

Existence and uniqueness for C_0 -semigroups on the dual of a Banach space

LUDOVIC DAN LEMLE

ABSTRACT.

The main results of this paper are a satisfactory variant of Hille-Yosida theorem and a uniqueness theorem for a C_0 -semigroup on the dual of a Banach space. As application a simplified Hille-Yosida theorem for positive C_0 -semigroups on L^∞ is given. Moreover, the uniqueness of Schrödinger's operator in L^∞ is presented.

REFERENCES

- [1] Albanese, A., Lorenzi, L. and Mangino, E., *L^p -uniqueness for elliptic operators with unbounded coefficients in \mathbb{R}^N* , J. Funct. Anal. **256** (2009), 1238-1257
- [2] Arendt, W., *The abstract Cauchy problem, special semigroups and perturbation*, Lect. Notes Math. **1184** (1986), Springer, Berlin
- [3] Arendt, W., Metafune, G. and Pallara, D., *Schrödinger operators with unbounded drift*, J. Operator Theory **55** (2006), 185-211
- [4] Cerrai, S., *A Hille-Yosida theorem for weakly continuous semigroups*, Semigroups Forum **49** (1994), 349-367
- [5] Davies, E. B., *One-parameter semigroups*, Academic Press, London, New York, Toronto, Sydney, San Francisco, 1980
- [6] Dynkin, E. B., *Markov Processes*, Grundlehren der mathematischen Wissenschaften 121,122, Springer Verlag, Berlin, Göttingen, Heidelberg, 1965
- [7] Eberle, A., *Uniqueness and Non-Uniqueness of Semigroups Generated by Singular Diffusion Operators*, Lect. Notes Math. **1718** (1999), Springer, Berlin
- [8] Feller, W., *The parabolic differential equations and the associated semigroups of transformations*, Ann. Math. **55** (1952), 468-519
- [9] Feller, W., *Semi-groups of transformations in general weak topologies*, Ann. Math. **57** (1953), 287-308
- [10] Goldstein, J. A., *Semigroups of Operators and Applications*, Oxford University Press, 1985
- [11] Jefferies, B., *Weakly integrable semigroups on locally convex spaces*, J. Funct. Anal. **66** (1986), 347-364
- [12] Jefferies, B., *The generation of weakly integrable semigroups*, J. Funct. Anal. **73** (1987), 195-215
- [13] Kato, T., *Perturbation theory for linear operators*, Springer Verlag, Berlin, Heidelberg, New York, 1984
- [14] Komatsu, H., *Semigroups of operators in locally convex spaces*, J. Math. Soc. Japan **16** (1964), 230-262
- [15] Kühnemund, F., *A Hille-Yosida Theorem for bi-continuous semigroups*, Semigroup Forum **67** (2003), 205-225
- [16] Lemle, L. D., *Integrated semigroups of operators, uniqueness of pre-generators and applications*, Doctor degree thesis, Blaise Pascal University of Clermont-Ferrand, 2007
- [17] Lemle, L. D., *L^∞ -uniqueness of Schrödinger operators on a Riemannian manifold*, Differ. Geom. Dyn. Syst. **9** (2007), 103-110
- [18] Lemle, L. D., *$L^1(\mathbb{R}^d, dx)$ -uniqueness of weak solution for the Fokker-Planck equation associated to a class of Dirichlet operators*, Electron. Res. Announc. Math. Sci. **15** (2008), 65-70
- [19] Lemle, L. D., *Desch-Schappacher perturbation theorem for C_0 -semigroups on the dual of a Banach space*, Acta Univ. Apulensis Math. Inform. **15** (2008), 191-194
- [20] Lemle, L. D., *L^∞ -uniqueness of Schrödinger operators restricted in an open domain*, in *Hot Topics in Operator Theory: Proceedings of the 21-th International Conference on Operator Theory*, Timișoara, Romania, June 29-July 4, 2006 (Douglas, R. et al., Eds.), Theta Ser. Adv. Math. **9**, București, 2008, 137-143
- [21] Lemle, L. D., Bînzar, T. and Pater, F., *L^1 -uniqueness of weak solution for the one-dimensional mass transport equation*, in *Numerical Analysis and Applied Mathematics: Proceedings of the International Conference on Numerical Analysis and Applied Mathematics*, Rethymno, Greece, September 18-22, 2009 (Simos, et al., Eds.), American Institute of Physics **1168**, Melville, 2009, 160-163
- [22] Lemle, L. D. and Wu, L. M., *Unicité des pré-générateurs dans les espaces localement convexes*, C. R. Acad. Sci. Paris **347** (2009), 1281-1284
- [23] Liskevitch, V., *On the uniqueness problem for Dirichlet operators*, J. Funct. Anal. **162** (1999), 1-13
- [24] Lotz, H. P., *The abstract Cauchy problem, special semigroups and perturbation*, Lect. Notes Math. **1184** (1986), Springer, Berlin
- [25] Pazy, A., *Semigroups of linear operators and applications to partial differential equations*, Springer Verlag, New York, Berlin, 1983
- [26] Reed, M. and Simon, B., *Methods of Modern Mathematical Physics*, Academic Press, New York, 1975
- [27] Röckner, M., *L^p -analysis of finite and infinite dimensional diffusion operators*, Lect. Notes Math. **1715** (1998), Springer, Berlin
- [28] Schaefer, H. H., *Topological Vector Spaces*, Springer Verlag, Berlin, Heidelberg, New York, Tokyo, 1971
- [29] Simon, B., *Schrödinger Semigroups*, Bull. Amer. Math. Soc. **7** (1982), 447-526
- [30] Stannat, W., *(Nonsymmetric) Dirichlet operators on L^1 : Existence, uniqueness and associated Markov processes*, Ann. Scuole Norm. Sup. Pisa Cl. Sci. **28** (1999), 99-140
- [31] Stannat, W., *Time-dependent diffusion operators on L^1* , J. Evol. Equ. **4** (2004), 463-495
- [32] Wu, L. M., *Uniqueness of Schrödinger Operators Restricted in a Domain*, J. Funct. Anal. **153** (1998), 276-319
- [33] Wu, L. M., *Uniqueness of Nelson's diffusions*, Probab. Theory Relat. Fields **114** (1999), 549-585
- [34] Wu, L. M. and Zhang, Y., *A new topological approach for uniqueness of operators on L^∞ and L^1 -uniqueness of Fokker-Planck equations*, J. Funct. Anal. **241** (2006), 557-610
- [35] Yosida, K., *Functional Analysis*, Springer Verlag, New York, 1971

POLITEHNICA UNIVERSITY OF TIMIȘOARA
THE ENGINEERING FACULTY OF HUNEDOARA
5 REVOLUȚIEI STREET, 331128-HUNEDOARA, ROMANIA
E-mail address: dan.lemle@fih.upt.ro

Received: 14.05.2009; In revised form: 10.11.2009; Accepted: 08.02.2010

2000 Mathematics Subject Classification. 47D03, 35J10.

Key words and phrases. C_0 -semigroup, C_0 -semigroup adjoint, Hille-Yosida theorem, L^∞ -uniqueness, Schrödinger operators.