

PICARD SEQUENCES IN b -METRIC SPACES

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Abstract. The purpose of this article is to provide much simpler and shorter proofs of some important results in the framework of b -metric spaces. Namely, we show that the given contractive condition implies b -Cauchyness of the corresponding Picard sequence. The obtained results improve well-known comparable results in the literature.

Key Words and Phrases: b -metric space, b -complete, b -Cauchy, b -continuous, Picard sequence.

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REFERENCES

- [1] M. Abbas, I.Z. Chema, A. Razani, *Existence of common fixed point for b -metric rational type contraction*, Filomat, **30**(6)(2016), 1413-1429.
- [2] A. Aghajani, M. Abbas, J.R. Roshan, *Common fixed point of generalized weak contractive mappings in partially ordered b -metric spaces*, Math. Slovaca, **64**(2014), no. 4, 941-960.
- [3] R. Allahyari, R. Arab, A.S. Haghighi, *A generalization on weak contractions in partially ordered b -metric spaces and its applications to quadratic integral equations*, J. Inequal. Appl. 2014, 2014:355.
- [4] E. Amer, M. Arshad, W. Shatanawi, *Common fixed point results for generalized α_* - ψ -contraction multivalued mappings in b -metric spaces*, J. Fixed Point Theory Appl., 19 (4), 3069-3086.
- [5] A.H. Ansari, A. Razani, N. Hussain, *Fixed and coincidence points for hybrid rational Geraghty contractive mappings in ordered b -metric spaces*, Int. J. Nonlinear Anal. Appl., **8**(2017), no. 1, 315-329.

- [6] H. Aydi, M.F. Bota, E. Karapinar, S. Mitrović, *A fixed point theorem for set-valued quasi-contractions in b-metric spaces*, Fixed Point Th. Appl., 2012, 2012:88.
- [7] I.A. Bakhtin, *The contraction principle in quasimetric spaces*, Funct. Anal., **30**(1989), 26–37.
- [8] S. Banach, *Sur les opérations dans les ensembles abstraits et leur application aux équations intégrales*, Fundam. Math., **3**(1922), 133-181.
- [9] S. Chandok, M. Jovanović, S. Radenović, *Ordered b-metric spaces and Geraghty type contractive mappings*, Vojnotehnički Glasnik, Military Technical Courier, **65**(2017), no. 2, 331-345.
- [10] S. Czerwinski, *Contraction mappings in b-metric spaces*, Acta Math. Inform., Univ. Ostrav., **1**(1993), 5-11.
- [11] M. Demma, P. Vetro, *Picard sequence and fixed point results on b-metric spaces*, J. Function Spaces, Volume 2015, Article ID 189861, 6 pages.
- [12] A. Denjoy, *Sur l'itération des fonctions analytiques*, C.R. Acad. Sc. Paris, Serie 1, **182**(1926), 255–257.
- [13] T. Došenović, M. Pavlović, S. Radenović, *On a various contractive conditions in b-metric spaces*, Vojnotehnički Glasnik, Military Technical Courier, **65**(2017), no. 4, 851-865.
- [14] A.A. Harandi, *Fixed point theory for quasi-contraction maps in b-metric spaces*, Fixed Point Theory, **15**(2014), no. 2, 351-358.
- [15] T.L. Hicks, B.E. Rhoades, *A Banach type fixed point theorem*, Math. Japonica, **24**(1979), 327-320.
- [16] N. Hussain, Z.D. Mitrović, *On multi-valued weak quasi-contractions in b-metric spaces*, J. Nonlinear Sci. Appl., **10**(2017), 3815-3823.
- [17] G.S. Jeong, B.E. Rhoades, *Maps for which $F(T) = F(T^n)$* , Fixed Point Theory Appl., **6**(2005), 87-131.
- [18] J.M. Josepl, D.D. Roselin, M. Marudi, *Fixed point theorems on multi valued mappings in b-metric spaces*, Springer Plus, (2016), 5:217.
- [19] M. Jovanović, *Contribution to the Theory of Abstract Metric Spaces*, Doctoral Dissertation, Belgrade, 2016.
- [20] M.A. Khamsi, N. Hussain, *KKM mappings in metric type spaces*, Nonlinear Anal., **73**(2010), 3123-3129.
- [21] M.S. Khan, M. Swaleh, S. Sessa, *Fixed point theorems by altering distances between the points*, Bull. Aust. Math. Soc., **30**(1984), no. 1, 1-9.
- [22] M. Kir, H. Kiziltunc, *On some well known fixed point theorems in b-metric spaces*, Turkish J. Anal. Numb. Theory, **1**(2013), no. 1, 13-16.
- [23] P. Kumam, W. Sintunavarat, S. Sedghi, N. Shobkolaei, *Common fixed point of two R-weakly commuting mappings in b-metric spaces*, J. Function Spaces, Volume 2015, Article ID 350840, 5 pages.
- [24] A. Latif, V. Parvaneh, P. Salimi, A.E. Al-Mazrooei, *Various Suzuki type theorems in b-metric spaces*, J. Nonlinear Sci. Appl., **8**(2015), 363-377.
- [25] L. Liu, F. Gu, *Common fixed point theorems for six self-maps in b-metric spaces with nonlinear contractive conditions*, J. Nonlinear Sci. Appl., **9**(2016), 5909-5930.
- [26] R. Miculescu, A. Mihail, *New fixed point theorems for set-valued contractions in b-metric spaces*, J. Fixed Point Theory Appl., **19** (3), 2153-2163.
- [27] Z.D. Mitrović, S. Radenović, *The Banach and Reich contractions in $b_v(s)$ -metric spaces*, J. Fixed Point Theory Appl., **19** (4), 3087-3095.
- [28] S.B. Nadler, *Multivalued contraction mappings*, Pacific J. Math., **30**(1969), 475-488.
- [29] Lj. Paunović, P. Kaushik, S. Kumar, *Some applications with new admissibility contractions in b-metric spaces*, J. Nonlinear Sci. Appl., **10**(2017), 4162-4174.
- [30] H. Piri, P. Kumam, *Fixed point theorems for generalized F-Suzuki-contraction mappings in complete b-metric spaces*, Fixed Point Theory Appl., (2016), 2016:90.
- [31] A. Petrușel, G. Petrușel, J. C. Yao, *Fixed point and coincidence point theorems in b-metric spaces with applications*, Appl. Anal. Discrete Math., **11**(2017), 199-215.
- [32] B.E. Rhoades, *A comparison of various definitions of contractive mappings*, Trans. Amer. Math. Soc., **226**(1977), 257-290.

