

Review of the Ph.D. thesis

Name of thesis: Spatially invariant systems: Modelling, analysis and control via polynomial approach

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Study program: Control Engineering and Robotics

Reviewer: prof. Ing. Roman Prokop, CSc., FAI UTB ve Zlíně, Nad Stráněmi 4511, 762 72 Zlín

1. Importance, goals, structure and contents of the thesis

The submitted dissertation belongs to theoretical works with program and control design outputs. The fundamental object of the thesis is a class of spatially distributed systems described by partial differential equations. The author proved and demonstrated deep knowledge, abilities in control theory, mathematics as well as in programming. The formal level of the work is fair, the structure, mathematical comprehensibility and clarity is without relevant objections.

The work is written in English language within the range of 86 pages. The list of reference represents 75 items, 10 references are own contributions of the author. The thesis is divided into 9 chapters, the main beneficial contributions are presented in chapters 3-8.

Chapter 1 is an introduction of modeling and analysis of spatially distributed systems. Three main aims of the thesis are also formulated in this chapter. The first aim consists in modeling (method) of spatially invariant systems by transfer functions. The second task is aimed to stability analysis and the third one deals with control design. Naturally, the algebraic approach and tools of 2-D systems are preferred. The main contributions and outputs of the thesis with authors bibliography are also referred in this chapter.

Brief chapter 2 represents a State of the art. Chapter 3 deals with modeling of spatially distributed systems by partial differential equations. Especially, the finite difference method is described more precisely.

Chapter 4 is devoted to transfer function descriptions of je spatially distributed systems while chapter 5 is dealing with stability analysis of mentioned systems in continuous as well as in discrete time representation. Chapter 6 is aimed to algebraic control design of studied systems wit the main results of the work. Tools of the thesis are outlined in chapter 7 and comparison to other existing methods is presented in chapter 8. Finally, chapter 9 is a conclusion with summarized results and contributions.

2. Importance, used approach and results of the thesis

The goals of the thesis are formulated correctly and clearly with the adequate relations to the state of work in the world. The theoretical tools and program realizations proved the high level of author's knowledge and scientific orientation.

Discrete and continuous-time models are derived and simulated. A positive polynomial approach to stability analysis was proposed. The Schur-Cohn and Hermite-Fijivara matrix is utilized for the discrete and continuous-time case. And finally, several controllers (LQG, H_2 , Dead-beat) were designed. From my point of view, all formulated goals were fulfilled.

Also a set of program products were developed as outputs of the thesis. Results and contributions have been published in three journal articles and 7 conference papers. Some of them have some citation response.

3. Remarks and questions

The basic feature of the thesis is briefness. The formal site of the work is good and sufficient typist errors like p. 19₁₀ (cab be) are exceptional. The following suggestions and remarks should be understood advisory and consultative:

- p1. Inconsistent numbering of equations.
- p2. Article „we“ is used too frequently and sometimes unsuitably.
- p3. State of the art is too brief. I expected deeper insight into the topic with wider list of bibliography items.
- p4. Fig. 6.2 is unintelligible with eq. (6.6), (6.7).
- p5. What is the member $z/(1-z)$ in Fig. 6.20 and what is the interpretation for dead-beat control?
- p6. What is the difference between $R[z,w]$ and $R[w][z]$ in p. 63?
- P7. An untypical indication of input/output variable is sometimes used see f s.20, q in s. 22, outputs u in 20,22....


4. Conclusion

With respect to the facts and statements listed above I claim that **Ing. Petr Augusta** has proved to be capable of solving scientific problems and his doctoral thesis presents new results and contributions. Also developed results can be applied into technological practice and program tools. The thesis satisfies all conditions given by Czech Act 111/98 (section 47, p. 4) and therefore

I recommend

Ing. Petra Augusta thesisi to be accepted by the committee to be presented and defended in the Control Engineering and Robotics study branch.

In Zlín 15.2.2011



Prof. Ing. Roman Prokop, *QSc.*