

VISCOSITY APPROXIMATION METHOD FOR EQUILIBRIUM AND FIXED POINT PROBLEMS

A. RAZANI^{*,**} AND M. YAZDI^{*}

^{*}Department of Mathematics, Faculty of Science, Imam Khomeini International University
P.O. Box: 34149-16818, Qazvin, Iran

^{**} School of Mathematics, Institute for Research in Fundamental Sciences
P. O. Box 19395-5746, Tehran, Iran
E-mail: razani@sci.ikiu.ac.ir and msh_yazdi@ikiu.ac.ir

Abstract. In this paper, we introduce a new iterative scheme by the viscosity approximation method for finding a common element of the set of solutions of an equilibrium problem and the set of common fixed points of infinitely many nonexpansive mappings in a Hilbert space. Then, we prove a strong convergence theorem which improves and extends some recent results.

Key Words and Phrases: Equilibrium problem, fixed point, nonexpansive mapping, viscosity approximation method, variational inequality.

2010 Mathematics Subject Classification: 47H10, 47H09.

Acknowledgment. The authors would like to thanks the referees for their valuable comments. Moreover, the research of A. Razani was in part supported by a grant from the School of Mathematics, Institute for Research in Fundamental Sciences (No. 92470122).

REFERENCES

- [1] Q.H. Ansari, N.C. Wong, J.C. Yao, *The existence of nonlinear inequalities*, Applied Math. Lett., **12**(1999), no. 5, 89-92.
- [2] H.H. Bauschke, *The approximation of fixed points of compositions of nonexpansive mappings in Hilbert spaces*, J. Math. Anal. Appl., **202**(1996), 150-159.
- [3] H.H. Bauschke, J.M. Borwein, *On projection algorithms for solving convex feasibility problems*, SIAM Rev., **38**(1996), 367-426.
- [4] E. Blum, W. Oettli, *From optimization and variational inequalities to equilibrium problems*, Math. Student., **63**(1994), 123-145.
- [5] L.C. Ceng, Q.H. Ansari, J.L. Ho, *Hybrid viscosity-like approximation methods for general monotone variational inequalities*, Taiwanese J. Math., **15**(2011), no. 3, 1871-1896.
- [6] L.C. Ceng, Q.H. Ansari, S. Schaible, J.C. Yao, *Iterative methods for generalized equilibrium problems, systems of general generalized equilibrium problems and fixed point problems for nonexpansive mappings in Hilbert spaces*, Fixed Point Theory, **12**(2011), no. 2, 293-308.
- [7] L.C. Ceng, Q.H. Ansari, J.C. Yao, *On relaxed viscosity iterative methods for variational inequalities in Banach spaces*, J. Comput. Appl. Math., **230**(2009), no. 2, 813-822.
- [8] L.C. Ceng, Q.H. Ansari, J.C. Yao, *Viscosity approximation methods for generalized equilibrium problems and fixed point problems*, J. Global Optimization, **43**(2009), no. 4, 487-502.

- [9] L.C. Ceng, J.C. Yao, *Hybrid viscosity approximation schemes for equilibrium problems and fixed point problems of infinitely many nonexpansive mappings*, Appl. Math. Comput., **198**(2008), 729-741.
- [10] P.L. Combettes, *Constrained image recovery in product space*, In: Proceedings of the IEEE International Conference on Image Processing (Washington, DC, 1995), Computer Society Press, California, 1995, 2025-2028.
- [11] P.L. Combettes, *The foundations of set theoretic estimation*, Proc. IEEE., **81**(1993), 182-208.
- [12] P.L. Combettes, S.A. Hirstoaga, *Equilibrium programming in Hilbert spaces*, J. Nonlinear Convex Anal., **6**(2005), 117-136.
- [13] F. Deutsch, H. Hundal, *The rate of convergence of Dykstra's cyclic projections algorithm: The polyhedral case*, Numer. Funct. Anal. Optim., **15**(1994), 537-565.
- [14] S.D. Flam, A.S. Antipin, *Equilibrium programming using proximal-like algorithms*, Math. Program., **78**(1997), 29-41.
- [15] A.N. Iusem, A.R. De Pierro, *On the convergence of Han's method for convex programming with quadratic objective*, Math. Program, Ser B., **52**(1991), 265-284.
- [16] Z. Opial, *Weak convergence of the sequence of successive approximation for nonexpansive mappings*, Bull. Amer. Math. Soc., **73**(1967), 561-597.
- [17] J.G. O' Hara, P. Pillay, H.K. Xu, *Iterative approaches to convex feasibility problems in Banach spaces*, Nonlinear Anal., **64**(2006), no. 9, 2022-2042.
- [18] G. Marino, H.K. Xu, *A general iterative method for nonexpansive mappings in Hilbert spaces*, J. Math. Anal. Appl., **318**(2006), 43-52.
- [19] A. Moudafi, *Viscosity approximation methods for fixed point problems*, J. Math. Anal. Appl., **241**(2000), 46-55.
- [20] K. Shimoji, W. Takahashi, *Strong convergence to common fixed points of infinite nonexpansive mappings and applications*, Taiwanese J. Math., **5**(2001), 387-404.
- [21] A. Tada, W. Takahashi, *Strong convergence theorem for an equilibrium problem and a nonexpansive mapping*, Nonlinear Analysis and Convex Analysis, (W. Takahashi, T. Tanaka - Eds.), Yokohama Publishers, Yokohama, Japan, 2005.
- [22] S. Takahashi, W. Takahashi, *Viscosity approximation methods for equilibrium problems and fixed point problems in Hilbert space*, J. Math. Anal. Appl., **331**(2007), 506-515.
- [23] T. Suzuki, *Strong convergence of Krasnoselskii and Mann's type sequences for one-parameter nonexpansive semigroups without Bochner integrals*, J. Math. Anal. Appl., **305**(2005), 227-239.
- [24] H.K. Xu, *An iterative approach to quadratic optimization*, J. Optim. Theory Appl., **116**(2003), 659-678.
- [25] Y. Yao, Y.C. Liou, R. Chen, *A general iterative method for an infinite family of nonexpansive mappings*, Nonlinear Anal., **69**(2008), 1644-1654.
- [26] Y. Yao, Y.C. Liou, J.C. Yao, *Convergence theorem for equilibrium problems and a for and fixed point problems of infinite family of nonexpansive mappings*, Fixed Point Theory Appl., **2007**(2007), doi:10.1155/2007/64363.
- [27] D.C. Youla, *Mathematical theory of image restoration by the method of convex projections*, Image Recovery: Theory and Applications, (H. Stark - Ed.), Academic Press, Felorida, 1987, 29-77.

Received: August 2, 2011; Accepted: March 9, 2012.