

ON THE HYERS—ULAM STABILITY OF SEXTIC FUNCTIONAL EQUATIONS IN β -HOMOGENEOUS PROBABILISTIC MODULAR SPACES

YEOL JE CHO, MOHAMMAD BAGHER GHAEMI,
MEHDI CHOUBIN AND MADJID ESHAGHI GORDJI

Abstract. In this paper, we present a fixed point method to prove the generalized Hyers–Ulam stability of the systems of additive-quadratic-cubic functional equations with constant coefficients in β -homogeneous probabilistic modular spaces.

Mathematics subject classification (2010): Primary 39B52; Secondary 39B72, 47H09.

Keywords and phrases: Fixed point method, Hyers–Ulam stability, modular spaces, sextic functional equation.

REFERENCES

- [1] J. ACZEL AND J. DHOMBRES, *Functional Equations in Several Variables*, Cambridge University Press, Cambridge, 1989.
- [2] T. AOKI, *On the stability of the linear transformation in Banach spaces*, J. Math. Soc. Japan **2** (1950), 64–66.
- [3] V. K. BALACHANDRAN, *Topological Algebras*, Narosa Publishing House, New Delhi, Madras, Bombay, Calcutta, London, 1999.
- [4] L. CĂDARIU AND V. RADU, *Fixed points and the stability of Jensen’s functional equation*, J. Inequal. Pure Appl. Math. **4**, no. 1, Art. 4 (2003).
- [5] Y. J. CHO, M. ESHAGHI GORDJI AND S. ZOLFAGHARI, *Solutions and stability of generalized mixed type QC functional equations in random normed spaces*, J. Inequal. Appl. Vol. 2010 (2010), Article ID 403101, 16 pp.
- [6] Y. J. CHO AND R. SAADATI, *Lattice non-Archimedean random stability of ACQ functional equations*, Advan. in Diff. Equat. 2011, 2011:31.
- [7] P. W. CHOLEWA, *Remarks on the stability of functional equations*, Aequat. Math. **27** (1984), 76–86.
- [8] S. CZERWIK, *On the stability of the quadratic mapping in normed spaces*, Abh. Math. Sem. Univ. Hamburg **62** (1992), 59–64.
- [9] A. EBADIAN, A. NAJATI AND M. E. GORDJI, *On approximate additive-quartic and quadratic-cubic functional equations in two variables on abelian groups*, Results. Math. DOI 10.1007/s00025-010-0018-4 (2010).
- [10] A. EBADIAN, N. GHOBADIPOUR AND M. E. GORDJI, *A fixed point method for perturbation of bimultipliers and Jordan bimultipliers in C^* -ternary algebras*, J. Math. Phys. **51** (2010), 10 pp., doi:10.1063/1.3496391.
- [11] M. ESHAGHI GORDJI, Y. J. CHO, M. B. GHAEMI AND H. MAJANI, *Approximately quintic and sextic mappings from r -divisible groups into Šerstnev probabilistic Banach spaces: fixed point method*, Discrete Dynamics in Nature and Society, Vol. 2011, Article ID 572062, 16 pp.
- [12] K. FALLAHI AND K. NOUROUZI, *Probabilistic modular spaces and Linear operators*, Acta Appl. Math. **105** (2009), 123–140.

