

# Lectures on Differential-Algebraic Equations

René Lamour  
DFG Research Center MATHEON  
Humboldt-University of Berlin

The lecture will give an introduction into the world of Differential-Algebraic Equations (DAEs), which arise in various fields of natural sciences. Starting with the classical result of Kronecker for constant coefficients I will introduce the *tractability index concept* to analyse linear, time dependent DAEs. The tractability index provide a decomposition of the DAE, which is very useful to investigate the application of numerical methods to DAEs. A basic knowledge on linear algebra, numerical analysis and ordinary differential equations would be advantageously.

- Introduction: History, Examples, Applications
- Linear DAEs with Constant Coefficients
  - The Kronecker Index
- Linear DAEs with Time-Dependent Coefficients
  - DAEs with Properly Stated Leading Term
  - The Tractability Index
  - Integration Methods
- Consistent Initial Values
- Boundary Value Problems - Shooting Methods

## References

- D. Estevez Schwarz, R. Lamour *The Computation of consistent initial values for nonlinear index 2 DAEs*, Numerical Algorithms, 26 (2001) 49-75 (**PrePrint** 99-13)
- R. Lamour *A Shooting method for fully implicit index-2 DAEs*, SIAM J.Sci.Comput. 18 (1997) 94-114
- R. Lamour *Index Determination and Calculation of Consistent Initial Values for DAEs*, Computers and Mathematics with Applications to appear (2005) (**PP** 01-19)
- R. März *Solvability of linear differential algebraic equations with properly stated leading term*, Results in Mathematics 45 (2004) 88-105 (**PP** 20-12)
- R. März *Fine decoupling of regular differential algebraic equations*, Results in Mathematics 46 (2004) 57-72 (**PP** 04-4)
- I. Higuera, R. März, C.Tischendorf *Stability preserving integration of index-1 DAEs*, Applied Numerical Mathematics 45 (2003) 175-200 (**PP** 01-5)
- I. Higuera, R. März, C.Tischendorf *Stability preserving integration of index-2 DAEs*, Applied Numerical Mathematics 45 (2003) 201-229 (**PP** 01-10)

The preprint versions given to most of the references are available under

<http://www.math.hu-berlin.de> -> Publications -> select the year (PP 99-13 = 1999)