

SOME NOVEL ASPECTS AND APPLICATIONS OF NOOR ITERATIONS AND NOOR ORBITS

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ABSTRACT. In this paper, we give a brief idea of Noor iterations, which were introduced by Noor in 2000 and had influenced several areas of applicable sciences including fractal geometry, chaos, design, financial, population, climate, language. Noor iterations and Noor orbits are related to fixed point theory, logistic maps, machine learning, artificial intelligence, Julia sets, Mandelbot sets. These iterations perform better than the Mann iteration (1953), Ishikawa iterations (1974) and being used in the design of solar panels related to green innovation (climate related problems). In recent years, Noor iterations have been modified and generalization in several directions using novel and innovative techniques to consider complicated complex problems.

REFERENCES

- [1] A.A. AlShejari, M.A. Noor and K.I. Noor: *Recent developments in general quasi variational inequalities*, Inter. J. Anal. Appl., 2024, 22:84, 39 pages.
- [2] K. Ashish, M. Rani and R. Chugh: *Julia sets and Mandelbrot sets in Noor orbit*, Appl. Math. Comput., **228**(2014), No. 1, 615-631.
- [3] Ashish, R. Chugh and M. Rani: *Fractals and Chaos in Noor Orbit: a Four-Step Feedback Approach*, Lap Lambert Academic Publishing, Saarbrücken, Germany, 2021.
- [4] Ashish, J. Cao and M.A. Noor: *Stabilization of fixed points in chaotic maps using Noor orbit with applications in cardiac arrhythmia*, J. Appl. Anal. Comput., **13**(2023), No. 5, 2452-2470.
- [5] C. Chairatsiripong and T. Thianwan: *Novel Noor iterations technique for solving nonlinear equations*, AIMS Math., **7**(2022), No. 6, 10958-10976.
- [6] C. Chairatsiripong, D. Yambangwai and T. Thianwan: *New iterative methods for nonlinear operators as concerns convex programming applicable in differential problems, image deblurring, and signal recovering problems*, Math. Methods Appl. Sci., **46**(2022), No. 3.
- [7] C. Chairatsiripong, D. Yambangwai and Tanakit Thianwan: *Convergence analysis of M-iteration for g -nonexpansive mappings with directed graphs applicable in image deblurring and signal recovering problems*, Demonstr. Math., **56**(2023), No. 1, Art. No. 20220234, 21 pages.
- [8] S.Y. Cho, A.A. Shahid, W. Nazeer and S.M. Kang: *Fixed point results for fractal generation in Noor orbit and s -convexity*, SpringerPlus, **5**(2006), Art. No. 1843, 16 pages.
- [9] R. Chugh, M. Rani and Ashish: *On the convergence of logistic map in Noor orbit*, Int. J. Comput. Appl., **43**(2012), No. 18, 1-4.
- [10] M. Chyne and N. Kumar: *Picard-Noor hybrid iterative method and its convergence analysis*, in: Advancements in Physical & Mathematical Sciences Proceedings of the 2nd International Conference on Functional Materials and Simulation Techniques, 1011 January 2022, Mohali, India, **2735**(2023), No. 1, Art. No. 040034.

