Differential
Equations
& Applications
Volume 10, Number 4 (2018), 397–411
doi:10.7153/dea-2018-10-27

# ULAM–HYERS–RASSIAS STABILITY OF A NONLINEAR STOCHASTIC ITO–VOLTERRA INTEGRAL EQUATION

NGO PHUOC NGUYEN NGOC AND NGUYEN VAN VINH

*Abstract.* In this paper, by using the classical Banach contraction principle, we investigate and establish the stability in the sense of Ulam-Hyers and in the sense of Ulam-Hyers-Rassias for the following stochastic integral equation

$$X_t = \xi_t + \int_0^t A(t,s,X_s)ds + \int_0^t B(t,s,X_s)dW_s,$$

where $\int_0^t B(t,s,X_s)dW_s$ is Ito integral.

*Mathematics subject classification* (2010): Primary 60H20, 34K20; Secondary 47H10..

*Keywords and phrases*: Ulam-Hyers-Rassias stability, Stochastic integral equations, Banach's fixed point theorem.

## REFERENCES

[1] M. AKKOUCHI, A. BOUNABAT, M. H. L. RHALI, *Fixed point approach to the stability of an integral equation in the sense of Ulam-Hyers-Rassias*, Annales Mathematicae Silesianae **25** (2011), 27–44.

[2] T. AOKI, *On the stability of the linear transformation in Banach spaces*, J. Math. Soc. Japan. **2** (1950), 64–66.

[3] J. A. BAKER, *The stability of certain functional equations*, Proceedings of The American Mathematical Society, Volume 112, Number 3, July 1991.

[4] N. B. BELLOUT, J. BRZDEK, K. CIEPLINSKI, *On some recent developments in Ulam's type stability*, Abstract and Applied Analysis, Volume 2012, Article ID 716936, 41 pages.

[5] L. P. CASTRO, D.A. RAMOS, *Hyers-Ulam-Rassias stability for a class of nonlinear Volterra integral equations*, Banach J. Math. Anal. **3**, 1 (2009), 36–43.

[6] L. CĂDARIU, V. RADU, *Fixed points and the stability of Jensen's functional equation*, J. Inequal. Pure Appl. Math. **4**, 1 (2003), Art. ID 4.

[7] Y. J. CHO, TH. M. RASSIAS, R. SAADATI, *Stability of functional equations in random normed spaces*, Springer, 2013.

[8] D. H. HYERS, *On the stability of linear functional equation*, Proc. Natl. Acad. Sci. USA 27 (1941), 222–224.

[9] D. H. HYERS, G. ISAC, TH. M. RASSIAS, *Stability of functional equation in several variables*, Birkhäuser, Basel, 1998.

[10] I. ITO, *On the existence and uniqueness of solutions of stochastic integral equations of the Volterra type*, Kodai Math. J. **2** (1979), 158–170.

[11] S. M. JUNG, *A fixed point approach to the stability of a Volterra integral equation*, Fixed Point Theory and Applications, Vol. 2007, 9 pages.

[12] S. M. JUNG, *Hyers-Ulam-Rassias stability of functional equations in nonlinear analysis*, Springer, 2010.

[13] S. M. JUNG, *A fixed point approach to the stability of differential equations* $y' = F(x,y)$, Bull. Malays. Math. Sci. Soc. (2) **33**, 1 (2010), 47–56.

[14] H. A. KENARY, S. Y. JANG, C. PARK, *A fixed point approach to the Hyers-Ulam stability of a functional equation in various normed spaces*, Fixed Point Theory and Applications, December 2011, 2011:67.


Paper DEA-10-27

[15] H. H. KUO, *Introduction to stochastic integration*, Springer, 2006.
[16] T. MIURA, S. MIYAJIMA, S. E. TAKAHASI, *A characterization of Hyers-Ulam stability of first order linear differential operators*, J. Math. Anal. Appl. **286**, 1 (2003), 136–146.
[17] T. MIURA, S. MIYAJIMA, S.-E. TAKAHASI, *Hyers-Ulam stability of linear differential operator with constant coefficients*, Math. Nachr. **258** (2003), 90–96.
[18] N. P. N NGOC, *Ulam-Hyers-Rassias stability of a nonlinear stochastic integral equation*, Differential equations & Applications, **9**, 2 (2017), 183–193.
[19] B. ØKSENDAL, *Stochastic Differential Equations*, Springer-Verlag Heidelberg New York, Fifth Edition.
[20] W. J. PADGETT, A. N. V RAO, *Solution of a stochastic integral equation using integral contractors*, Information and Control **41** (1979), 56–66.
[21] V. RADU, *The fixed point alternative and the stability of functional equations*, Fixed Point Theory, **4**, 1 (2003), 91–96.
[22] TH. M. RASSIAS, *On the stability of the linear mapping in Banach spaces*, Proc. Amer. Math. Soc. **72** (1978), 297–300.
[23] I. A. RUS, *Gronwall lemma approach to the Hyers-Ulam-Rassias stability of an integral equation, Chapter 13*, Nonlinear Analysis and Variational Problems, Volume 35 of the series Springer Optimization and Its Applications.
[24] S. M. ULAM, *Problems in Modern Mathematics, Chapter VI*, Science Editions Wiley, New York, 1960.
[25] S. M. ULAM, *A Collection of the Mathematical Problems*, Interscience Publ., New York, 1960.
[26] J. WANG, *Some further generalizations of the Hyers-Ulam-Rassias stability of functional equations*, J. Math. Anal. Appl. **263** (2001), 406–423.
[27] X. ZHAO, *Mean square Hyers-Ulam stability of stochastic differential equations driven by Brownian motion*, Advances in Difference Equations (2016) 2016:271.

Differential Equations & Applications
www.ele-math.com
dea@ele-math.com