MUNI

PUBLIC LECTURE EVALUATION

Masaryk University	
Faculty	Faculty of Science
Procedure field	Mathematics – Mathematical Analysis
Applicant	Mgr. Peter Šepitka, Ph.D.
Lecture date	15. 11. 2021
Lecture topic	New perspectives on theory of Riccati matrix differential equations
Persons present (number)	17 (on-site) + 13 (online)
Designated evaluators (board members)	Prof. RNDr. Zuzana Došlá, DSc. (on-site)
	Prof. RNDr. Pavel Drábek, DrSc. (online)
	Prof. RNDr. Stanislav Hencl, Ph.D. (online)

The applicant started the lecture by motivating the importance of the Riccati matrix differential equations in the problem of optimal linear-quadratic regulation, or more generally in nonlinear optimal control theory. He also presented some historical connections of the Riccati equations with linear Hamiltonian systems and spectral theory. In the main part of the lecture he presented his own results regarding the theory of Riccati equations for uncontrollable (abnormal) systems, in particular he made connections with the theory of genera of conjoined bases for such systems. He also paid a particular attention to distinguished solutions of Riccati equations and their minimality properties at infinity. Finally, he presented the utility of the symmetric solutions of the Riccati equation for the calculation of the comparative index of two conjoined bases. Such a connection is important for the development of the Sturmian theory. These results form one of the main parts of the habilitation thesis. At the end of the lecture the applicant presented further possible research directions and open problems, which are relevant to this subject.

The lecture was concluded with a discussion of the questions posed in reviewers' reports and from the on-site and online audience.

1. Has the applicant worked on the connections between the comparative index and the Maslov index?

   Yes, he is already working on the subject and there is a submitted paper with prof. Elyseeva and prof. Hilscher.

2. Is there a simple example of a physical system, or a system from a different area of science, which could be described by an abnormal linear Hamiltonian system?

   He did not find any so far.

3. Which of the many subspaces appearing in the habilitation thesis are Lagrangian, and which are merely isotropic?

   He explained in detail which subspaces are Lagrangian (e.g., generated by the columns of conjoined bases of any linear Hamiltonian differential system), others are neither Lagrangian nor isotropic.

4. Is there a geometric interpretation of the comparative index?

   This was partially answered in one of his papers using Lidskii angles for symplectic matrices. He explained its geometrical meaning to the reviewer in detail.

5. What are further research directions?

   Weakly disconjugate systems, theory without controllability assumption, symplectic dynamical systems on times scales.

6. What is the relationship between the Lagrangian planes and the associated symmetric (orthogonal) matrices? He explained the relationship in the context of his work.

7. What is the connection to the classical theory that I know?

   This is the extended theory.

The applicant demonstrated in his talk as well as in the discussion that he is an expert in the field. The talk has been carefully prepared, and the questions were answered satisfactorily.

Conclusion

The lecture delivered by Peter Šepitka, entitled "New perspectives on theory of Riccati matrix differential equations" and delivered as part of the habilitation procedure, **demonstrated** sufficient scholarly qualifications and pedagogical capabilities expected of applicants participating in a habilitation procedure in the field of Mathematics – Mathematical Analysis.

The lecture took place in a hybrid form at 12:00. The above-mentioned members of the board attended the lecture and provided its evaluation. All designated evaluators are familiar with the text of the evaluation and agree with it.

Date: 15.11.2021

Zuzana Došlá   …………………
                                               signature

Pavel Drábek (online)

Stanislav Hencl (online)