On data-dependence of exponential stability and stability radii for linear time-varying differential-algebraic systems

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Abstract: This paper is addressed to some questions concerning the exponential stability and its robustness measure for linear time-varying differential-algebraic systems of index 1. First, the Bohl exponent theory that is well known for ordinary differential equations is extended to differential-algebraic equations. Then, it is investigated that how the Bohl exponent and the stability radii with respect to dynamic perturbations for a differential-algebraic system depend on the system data. The paper can be considered as a continued and complementary part to a recent paper on stability radii for time-varying differential-algebraic equations [N.H. Du, V.H. Linh, Stability radii for linear time-varying differential-algebraic equations with respect to dynamic perturbations, J. Differential Equations 230 (2006) 579-599]. ?? 2008 Elsevier Inc. All rights reserved.

Author Keywords: Bohl exponent; Data-dependence; Differential-algebraic equations; Exponential stability; Stability radii

Year: 2008
Source title: Journal of Differential Equations
Volume: 245
Issue: 8
Page : 2078-2102
Cited by: 1
Link: Scorpus Link
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ISSN: 220396
CODEN: JDEQA
DOI: 10.1016/j.jde.2008.07.016
Language of Original Document: English
Abbreviated Source Title: Journal of Differential Equations
Document Type: Article
Source: Scopus
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References:

1. Ascher, U.M., Petzold, L.R., Stability of computation for constrained dynamical systems (1993) SIAM J. Sci. Statist. Comput., 14, pp. 95-120
2. Balla, K., M??rz, R., Linear differential algebraic equations of index 1 and their adjoint equations (2000) Results Math., 37 (1-2), pp. 13-35
3. Beckner, W., Inequalities in Fourier analysis (1975) Ann. of Math. (2), 102 (1), pp. 159-182
4. M. Bracke, On stability radii of parametrized linear differential-algebraic systems, PhD thesis, University of Kaiserslautern, 2000Brenan, K.E., Campbell, S.L., Petzold, L.R., (1996) Numerical Solution of Initial Value Problems in Differential Algebraic Equations, , SIAM, Philadelphia
5. Byers, R., Nichols, N., On the stability radius of a generalized state-space system (1993) Linear Algebra Appl., 188-189, pp. 113-134
6. Cong, N.D., Nam, H., Lyapunov inequality for differential-algebraic equations (2003) Acta Math. Vietnam., 28 (1), pp. 73-88
7. Cong, N.D., Nam, H., Lyapunov's regularity for linear differential-algebraic equations of index-1 (2004) Acta Math. Vietnam., 29 (1), pp. 1-21
8. Daleckii, J.L., Krein, M.G., (1974) Stability of Solutions of Differential Equations in Banach Spaces, , Amer. Math. Soc., Providence, RI
9. Du, N.H., Stability radii for differential-algebraic equations (1999) Vietnam J. Math., 27, pp. 379-382
10. Du, N.H., Linh, V.H., Robust stability of implicit linear systems containing a small parameter in the leading term (2006) IMA J. Math. Control Inform., 23, pp. 67-84
11. Du, N.H., Linh, V.H., Stability radii for linear time-varying differential-algebraic equations with respect to dynamic perturbation (2006) J. Differential Equations, 230, pp. 579-599
12. Fridman, E., Stability of linear descriptor systems with delay: A Lyapunov-based approach (2002) J. Math. Anal. Appl., 273, pp. 24-44
13. Griepentrog, E., M??rz, R., (1986) Differential-Algebraic Equations and Their Numerical Treatment, , Teubner-Texte zur Mathematik, Leipzig
14. Higueras, I., M??rz, R., Tischendorf, C., Stability preserving integration of index-1 DAEs (2003) Appl. Numer. Math., 45, pp. 175-200
15. Hinrichsen, D., Ilchmann, A., Pritchard, A.J., Robustness of stability of time-varying linear systems (1989) J. Differential Equations, 82, pp. 219-250
16. Hinrichsen, D., Pritchard, A.J., Stability radius for structured perturbations and the algebraic Riccati equation (1986) Systems Control Lett., 8, pp. 105-113
17. Hinrichsen, D., Pritchard, A.J., A note on some difference between real and complex stability radii (1990) Systems Control Lett., 14, pp. 401-408
18. Hinrichsen, D., Pritchard, A.J., Destabilization by output feedback (1992) Differential Integral Equations, 5 (2), pp. 357-386
19. Ilchmann, A., Mareels, I.M.Y., On stability radii of slowly time-varying systems (2001) Advances in Mathematical System Theory, pp. 55-75. , Birkh??user, Boston
20. Jacob, B., A formula for the stability radius of time-varying systems (1998) J. Differential Equations, 142, pp. 167-187
21. Kunkel, P., Mehrmann, V., (2006) Differential-Algebraic Equations. Analysis and Numerical Solution, , EMS Publishing House, Z?rich, Switzerland
22. Kunkel, P., Mehrmann, V., Stability properties of differential-algebraic equations and spin-stabilized discretization (2007)

Electron. Trans. Numer. Anal., 26, pp. 385-420

23. Lamour, R., M??rz, R., Winkler, R., How Floquet theory applies to differential-algebraic equations (1998) J. Math. Anal. Appl., 217, pp. 372-394
24. V.H. Linh, V. Mehrmann, Spectral intervals for differential algebraic equations and their numerical approximations, preprint 402, DFG Research Center Matheon, TU Berlin, Berlin, Germany, 2007, url: http://www.matheon.de/M??rz, R., Numerical methods for differential-algebraic equations (1992) Acta Numer., pp. 141-198
25. M??rz, R., Practical Lyapunov stability criteria for differential algebraic equations (1994) Banach Center Publ., 29, pp. 245-266
26. M??rz, R., Criteria for the trivial solution of differential algebraic equations with small nonlinearities to be asymptotically stable (1998) J. Math. Anal. Appl., 225, pp. 587-607
27. Qiu, L., Benhardson, B., Rantzer, A., Davison, E.J., Young, P.M., Doyle, J.C., A formula for computation of the real stability radius (1995) Automatica, 31, pp. 879-890
28. Qiu, L., Davison, E.J., The stability robustness of generalized eigenvalues (1992) IEEE Trans. Automat. Control, 37, pp. 886-891
29. Stykel, T., On criteria for asymptotic stability of differential-algebraic equations (2002) Z. Angew. Math. Mech., 92, pp. 147-158
30. Tischendorf, C., On stability of solutions of autonomous index-1 tractable and quasilinear index-2 tractable DAE's (1994) Circuits Systems Signal Process., 13, pp. 139-154
31. Wirth, F., Hinrichsen, D., On stability radii of infinite-dimensional time-varying discrete-time systems (1994) IMA J. Math. Control Inform., 11 (3), pp. 253-276
32. Xu, S., Van Dooren, P., Radu, S., Lam, J., Robust stability and stabilization for singular systems with state delay and parameter uncertainty (2002) IEEE Trans. Automat. Control, 47, pp. 1122-1128
33. Zhu, W., Petzold, L., Asymptotic stability of linear delay differential algebraic equations and numerical methods (1997) Appl. Numer. Math., 24, pp. 247-264
34. Zhu, W., Petzold, L., Asymptotic stability of Hessenberg delay differential-algebraic equations of retarded or neutral type (1998) Appl. Numer. Math., 27, pp. 309-325