

REVIEW ON THE HABILITATION THESIS

Title: RELIABILITY ANALYSIS OF NON-COHERENT SYSTEMS

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The habilitation thesis of Ing. Peter Sedláček, PhD. has been performed in the study program “Applied Informatics” at the University of Zilina, Faculty of Management Science and Informatics.

Topicality of the habilitation thesis: Modern systems are more and more complex as well as reliable so that their reliability analysis is more and more difficult. Non-coherent systems including multi state systems are particularly complicated to be analyzed from reliability point of view (for example reliability of software systems). Since they are occurring more and more frequently in real practice, I can declare that the habilitation thesis is highly topical.

The habilitation thesis is structured into seven chapters, introduction and conclusion. It is intended rather as a summary of results bringing new pieces of knowledge in the field of reliability analysis of non-coherent systems than a standard habilitation thesis.

The first chapter contains 20 pages including article (15 pages) published in highly recognized journal (Reliability Engineering & System Safety). As a member of the Editorial Board of the journal I declare that results demonstrated in the article are significant and the article brings clear novelties in reliability analysis: 1) the new approach for the analysis of non-coherent MSSs based on the use of methodology of MVL (Multi-Valued Logic) is proposed, 2) the new method for finding the critical system states of non-coherent systems is developed, which can be used as the basis for the development of methods of important analysis. In this Chapter I appreciate clear arrangement of the explained methodology as well as the effort to employ the methodology on practical and comprehensible case studies. In comparison with coherent systems the analysis of non-coherent systems has higher computational demands what is clearly commented.

The second chapter brings further continuation of Chapter 1 in applications. The methodology is applied on specific non-traditional redundant system k -to- l -out-of- n called as a drone fleet in limited space. The author showed that the methodology is so strong that it allows to investigate critical states of such complicated system using structure function and integrated partial logical derivatives that were proposed for the non-coherent MSS analysis.

The third and fourth chapters are structured similarly as first chapter: they contain short description of methodology and articles published in highly recognized journal.

Chapter 3 is devoted to importance analysis of non-coherent binary-state systems, especially to calculation of Birnbaum importance. In this section, the new approach for calculation of the Birnbaum importance measure for the non-coherent system is developed. This approach assumes that the investigated system is represented by Boolean expression (algebraic representation) or by the truth table (matrix representation). This approach is based on

mathematical methodology of Logical Differential Calculus, in particular, its parts known as Boolean Derivatives (BD) and Direct Partial Boolean Derivatives (DPBD). The Birnbaum importance measure of several components proposed in this article is not restricted by two components only, it can be calculated for any number of components and the algorithm for calculation might not be modified. Novelty is clearly discussed in the article, I have no other comments to this part.

Chapter 4 is continuation of Chapter 3, it shows authors new result published in this year (2026). It brings a new method for the importance analysis of components of non-coherent MSS. The use of logical differential calculus, particularly the IDPLD, is the background of the new method. I have no critical comments to this part, the article brings original new results.

Chapter 5 brings continuation of author's dissertation thesis. It proposes the new approach for reliability analysis of software, which is a specific kind of non-coherent system. The chapter consists of short description of the software reliability model based on syntax tree and conference paper published by IEEE publisher (2021). The fault tree and structure function, needed for further reliability analysis, are generated from syntax tree which is created immediately from the source code of an investigated software. In the Conclusions of the conference paper authors declare 2 main problems: large dimension and usage of the AND gates, what can lead to inaccuracy of the created model.

Question:

Did authors recently a progress concerning the solution of these problems?

Chapter 6 relates to methodology of reliability analysis only marginally. It deals with software tests that can serve as a way for development of reliable software. Testing of functionality of a software must be done by properly selected tests. Author presents a specific method that allows to evaluate the quality of these tests. Method is published as one chapter in a Springer book.

Chapter 7 is last and it integrates previous author's experience with reliability analyses. In form of conference paper it gives instructions for reliability researchers how to perform all necessary steps needed for high-quality reliability analysis. Authors intend to design a software product serving for a lot of specific reliability analyses.

Conclusion

Mr. Ing. Peter Sedláček, PhD. has published his results on various journals, conferences and workshops. They were accepted by scientific community in the area of applied informatics. He is author or co-author of 33 publications on Scopus (including articles in highly recognized journals as Reliability Engineering & System Safety for example – participation in 3 articles), having *h*-index 4 (excluding self-citations).

In the habilitation thesis Mr. Ing. Peter Sedláček, PhD. clearly demonstrated his ability to produce original creative research work. He is active member the research team which proposed the novel approach for reliability analyses of non-coherent systems.

The habilitation thesis fulfilled all important criteria and thus I recommend Mr. Ing. Peter Sedláček, PhD. after a successful defense of his work to receive the scientific-pedagogic degree “Docent” from the Faculty of management science and informatics, University of Zilina in Zilina.

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