- [13] Z. GAJDA, *On stability of additive mappings*, Internat. J. Math. Math. Sci. **14** (1991), 431–434.
- [14] P. GÄVRUTA, *A generalization of the Hyers–Ulam–Rassias stability of approximately additive mappings*, J. Math. Anal. Appl. **184** (1994), 431–436.
- [15] P. GÄVRUTA AND L. GÄVRUTA, *A new method for the generalized Hyers–Ulam–Rassias stability*, Int. J. Nonlinear Anal. Appl. **1** (2010), 11–18.
- [16] M. GRABIEC, Y. J. CHO AND V. RADU, *On Nonsymmetric Topological and Probabilistic Structures*, Nova Science Publishers, Inc., New York, 2006.
- [17] M. B. GHAEMI, M. E. GORDJI AND H. MAJANI, *Approximately quintic and sextic mappings on the probabilistic normed spaces*, Preprint.
- [18] M. E. GORDJI, *Stability of a functional equation deriving from quartic and additive functions*, Bull. Korean Math. Soc. **47** (2010), 491–502.
- [19] M. E. GORDJI AND M. B. SAVADKOUHI, *Stability of a mixed type cubic–quartic functional equation in non-Archimedean spaces*, Appl. Math. Lett. **23** (2010), 1198–1202.
- [20] M. E. GORDJI, M. B. GHAEMI, S. K. GHARETAPEH, S. SHAMS AND A. EBADIAN, *On the stability of J^* -derivations*, J. Geom. Phys. **60** (2010), 454–459.
- [21] M. E. GORDJI, S. KABOLI GHARETAPEH, C. PARK AND S. ZOLFAGHRI, *Stability of an additive–cubic–quartic functional equation*, Advances in Differ. Equat. Vol. 2009, Article ID 395693, 20 pp.
- [22] M. E. GORDJI, S. K. GHARETAPEH, J. M. RASSIAS AND S. ZOLFAGHARI, *Solution and stability of a mixed type additive, quadratic and cubic functional equation*, Advances in differ. Equat. Vol. 2009, Article ID 826130, 17 pp.
- [23] M. E. GORDJI AND H. KHODAEI, *Solution and stability of generalized mixed type cubic, quadratic and additive functional equation in quasi-Banach spaces*, Nonlinear Anal. **71** (2009), 5629–5643.
- [24] M. E. GORDJI AND H. KHODAEI, *On the generalized Hyers–Ulam–Rassias stability of quadratic functional equations*, Abstr. Appl. Anal. Vol. 2009, Article ID 923476, 11 pp.
- [25] M. E. GORDJI AND H. KHODAEI, *The fixed point method for fuzzy approximation of a functional equation associated with inner product spaces*, Discr. Dynam. in Nature and Soc. Vol. 2010, Article ID 140767, 15 pp.
- [26] M. E. GORDJI, H. KHODAEI AND R. KHODABAKHSH, *General quartic–cubic–quadratic functional equation in non-Archimedean normed spaces*, U.P.B. Sci. Bull., Series A **72** (2010), 69–84.
- [27] M. E. GORDJI AND A. NAJATI, *Approximately J^* -homomorphisms: A fixed point approach*, J. Geom. Phys. **60** (2010), 809–814.
- [28] D. H. HYERS, *On the stability of the linear functional equation*, Proc. Natl. Acad. Sci. USA **27** (1941), 222–224.
- [29] D. H. HYERS, G. ISAC AND TH. M. RASSIAS, *Stability of Functional Equations in Several Variables*, Birkhäuser, Basel, 1998.
- [30] K. W. JUN AND H. M. KIM, *The generalized Hyers–Ulam–Rassias stability of a cubic functional equation*, J. Math. Anal. Appl. **274** (2002), 867–878.
- [31] K. W. JUN, H. M. KIM AND I. S. CHANG, *On the Hyers–Ulam stability of an Euler–Lagrange type cubic functional equation*, J. Comput. Anal. Appl. **7** (2005), 21–33.
- [32] S. M. JUNG, *Hyers–Ulam–Rassias Stability of Functional Equations in Mathematical Analysis*, Hadronic Press Inc., Palm Harbor, Florida, 2001.
- [33] S. M. JUNG, *Hyers–Ulam–Rassias stability of Jensen’s equation and its application*, Proc. Amer. Math. Soc. **126** (1998), 3137–3143.
- [34] S. M. JUNG, *Stability of the quadratic equation of Pexider type*, Abh. Math. Sem. Univ. Hamburg **70** (2000), 175–190.
- [35] S. M. JUNG AND J. M. RASSIAS, *A fixed point approach to the stability of a functional equation of the spiral of Theodorus*, Fixed Point Theory Appl. Vol. 2008, Article ID 945010, 7 pp.
- [36] P. KANNAPPAN, *Quadratic functional equation and inner product spaces*, Results Math. **27** (1995), 368–372.

