

## Stability of Picard iteration for contractive mappings satisfying an implicit relation

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### ABSTRACT.

We obtain new and very general stability results for Picard iteration associated to self operators satisfying an implicit relation. Our stability results unify, extend, generalize, enrich and complement a multitude of related stability results from recent literature.

### REFERENCES

- [1] Abbas, M., Vetro P. and Khan, S.H., *On fixed points of Berinde's contractive mappings in cone metric spaces*, Carpathian J. Math. **26** (2009), No. 2, 121–133
- [2] Ali, J. and Imdad, M., *Unifying a multitude of common fixed point theorems employing an implicit relation*, Commun. Korean Math. Soc. **24** (2009), No. 1, 41–55
- [3] Aliouche, A. and Popa, V., *General common fixed point theorems for occasionally weakly compatible hybrid mappings and applications*, Novi Sad J. Math. **39** (2009), No. 1, 89–109
- [4] Beg, I. and Butt, A. R., *Fixed points for weakly compatible mappings satisfying an implicit relation in partially ordered metric spaces*, Carpathian J. Math. **25** (2009), No. 1, 1–12
- [5] Beg, I. and Abbas, M., *Fixed points and invariant approximation in random normed spaces*, Carpathian J. Math. **26** (2010), No. 1, 36–40
- [6] Berinde, V., *On the stability of fixed point iteration procedures*, Bul. Ştiinţ. Univ. Baia Mare, Fasc. Mat.-Inf. **18** (2002), No. 1, 7–12
- [7] Berinde, V., *Summable almost stability of fixed point iteration procedures*, Carpathian J. Math. **19** (2003), No. 2, 81–88
- [8] Berinde, V., *Approximation fixed points of weak contractions using the Picard iteration*, Nonlinear Analysis Forum **9** (2004), No. 1, 43–53
- [9] Berinde, V., *Error estimates for approximating fixed points of quasi contractions*, General Math. **13** (2005), No. 2, 23–34
- [10] Berinde, V., *Iterative Approximation of Fixed Points*, Springer, Berlin Heidelberg New York, 2007
- [11] Berinde, V., *Approximating common fixed points of noncommuting discontinuous weakly contractive mappings in metric spaces*, Carpathian J. Math. **25** (2009), No. 1, 13–22
- [12] Berinde, V., *Some remarks on a fixed point theorem for Ćirić-type almost contractions*, Carpathian J. Math. **25** (2009), No. 2, 157–162
- [13] Browder, F. E., *On the convergence of successive approximations for nonlinear functional equation*, Indag. Math. (N.S.) **30** (1968), 27–35
- [14] Chatterjea, S. K., *Fixed-point theorems*, C. R. Acad. Bulgare Sci. **25** (1972), 727–730
- [15] Harder, A. M. and Hicks, T. L., *A stable iteration procedure for nonexpansive mappings*, Math. Japon. **33** (1988), No. 5, 687–692
- [16] Harder, A. M. and Hicks, T. L., *Stability results for fixed point iteration procedures*, Math. Japon. **33** (1988), No. 5, 693–706
- [17] Imoru, C. and Olatinwo, M. O., *On the stability of Picard and Mann iteration processes*, Carpathian J. Math. **19** (2003), No. 2, 155–160
- [18] Jachymski, J. R., *An extension of A. Ostrowski's theorem on the round-off stability of iterations*, Aequationes Math. **53** (1997), No. 3, 242–253
- [19] Kannan, R., *Some results on fixed points*, Bull. Calcutta Math. Soc. **10** (1968) 71–76
- [20] Olatinwo, M. O., *Some stability results in complete metric space*, Acta Univ. Palack. Olomuc. Fac. Rerum Natur. Math. **48** (2009), 83–92
- [21] Osilike, M. O., *Stability results for fixed point iteration procedures*, J. Nigerian Math. Soc. **14/15** (1995/96), 17–29
- [22] Osilike, M. O., *Stability of the Mann and Ishikawa iteration procedures for  $\phi$ -strong pseudocontractions and nonlinear equations of the  $\phi$ -strongly accretive type*, J. Math. Anal. Appl. **227** (1998), No. 2, 319–334
- [23] Osilike, M. O., Udomene, A., *Short proofs of stability results for fixed point iteration procedures for a class of contractive-type mappings*, Indian J. Pure Appl. Math. **30** (1999), No. 12, 1229–1234
- [24] Ostrowski, A. M., *The round-off stability of iterations*, Z. Angew. Math. Mech. **47** (1967), 77–81
- [25] Popa, V., *Fixed point theorems for implicit contractive mappings*, Stud. Cerc. St. Ser. Mat. Univ. Bacau **7** (1997), 127–133
- [26] Popa, V., *Some fixed point theorems for compatible mappings satisfying an implicit relation*, Demonstratio Math. **32** (1999), 157–163
- [27] Popa, V., *Fixed points for non-surjective expansion mappings satisfying an implicit relation*, Bul. Ştiinţ. Univ. Baia Mare Ser. B Fasc. Mat.-Inform **18** (2002), No. 1, 105–108
- [28] Qing, Y. and Rhoades, B. E., *T-stability of Picard iteration in metric spaces*, Fixed Point Theory Appl. 2008, Art. ID 418971, 4 pp.
- [29] Reich, S., *Fixed points of contractive functions*, Boll. Un. Mat. Ital. (4) **5** (1972), 26–42
- [30] Rhoades, B. E., *A comparison of various definitions of contractive mappings*, Trans. Amer. Math. Soc. **226** (1977), 257–290
- [31] Rhoades, B. E., *Fixed point theorems and stability results for fixed point iteration procedures*, Indian J. Pure Appl. Math. **21** (1990), No. 1, 1–9
- [32] Rhoades, B. E., *Some fixed point iteration procedures*, Int. J. Math. Math. Sci., **14** (1991), No. 1, 1–16
- [33] Rhoades, B. E., *Fixed point theorems and stability results for fixed point iteration procedures. II*, Indian J. Pure Appl. Math. **24** (1993), No. 11, 691–703
- [34] Rus, I. A., *Generalized Contractions and Applications*, Cluj University Press, Cluj-Napoca, 2001
- [35] Turinici, M., *Fixed points of implicit contraction mappings*, An. Şt. Univ. "A. I. Cuza" Iaşi Secţ. I a Mat. (N.S.) **22** (1976), No. 2, 177–180
- [36] Turinici, M., *Fixed points of implicit contractions via Cantor's intersection theorem*, Bul. Inst. Politehn. Iaşi Secţ. I **26(30)** (1980), No. 1-2, 65–68
- [37] Zamfirescu, T., *Fix point theorems in metric spaces*, Arch. Math. (Basel) **23** (1972), 292–298
- [38] Zhou, H. Y., Chang, S.-S. and Cho, Y. J., *Weak stability of the Ishikawa iteration procedures for  $\phi$ -hemicontractions and accretive operators*, Appl. Math. Lett. **14** (2001), No. 8, 949–954
- [39] Walter, W., *Remarks on a paper by F. Browder about contraction*, Nonlinear Anal. TMA **5** (1981), 21–25

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