

Spectrum-based robust stability analysis of linear delay differential-algebraic equations

V.H. Linh¹ and D.D. Thuan²

¹Faculty of Mathematics, Mechanics and Informatics, Vietnam National University, Hanoi, Vietnam, linhvh@vnu.edu.vn

²School of Applied Mathematics and Informatics, Hanoi University of Science and Technology, Hanoi, Vietnam, ducthuank7@gmail.com

In this talk we discuss recent results on the robust stability analysis of linear delay ordinary differential equations (DODEs) and linear delay differential-algebraic equations (DDAEs). We investigate whether the asymptotic/exponential stability of a given system is preserved when the system coefficients are subject to structured perturbations. In particular, we are interested in computing the distance (measured in an appropriate metric) between the nominal stable system and the closest perturbed systems that loses the stability. This quantity is called the distance to instability or the *stability radius* of the system. We focus on the spectrum-based stability criteria and the formulation of stability radii for linear delay systems. The stability and robust stability analysis for DAEs is quite different from that of ODEs since the system dynamics is constrained, see [1]. Not only the stability, but also some other DAE properties must be considered. If the time-delay is involved, then the existence and the behaviour of solutions become more complicated, see [2]. In the first part of the talk, we briefly overview important results on the stability radii for linear time-invariant DODEs and an extended result for linear time-varying DODEs. In the second part, we discuss some recent results on the spectrum-based stability and robust stability analysis for general linear time-invariant DDAEs [2]. We close the talk by mentioning some further related results and topics for future research.

References

- [1] N.H. Du, V. H. Linh, and V. Mehrmann, Robust stability of differential-algebraic equations. In: *Surveys in Differential-Algebraic Equations I*, DAE-F (2013), 63–95.
- [2] N.H. Du, V. H. Linh, V. Mehrmann, and D.D. Thuan, Stability and robust stability of linear time-invariant delay differential-algebraic equations. *SIAM J. Matrix Anal. Appl.*, **34** (2013), 1631–1654.
- [3] P. Ha, V. Mehrmann, and A. Steinbrecher, Analysis of linear variable coefficient delay differential-algebraic equations. *J. Dyn. Diff. Eqs.*, **26** (2014), 889–914.