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- [11] S.F. Galán: *Minimum modulus visualization of algebraic fractals*, J. Comput. Languages, **76**(2023), Art. No. 101222, 13 pages.
- [12] F. Gürsoy, V. Karakaya and B.E. Rhoades: *Data dependence results of new multi-step and S-iterative schemes for contractive-like operators*, Fixed Point Theory Appl., 2013, Art. No. 76, 12 pages.
- [13] Z.Y. Huang, F.W. Bu and M.A. Noor: *On the equivalence of the convergence criteria between modified Mann-Ishikawa and multi-step iterations with errors for successively strongly pseudo-contractive operators*, Appl. Math. Comput., **180**(2006), 641-647.
- [14] S. Ishikawa: *Fixed points by a new iteration method*, Proc. Amer. Math. Soc., **44**(1974), No. 1, 147-150.
- [15] G. Julia: *Sur l'iteration des fonctions rationnelles*, J. Math. Pures Appl. (9), **8**(1918), 737-747.
- [16] S.S. Kang, W. Nazeer, M. Tanveer and A.A. Shahid: *New fixed point results for fractal generation in Jungck-Noor Orbit with s-Convercity*, J. Funct. Spaces, **2015**(2015), ID 963016, 7 pages.
- [17] S.M. Kang, A. Rafiq, M. Tanveer, F. Ali and Y.C. Kwun: *Julia and Mandelbrot sets in modified Jungck three-step orbit*, Wulfenia J., **22**(2015), 167-185.
- [18] K. Kankam, S. Pheetarakorn and W. Cholamjiak: *The modified SP and Noor iterations with shrinking projection methods for three $\mathcal{G}$ -nonexpansive mappings in Hilbert spaces with graphs*, Thai J. Math., **18**(2020), No. 3, 1285-1297.
- [19] S. Kumari and R. Chugh: *A new experiment with the convergence and stability of logistic map via SP-Orbit*, Int. J. Appl. Eng. Res., **14**(2019), No. 3, 797-801.
- [20] B.B. Mandelbrot: *The Fractal Geometry of Nature*, W.H. Freeman, New York, 1982.
- [21] W.R. Mann: *Mean value methods in iteration*, Proc. Amer. Math. Soc., **4**(1953), No. 3, 506-510.
- [22] K. Nammanee, M.A. Noor and S. Suantai: *Convergence criteria of modified Noor iterations with errors for asymptotically nonexpansive mappings*, J. Math. Anal. Appl., **314**(2006), 320-334.
- [23] S.K. Natarajan and D. Negi: *Green innovations utilizing fractal and power for solar panel optimization*, in *Green Innovations for Industrial Development and Business Sustainability* (R. Sharma, G. Rana and S. Agarwal (Eds)), CRC Press, Florida, Boca Raton, USA, 2024, pp. 146-152.
- [24] M.A. Navascués and R.N. Mohapatra: *Fixed point dynamics in a new type of contraction in b-metric spaces*, Symmetry, **16**(2024), Art. No. 506, 22 pages.
- [25] D. Negi, A.K. Saini, N. Pandey, S.C. Wariyal and R. Sharma: *An analysis of Julia sets and Noor iterations using a complex Mandelbrot iteration scheme*, Preprint, 2016, 6 pages.
- [26] M.A. Noor: *New approximation schemes for general variational inequalities*, J. Math. Anal. Appl., **251**(2000), 217-230.
- [27] M.A. Noor: *Projection-splitting algorithms for monotone variational inequalities*, Comput. Math. Appl., **39**(2000), 73-79.
- [28] M.A. Noor: *Three-step iterative algorithms for multivalued quasi variational inclusions*, J. Math. Anal. Appl., **255**(2001), No. 2, 589-604.
- [29] M.A. Noor: *Modified resolvent splitting algorithms for general mixed variational inequalities*, J. Comput. Appl. Math., **135**(2001), No. 1, 111-124.
- [30] M.A. Noor: *Some developments in general variational inequalities*, Appl. Math. Comput., **152**(2004), 199-277.
- [31] M.A. Noor: *Fundamentals of mixed quasi variational inequalities*, Int. J. Pure Appl. Math., **15**(2004), No. 2, 137-250.
- [32] M.A. Noor, K.I. Noor and M.T. Rassias: *New trends in general variational inequalities*, Acta Appl. Math., **170**(2020), No. 1, 981-1046.
- [33] M.A. Noor, Th.M. Rassias and Z.Y. Huang: *Three-step iterations for nonlinear accretive operator equations*, J. Math. Anal. Appl., **274**(2002), No. 1, 59-68.
- [34] M.A. Noor, K.I. Noor, S. Treanta and K. Nonlaopon: *On three-step iterative schemes associated with general quasi-variational inclusions*, Alexandria Eng. J., **61**(2022), No. 12, 12051-12059.
- [35] P. Piamsang and T. Thianwan: *A novel Noor iterative technique for mixed type asymptotically nonexpansive mappings in hyperbolic spaces*, Thai J. Math., **21**(2023), No. 3, 413-430.
- [36] S. Piamsang, D. Yambangwai and T. Thainwan: *A novel Noor iterative method of operators with property (E) as concerns convex programming applicable in signal recovery and polynomiography*, Math. Methods Appl. Sci., **47**(2024), No. 12, 1-18.
- [37] W. Phuengrattana and S. Suantai: *On the rate of convergence of Mann, Ishikawa, Noor and SP-iterations for continuous functions on an arbitrary interval*, J. Comput. Appl. Math., **235**(2011), No. 9, 3006-3014.

