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# ON SOME CONCEPTS OF POLYNOMIAL DICHOTOMY FOR LINEAR DISCRETE-TIME SYSTEMS IN BANACH SPACES

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Abstract. The aim of this paper is to present three concepts of nonuniform polynomial dichotomies for linear discrete systems and their correspondents in the uniform case. With the aid of particular discrete systems defined on infinite dimensional Banach spaces, we emphasize the connections between the presented concepts. The main result of the paper is given by a boundedness result of the dichotomic sequence of projections.

## REFERENCES

[1] R.P. Agarwal: *Difference equations and inequalities: theory, methods and applications*, Second Edition, Marcel Dekker, 2000.
[2] B. Aulbach and J. Kalbrenner: *Exponential forward splitting for noninvertible difference equations*, Comput. Math. Appl., **42**(2001), 743-751.
[3] M.-G. Babuţia, T. Ceauşu and N. M. Seimeanu: *On Uniform Exponential Dichotomy of Evolution operators*, Analele Universităţii de Vest, Timişoara, Seria Matematică - Informatică, L, **2**(2012), 3-14.
[4] M.-G. Babuţia, M. Megan and I.-L. Popa: *On $(h,k)$-dichotomies for nonautonomous difference equations in Banach spaces,* Int. J. Differ. Equ., **2013**(2013), Arcile ID 761680, 7 pages.
[5] L. Barreira, M. Fang, C. Valls and J. Zhang: *Robustness of nonuniform polynomial dichotomies for difference equations*, Topol. Methods Nonlinear Anal., **37**(2011), 357-376.
[6] A.J.G. Bento and C.M. Silva: *Stable manifolds for nonuniform polynomial dichotomies*, J. Funct. Anal., **257**(2009), 122-148.
[7] A.J. Bento and C. Silva: *Nonuniform $(\mu,\nu)$-dichotomies and local dynamics of difference equations*, Nonlinear Anal., **75**(2012), 78-90.
[8] A.J.G. Bento and C.M. Silva: *Stable manifolds for non-autonomous equations with non-uniform polynomial dichotomies*, Q. J. Math., **63**(2012), No. 2, 275308.
[9] A.J.G. Bento and C.M. Silva: *Generalized nonuniform dichotomies and local stable manifolds*, J. Dynam. Differential Equations, 2013, 25:1139-1158.
[10] C.V. Coffman and J.J. Schäffer: *Dichotomies for linear difference equations*, Math. Ann., **172**(1967), 139-166.
[11] W.A. Coppel, *Dichotomies in Stability Theory*, Lecture Notes in Math. No. 629, Springer-Verlag, Berlin-New York, 1978.
[12] J.L. Daleckii and M.G. Krein: *Stability of Solutions of Differential Equations in Banach Spaces*, Trans. Math. Monographs, Vol. 43, Amer. Math. Soc., Providence, R. I., 1974.
[13] D. Henry: *Geometric Theory of Semilinear Parabolic Equations*, Springer-Verlag, Berlin, 1981.
[14] T. Li: *Die Stabilitätsfrage bei Differenzengleichungen*, Acta Math., **63**(1934), 99-141.
[15] J.L. Massera and J.J. Schäffer: *Linear Differential Equations and Function Spaces*, Academic Press, New-York, 1966.

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[16] M. Megan, T. Ceauşu and A. A. Minda: *On Barreira-Valls Polynomial Stability of Evolution Operators in Banach Spaces*, Electron. J. Qual. Theory Differ. Equ., **33**(2011), 1-10.
[17] M. Megan, T. Ceauşu and M.L. Răamneanţu: *Polynomial stability of evolution operators in Banach spaces*, Opuscula Math., **31**(2011), No. 2, 279-288.
[18] N. Van Minh, F. Räbiger and R. Schnaubelt: *Exponential stability, exponential expansiveness and exponential dichotomy of evolution equations on the half-line*, Integral Equations Operator Theory, **32**(1998), 332-353.
[19] O. Perron: *Die stabilitätsfrage bei Differenzialgleischungen*, Math. Z., **32**(1930), 703-728.
[20] C. Pötzsche: *Geometric Theory of Discrete Nonautonomous Dynamical Systems*, Springer, 2002.
[21] M.L. Răamneanţu: *Uniform polynomial trichotomy of evolution operators in Banach spaces*, J. Adv. Math. Stud., **5**(2012), No. 2, 101-106.
[22] B. Sasu: *On exponential dichotomy of variational difference equations*, Discrete Dyn. Nat. Soc., (2009), DOI:10.1155/2009/324273.
[23] B. Sasu and A.L. Sasu: *On the dichotomic behavior of discrete dynamical systems on the half-line*, Discrete Contin. Dyn. Syst., **33**(2013), 3057-3084.
[24] L. Zhou, K. Lu and W. Zhang: *Roughness of tempered exponential dichotomies for infinite-dimensional random difference equations*, J. Differential Equations, **254**(2013), 4024-4046.

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