Technische Universität Berlin **Summer term 2014**
Fakultät II – Mathematik und Naturwissenschaften
Institut für Mathematik
Volker Mehrmann, Lena Scholz, Andreas Steinbrecher

Numerics of Differential-Algebraic Equations

Info Sheet

1. **General information:**

   Time of the seminar:

Preparatory Meeting	on 17. April 2014	Thursday	12 - 14	in MA 542
Weekly Meeting	from 24. April 2014	Thursday	16 - 18	in MA 542

   Webpage: `http://www3.math.tu-berlin.de/Vorlesungen/SS14/NumericsDAE`

2. **Consultation hours**

Volker Mehrmann	Wed	12:00-13:00	MA 466	`mehrmann@math.tu-berlin.de`
Lena Scholz	Tue	15:00-16:00	MA 463	`lscholz@math.tu-berlin.de`
Andreas Steinbrecher	Wed	10:00-11:00	MA 463	`anst@math.tu-berlin.de`

3. **Guidelines for the oral presentations:**

   - The talks have to be given in English.
   - Black board presentation of 90 minutes (including discussion).
   - For a graded certificate a registration in the examination office (Prüfungsamt) is required **before** the date of the oral presentation.
   - The final grade is made up of the grade for the oral presentation (40%) and the grade of the written report (60%).

4. **Guidelines for preparing the written reports:**

   - The reports have to be written in English and should have a maximal length of 10 pages (excluding Title, Table of Contents, References) in 11pt.
   - Deadline for handing in the written reports is in the seminar four weeks after the presentation of the talk.
   - Everything that is treated in the talk should also be documented in the report (including proofs!).
   - Proofs that are not given in the references have not to be carried out. If only the idea of a proof is mentioned, this is also sufficient for the report. However, possibly missing intermediate steps of given proofs should be carried out.
   - Citations should refer to the respective book chapter.

List of Topics:

1. **Runge-Kutta methods**
   - Hairer,E.; Lubich,C.; Roche,M.. The Numerical Solution of Differential-Algebraic Systems by Runge-Kutta Methods. Springer-Verlag, Berlin, Germany, 1989.
2. **BDF methods**
   - Brenan,K.E.; Campbell,S.L.; Petzold,L.R.. Numerical Solution of Initial-Value Problems in Differential Algebraic Equations. in Classics in Applied Mathematics. SIAM, volume 14. Philadelphia, PA, 1996.
   - Petzold,L.R.. A Description of DASSL: A differential/algebraic system solver. In Stepleman,R.S. and et al., editor, Scientific Computing, North Holland, pages 65-68. Amsterdam, 1983.
3. **Extrapolation methods**
   - Deuflhard,P.; Hairer,E.; Zugck,J.. One-step and extrapolation methods for differential-algebraic systems. Numerische Mathematik, volume 51. pages 501-516. 1987.
   - Deuflhard,P.; Nowak,U.. Extrapolation integrators for quasilinear implicit ODEs. In Deuflhard,P. and Engquist,B., editor, Large-Scale Scientific Computing, Birkhäuser, Boston, 1987.
4. **Half-explicit Runge-Kutta methods**
   - Arnold,M.. Half-explicit Runge-Kutta methods with explicit stages for differential-algebraic systems of index 2. BIT, volume 38. number 3. pages 415–438. 1998.
   - Brasey,V.; Hairer,E.. Half-Explicit Runge-Kutta-Methods for Differential-Algebraic Systems of Index 2. SIAM Journal on Numerical Analysis, volume 30. number 2. pages 538–552. 1993.
5. **Half-explicit extrapolation methods**
   - Ostermann,A.. A half-explicit extrapolation method for differential-algebraic systems of index 3. IMA J. Numer. Anal., volume 10. pages 171-180. 1990.
6. **General linear methods**
   - S.Schulz: General linear methods for linear DAEs, Preprints aus dem Institut für Mathematik, Humboldt Universität zu Berlin, No. 10, 2003.
   - S. Schneider. Convergence of general linear methods on differential- algebraic systems of index 3, BIT, Vol. 37, No. 2, pp. 424-441, 1997.
   - P. Chartier. General linear methods for differential-algebraic equations of index one and two, Institut de recherche en Informatique et systèmes aléatoires, Campus de Beaulieu, Publication interne no. 711, 1993.
7. **Generalized α-methods for mechanical systems**
   - Ch.Lunk, B.Simeon, Solving constrained mechanical systems by the family of Newmark and α-methods. ZAMM - Journal of Applied Mathematics and Mechanics, volume 86, number 10, 2006
   - J.Yen, L.Petzold, S.Raha, A time integration algorithm for flexible mechanism dynamics: The DAE α-method. Comput. Method. Appl. M., volume 158, page 341–355, 1998
8. **Structural Analysis**
   - J.D Pryce, A simple structural analysis method for DAEs, BIT 41 (2001) 364–394.
9. **Taylor Series methods**
   - Nedialkov,N.S.; Pryce,J.D.. Solving Differential-Algebraic Equations by Taylor Series (I): Computing Taylor Coefficients. BIT Numerical Mathematics, volume 45. number 3. pages 561–591. 2005.
   - Nedialkov,N.S.; Pryce,J.D.. Solving differential-algebraic equations by Taylor series (II): Computing the System Jacobian. BIT Numerical Mathematics, volume 47. number 1. pages 121–135. 2007.
   - Nedialkov,N.S.; Pryce,J.D.. Solving differential-algebraic equations by Taylor series (III): The DAETS code. Journal of Numerical Analysis, Industrial and Applied Mathematics, volume 3. pages 61–80. 2008.