M U N I

PUBLIC LECTURE EVALUATION

Masaryk University	
Faculty	Faculty of Science
Procedure field	Mathematics – Mathematical Analysis
Applicant	Mgr. Zuzana Pátíková, Ph.D.
Lecture date	March 14, 2022
Lecture topic	The use of the modified Riccati technique in the qualitative theory of half-linear equations
Persons present (number)	24
Designated evaluators (board members)	Prof. RNDr. Zuzana Došlá, DSc. (on-site) Prof. RNDr. Jaroslav Jaroš, CSc. (online) Prof. Mgr. Pavel Řehák, Ph.D. (online)

The applicant started the lecture by motivating the importance of the half-linear differential equations in theory of differential equations with p-Laplacian and in physics. She explained in detail the modified Riccati method in the study of half-linear equations. In the main part of the lecture, she presented her own results regarding the Euler type equations and general conditionally oscillation equations. In particular, she presented new asymptotical results, Hillari-Nehari criteria for conditionally oscillation and Hille-Winter type comparison theorems. She presented the utility of the improved modified Riccati method for the calculation of the critical coefficient for Euler type equations.
These results form one of the main parts of the habilitation thesis. During the lecture, where relevant, 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. (Džurina) Is it possible to extend author's results to higher (even) order differential equations? Eventually, what difficulties it yields?

Reply: For even order half-linear differential equations the so-called Reid's roundabout theorem is missing and the Riccati technique is not available. Considering the Euler-type version of equation the latest results [Došlý, Růžička, 2016] present only nonoscillatory criteria and conditional oscillation is not verified yet. However, there is a new possible direction of studying even order equations which is the reduction of order approach introduced by Jaroš, 2020.

2 (Hasil) The theory of difference equations contains analogies to many tools and methods used in the differential case and it is widely used in applications and very useful. Are there discrete versions of described results, do you intend to proceed in your research in this direction or are there some obstacles that make this way of research hard and/or impossible?

Reply: The modified Riccati technique works even in the discrete case, it was presented and used by Došlý and Fišnarová during the years 2008–2012. However, it is not so deeply developed since the discrete technique requires more assumptions (on coefficient functions, on the function h). There are some conjectures so that the technique should work similarly as in the continuous case, but the technical details resist so far.

3 (Hasil) Is it possible to quantify the computational complexity of the presented differential transformation method?

Reply: The applicant has not dug deeper in this direction. She did not consider the code optimization; however, she sees the following issues considering the problem. Firstly, there is a variant of the differential transform algorithm with a running adjustment of the two free parameters – the length of the next step and the order of the truncated series. Secondly, it looks like some programming settings might be more suitable for the coefficient calculations. The concept of the so-called automatic differentiation looks promising.

Conclusion

The lecture delivered by Zuzana Pátíková, entitled “The use of the modified Riccati technique in the qualitative theory of half-linear 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: 14.3.2022 Zuzana Došlá ……
signature