional laboratory model of the re-engineered KUKA KR-150 based on established and validated verification methods.

Optimization of simulation and off-line programming of reengineered robots has been performed.

An innovative solution for a wireless control panel protected by a registered patent application is proposed.

A concept for product commercialization as a result of commercializing activities is proposed.

I positively appreciate the credibility of the research done and the contributions made.

5. Scientific and scientifically-applied contributions in the dissertation.

I accept author's contributions that are with scientific and scientifically-applied matter. Some additional consolidation and refinement can be made.

The presented scientific and scientifically-applied contributions can be added to the following groups: proving new significant sides of already examined scientific areas, problems, theories, hypothesis; discovering new classifications, methods, constructions, technologies and achieving solid factors, constructions and methods for enriching existing knowledge with practical application.

6. Evaluating author's personal participation in contributions

The dissertation and the contributions are personally made by the author.

The work of the student makes a good impression with deep thought entering in new interdisciplinary area.

7. Assessment of the publications within the dissertation

Along with the dissertation 7 publications are made, 5 of which are made only by the author., 1 patent approved patent application is included, only made by the author. It can be concluded that the Results has been popularized to the scientific community. The publications well represent the work done and the achieved results.

8. Real use of the dissertation results

The used methodologies, research and solutions can be applied in research and testing the development and optimisation of different technologies. They are a good start for widening the work over this field in the future and commercializing of the results..

9. Evaluation of the autoreferat according to the requirements

The autoreferat meets the requirements for its design, corresponds to the content of the dissertation and presents exactly the main achievements in the dissertation.

10. Notes, advices and comments

The dissertation stands out with deep knowledge, desire to research a significant problem from different aspects and finding a working solution. The research field is modern and perspective.

My personal notes and recommendations are presented personally to the author and taken in consideration. Most of them have a technical character and doesn't decrease the importance of the achieved results and conclusions.

As a recommendation for the future I suggest that the student should make more publications in international prestigious journals and conferences.

CONCLUSION

The author has made a deep overview and analysis of the presented problem and has offered solutions in modern and perspective field. **All requirements of ЗРАСРБ, the application manual, and the special requirements for gaining a PhD title in IICT-BAS are fulfilled**, based on the volume and the quality of the dissertation paper.

Based on that my evaluation is positive and I offer **eng. Stefan Borisov Karastanev** to be awarded with educational and scientific title "doctor" in discipline 5 — Technical sciences, division 5.2. — Electrical engineering, Electronic and Automation, scientific area – Automated systems for information processing and management.

**NOT FOR
PUBLIC RELEASE**

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Sofia

Jury member: **prof. dr. Tasho Tashev**