- [38] E. Picard: *Memoire sur la theorie des equations aux derivees partielles et la methode des approximations successives*, J. Math. Pure Appl., 6(1890), 145-210.
- [39] A. Rafiq: *Modified Noor iterations for nonlinear equations in Banach spaces*, Appl. Math. Comput., 182(2006), 589-595.
- [40] M. Rani and R. Agarwal: *A new experimental approach to study the stability of logistic map*, Chaos, Solitons, Fractals, 41(2009), No. 4, 2062-2066.
- [41] M. Rani and R. Agarwal: *Effect of Noise on Julia sets generated by Logistic map*, in: 2010 The 2nd International Conference on Computer and Automation Engineering, Singapore IEEE, 2010.
- [42] M. Rani and S. Goel: *An experimental approach to study the logistic map in I-superior orbit*, Chaos Complexity Lett., 5(2011), No. 2, 95-101.
- [43] M. Rani and V. Kumar: *A new experimental approach study the stability of logistic maps*, J. Indian Acad. Math., 27(2005), No. 1, 143-156.
- [44] K. Rattanaseeha, S. Imnang, P. Inkrong and T. Thianwan: *Novel Noor iterative methods for mixed type asmpotically nonexpansive mappings from the perpestive of convex programming in hyperbolic spaces*, Int. J. Innovative Comput. Information and Control, 19(2023), No. 6, 1717-1734.
- [45] B.E. Rhoades and S.M. Soltuz: *The equivalence between Mann-Ishikawa iterations and multistep iteration*, Nonlinear Anal., 58(2004), 219-228.
- [46] S. Rawat, D.J. Prajapati, A. Tomar and K. Gdawiec: *Generation of Mandelbrot and Julia sets for generalized rational maps using SP-iteration process equipped with s-convexity*, Math. Comput. Simulation, 220(2024), 168-169.
- [47] H. Salarieh and A. Alasty: *Stabilizing unstable fixed points of chaotic maps via minimum entropy control*, Chaos Solitons Fractals, 37(2008), No. 3, 763-769.
- [48] S. Sharma, S.K. Padaliya and A. Tomar: *Fractals as Julia and Mandelbrot sets of logarithmic function using Dogan and Karakaya (DK) iterative scheme*, Ann. Sci. Allied Res., 1(2023), No. 1, 129-140.
- [49] S. Suantai: *Weak and strong convergence criteria of Noor iterations for asymptotically nonexpansive mappings*, J. Math. Anal. Appl., 331(2005), 506-517.
- [50] A. Tassaddiq: *General escape criteria for the generation of fractals in extended Jungck-Noor orbit*, Math. Comput. Simulation, 196(2022), 1-14.
- [51] A. Tassaddiq, S. Kanwal, F. Lakhani and R. Srivastava: *Strong and Δ -convergence fixed-point theorems using Noor iterations*, Axioms, 12(2023), Art. No. 271, 15 pages.
- [52] D. Thakur, B.S. Thakur and M. Postolache: *New iteration scheme for numerical reckoning fixed points of nonexpansive mappings*, J. Inequal. Appl., 2014(2014), Art. No. 328, 15 pages.
- [53] K. Ullah and M. Arshad: *On different results for new three step iteration process in Banach spaces*, SpringerPlus, 5(2016), Art. No. 1616, 15 pages.
- [54] G.I. Usurelu and M. Postolache: *Algorithm for generalized hybrid operators with numerical analysis and applications*, J. Nonlinear Var. Anal., 6(2022), No. 3, 255-277.
- [55] P.F. Verhulst: *Mathematical investigation of the law of population growth*, Memoires de L'Academie, Belgium, 18(1944).
- [56] B. Xu and M.A. Noor: *Fixed-point iterations for asymptotically nonexpansive mappings in Banach spaces*, J. Math. Anal. Appl., 267(2002), No. 2, 444-453.
- [57] A. Yadav and K. Jha: *Parrondo's paradox in the Noor logistic map*, Int. J. Adv. Research Eng. Technology, 7(2016), No. 5, 01-06.
- [58] D. Yambangwai and T. Thianwan: *Convergence point of 9-nonexpansive mappings in Banach spaces endowed with graphs applicable in image deblurring and signal recovering problems*, Ric. Mat., 73(2024), 633-660.

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