- [37] H. A. KENARY AND Y. J. CHO, *Stability of mixed additive-quadratic Jensen type functional equation in various spaces*, Comput. Math. Appl. **61** (2011), 2704–2724.
- [38] M. A. KHAMSI, *Quasicontraction Mapping in modular spaces without Δ_2 -condition*, Fixed Point Theory Appl. Vol. (2008), Artical ID 916187, 6 pp.
- [39] H. KHODAEI, M. ESHAGHI GORDJI, S. S. KIM AND Y. J. CHO, *Approximation of radical functional equations related to quadratic and quartic mappings*, J. Math. Anal. Appl. **397** (2012), 284–297.
- [40] H. KHODAEI AND TH. M. RASSIAS, *Approximately generalized additive functions in several variables*, Internat. J. Nonlinear Anal. Appl. **1** (2010), 22–41.
- [41] S. KOSHI, T. SHIMOGAKI, *On F -norms of quasi-modular spaces*, J. Fac. Sci. Hokkaido Univ. Ser. I **15** (1961), 202–218.
- [42] M. KRBEČ, *Modular interpolation spaces*, Z. Anal. Anwendungen **1** (1982), 25–40.
- [43] S. H. LEE, S. M. IM AND I. S. HAWNG, *Quartic functional equation*, J. Math. Anal. Appl. **307** (2005), 387–394.
- [44] W. A. LUXEMBURG, *Banach function spaces*, Ph. D. thesis, Delft Univrsity of Technology, Delft, The Netherlands, 1959.
- [45] L. MALIGRANDA, *Orlicz Spaces and Interpolation*, in: Seminars in Math., Vol. **5**, Univ. of Campinas, Brazil, 1989.
- [46] K. MENGER, *Statistical metrics*, Proc. Natl. Acad. Sci. USA **28** (1942), 535–537.
- [47] M. MOHAMMADI, Y. J. CHO, C. PARK, P. VETRO AND R. SAADATI, *Random stability of an additive-quadratic-quartic functional equation*, J. Inequal. Appl. Vol. 2010, Article ID 754210, 18 pp.
- [48] J. MUSIELAK, *Orlicz Spaces and Modular Spaces*, in: Lecture Notes in Math. Vol. **1034**, Springer-Verlag, Berlin, 1983.
- [49] A. NAJATI, *Hyers-Ulam-Rassias stability of a cubic functional equation*, Bull. Korean Math. Soc. **44** (2007), 825–840.
- [50] H. NAKANO, *Modulared Semi-Ordered Linear Spaces*, in: Tokyo Math. Book Ser., Vol. **1**, Maruzen Co., Tokyo, 1950.
- [51] K. NOUROUZI, *Probabilistic modular spaces*, Further Progress in Analysis, World Sci. Publ., Hackensack, 814–818, 2009.
- [52] W. ORLICZ, *Collected Papers*, Vols. **I, II**, PWN, Warszawa, 1988.
- [53] C. PARK, *On an approximate automorphism on a C^* -algebra*, Proc. Amer. Math. Soc. **132** (2004), 1739–1745.
- [54] C. PARK, Y. J. CHO AND H. A. KENARY, *Orthogonal stability of a generalized quadratic functional equation in non-Archimedean spaces*, J. Comput. Anal. Appl. **14**(2012), 526–535.
- [55] C. PARK AND M. E. GORDJI, *Comment on Approximate ternary Jordan derivations on Banach ternary algebras*, [Bavand Savadkouhi et al. J. Math. Phys. 50, 042303 (2009)], J. Math. Phys. **51**, 044102 (2010), 7 pp.
- [56] C. PARK AND A. NAJATI, *Generalized additive functional inequalities in Banach algebras*, Int. J. Nonlinear Anal. Appl. **1** (2010), 54–62.
- [57] C. PARK AND TH. M. RASSIAS, *Isomorphisms in unital C^* -algebras*, Internat. J. Nonlinear Anal. Appl. **1** (2010), 1–10.
- [58] C. PARK AND J. M. RASSIAS, *Stability of the Jensen-type functional equation in C^* -algebras: a fixed point approach*, Abstr. Appl. Anal. Vol. 2009, Article ID 360432, 17 pp.
- [59] TH. M. RASSIAS, *On the stability of the linear mapping in Banach spaces*, Proc. Amer. Math. Soc. **72** (1978), 297–300.
- [60] TH. M. RASSIAS, *On the stability of functional equations in Banach spaces*, J. Math. Anal. Appl. **251** (2000), 264–284.
- [61] TH. M. RASSIAS AND P. ŠEMRL, *On the behaviour of mappings which do not satisfy Hyers-Ulam stability*, Proc. Amer. Math. Soc. **114** (1992), 989–993.

- [62] R. SAADATI, Y. J. CHO AND J. VAHIDI, *The stability of the quartic functional equation in various spaces*, *Comput. Math. Appl.* **60** (2010), 1994–2002.
- [63] GH. SADEGHI, *A fixed point approach to stability of functional equations in modular spaces*, *Bull. Malays. Math. Sci. Soc.* (to appear).
- [64] GH. SADEGHI, *On the orthogonal stability of the pexiderized quadratic equations in modular spaces*, preprint.
- [65] F. SKOF, *Propriet locali e approssimazione di operatori*, *Rend. Sem. Mat. Fis. Milano.* **53** (1983), 113–129.
- [66] PH. TURPIN, *Fubini inequalities and bounded multiplier property in generalized modular spaces*, *Comment. Math., Tomus specialis in honorem Ladislai Orlicz I* (1978), 331–353.
- [67] S. M. ULAM, *Problems in Modern Mathematics*, Chapter VI, *Sci. Ed.*, Wiley, New York, 1964.
- [68] S. YAMAMURO, *On conjugate spaces of Nakano spaces*, *Trans. Amer. Math. Soc.* **90**(1959) 291–311.