

Differential-algebraic equations with delay - A 25 minute-journey

Ha Phi

Technical University Berlin
Email: *ha@math.tu-berlin.de*

Abstract

This talk aims at linear time-invariant delay differential-algebraic equations (DDAEs) of the form

$$A_k x^{(k)}(t) + \dots + A_0 x(t) + A_{-1} x(t - \tau) + \dots + A_{-\kappa} x^{(\kappa)}(t - \tau) = f(t), \quad (1)$$

and its special case

$$A_1 \dot{x}(t) + A_0 x(t) + A_{-1} x(t - \tau) = f(t). \quad (2)$$

Surprisingly, already in order to deal with (2), it is necessary to study linear high-order differential-algebraic equations of the form

$$A_m x^{(m)}(t) + \dots + A_0 x(t) = f(t), \quad (3)$$

for different orders m . Therefore, in the first part of the talk, we study system (3). The second part of the talk is about the solvability analysis of systems (1) and (2). The key tool of our analysis here is the combination of algebraic and behavior approaches [1, 2, 3].

References

- [1] P. Kunkel, V. Mehrmann, *Differential algebraic equations - Analytic and Numerical Solutions*, EMS textbook in mathematics, European Mathematics Society(EMS), Zürich, 2006.
- [2] J. W. Polderman and J. C. Willems, *Introduction to Mathematical Systems Theory: A Behavioural Approach*, Springer-Verlag, New York, 1998.
- [3] A. Steinbrecher, Regularization of quasi-linear differential-algebraic equations in multibody dynamics, In *Proceedings of Multibody Dynamics 2011 - ECCOMAS Thematic Conference Brussels (Bruxelles, Belgium, July 4-7, 2011)*, 2011.