

ON THE ROBUSTNESS OF EXPONENTIAL DICHOTOMIES

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Abstract. For linear evolution families in Banach spaces, we establish the robustness of a weaker notion of exponential dichotomy. This notion allows the contraction and expansion along the stable and unstable subspaces to be nonuniform and requires nothing from the angles between these subspaces.

Key Words and Phrases: Exponential dichotomies, perturbations, robustness, fixed point.

2010 Mathematics Subject Classification: 34D99, 37C75, 47H10.

Acknowledgment. Supported by Portuguese National Funds through FCT - Fundação para a Ciência e a Tecnologia within the project PTDC/MAT/117106/2010 and by CAMGSD.

REFERENCES

- [1] L. Barreira, Ya. Pesin, *Nonuniform Hyperbolicity*, Encyclopedia of Math. and Its Appl. 115, Cambridge Univ. Press, 2007.
- [2] L. Barreira, C. Valls, *Robustness of nonuniform exponential dichotomies in Banach spaces*, J. Diff. Eqs., **244**(2008), 2407–2447.
- [3] L. Barreira, C. Valls, *Stability of Nonautonomous Differential Equations*, Lecture Notes in Mathematics 1926, Springer, 2008.
- [4] C. Chicone, Yu. Latushkin, *Evolution Semigroups in Dynamical Systems and Differential Equations*, Mathematical Surveys and Monographs 70, Amer. Math. Soc., 1999.
- [5] S.-N. Chow, H. Leiva, *Existence and roughness of the exponential dichotomy for skew-product semiflow in Banach spaces*, J. Diff. Eqs., **120**(1995), 429–477.
- [6] W. Coppel, *Dichotomies and reducibility*, J. Diff. Eqs., **3**(1967), 500–521.
- [7] Ju. Dalec’kiĭ, M. Kreĭn, *Stability of Solutions of Differential Equations in Banach Space*, Translations of Mathematical Monographs 43, Amer. Math. Soc., 1974.
- [8] J. Massera, J. Schäffer, *Linear differential equations and functional analysis. I*, Ann. of Math., **67**(2)(1958), 517–573.
- [9] J. Massera, J. Schäffer, *Linear Differential Equations and Function Spaces*, Pure and Applied Mathematics 21, Academic Press, 1966.
- [10] R. Naulin, M. Pinto, *Admissible perturbations of exponential dichotomy roughness*, Nonlinear Anal., **31**(1998), 559–571.
- [11] K. Palmer, *Exponential dichotomies and transversal homoclinic points*, J. Diff. Eqs., **55**(1984), 225–256.

- [12] O. Perron, *Die Stabilitätsfrage bei Differentialgleichungen*, Math. Z., **32**(1930), 703–728.
- [13] V. Pliss, G. Sell, *Robustness of exponential dichotomies in infinite-dimensional dynamical systems*, J. Dynam. Diff. Eqs., **11**(1999), 471–513.
- [14] L. Popescu, *Exponential dichotomy roughness on Banach spaces*, J. Math. Anal. Appl., **314**(2006), 436–454.
- [15] G. Sell, Y. You, *Dynamics of Evolutionary Equations*, Applied Mathematical Sciences 143, Springer, 2002.

Received: March 11, 2013; Accepted: May 16, 2013.