- [33] J.R. Roshan, V. Parvaneh, I. Altun, *Some coincidence point results in ordered b -metric spaces and applications in a system of integral equations*, Appl. Math. Comput., **226**(2014), 725-737.
- [34] J.R. Roshan, V. Parvaneh, N. Shobkolaei, S. Sedghi, W. Shatanawi, *Common fixed points of almost generalized $(\psi, \varphi)_s$ -contractive mappings in ordered b -metric spaces*, Fixed Point Theory Appl., 2013, 2013:159.
- [35] J.R. Roshan, N. Shobkolaei, S. Sedghi, M. Abbas, *Common fixed point of four maps in b -metric spaces*, Hacet. J. Math. Stat., **43**(2014), no. 4, 613-624.
- [36] M. Sarwar, N. Jamal, Y. Li, *Coincidence point results via generalized (ψ, ϕ) -weak contractions in partial b -metric spaces with application*, J. Nonlinear Sci. Appl., **10**(2017), 3719-3731.
- [37] M. Sarwar, M.U. Rahman, *Fixed point theorems for Ćirić and generalized contractions in b -metric spaces*, Int. J. Anal. Appl., **7**(2015), no. 1, 70-78.
- [38] T. Suzuki, *Basic inequality on a b -metric space and its applications*, J. Ineq. Appl., (2017), 2017:256, <https://doi.org/10.1186/s13660-017-1528-3>.
- [39] J. Wolff, *Sur une généralisation d'un théorème de Schwartz*, C.R. Hebd. Seanc. Acad. Paris, **182**(1926), 918-920 and **183**(1926), 500-502.
- [40] F. Zabihi, A. Razani, *Fixed point theorems for hybrid rational Geraghty contractive mappings in ordered b -metric spaces*, J. Appl. Math., Vol. 2014, Art. ID 929821, 9 pages.

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