

STRONG CONVERGENCE THEOREMS FOR GENERAL VARIATIONAL INEQUALITY PROBLEMS AND FIXED POINT PROBLEMS IN q -UNIFORMLY SMOOTH BANACH SPACES

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Abstract. In this paper, we introduce a new iterative algorithm for finding a common element of the set of solutions of a general variational inequality and the set of common fixed points of an infinite family of nonexpansive mappings in q -uniformly smooth Banach space. We obtain some strong convergence theorems under suitable conditions. Furthermore we give an appropriate example such that all conditions of this result are satisfied. Our results extend the recent results announced by many others.

Key Words and Phrases: Strong convergence, general variational inequality, fixed point, Banach space.

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REFERENCES

- [1] K. Aoyama et al., *Approximation of common fixed points of a countable family of nonexpansive mappings in a Banach space*, *Nonlinear Anal.*, **67**(2007), 2350-2360.
- [2] A. Bnouhachem, M. Aslam Noor, Z. Hao, *Some new extragradient iterative methods for variational inequalities*, *Nonlinear Anal.*, **70**(2009), 1321-1329.
- [3] R.E. Bruck, *Properties of fixed point sets of nonexpansive mappings in Banach spaces*, *Trans. Amer. Math. Soc.*, **179**(1973), 251-262.
- [4] R.E. Bruck, *Nonexpansive projections on subsets of Banach space*, *Pacific J. Math.*, **47**(1973), 341-355.
- [5] L.C. Ceng, J.C. Yao, *Strong convergence theorem by an extragradient method for fixed point problems and variational inequality problems*, *Taiwanese J. Math.*, **10**(2006), 1293-1303.
- [6] L.C. Ceng, C. Wang, J.C. Yao, *Strong convergence theorems by a relaxed extragradient method for a general system of variational inequalities*, *Math. Methods Oper. Res.*, **67**(2008), 375-390.
- [7] L.C. Ceng, J.C. Yao, *Convergence and certain control conditions for hybrid viscosity approximation methods*, *Nonlinear Anal.*, **73**(2010), 2078-2087.
- [8] Y.J. Cho, X. Qin, *Systems of generalized nonlinear variational inequalities and its projection methods*, *Nonlinear Anal.*, **69**(2008), 4443-4451.
- [9] R.C. James, *Orthogonality and linear functionals in normed linear spaces*, *Trans. Amer. Math. Soc.*, **61**(1947), 265-292.

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- [10] S. Kitahara, W. Takahashi, *Image recovery by convex combinations of sunny nonexpansive retractions*, Topological Meth. in Nonlinear Anal., **2**(1993), 333-342.
- [11] H. Liduka, W. Takahashi, M. Toyoda, *Approximation of solutions of variational inequalities for monotone mappings*, Pan. Math. J., **14**(2004), 49-61.
- [12] D.S. Mitrinović, *Analytic Inequalities*, Springer-Verlag, New York, 1970.
- [13] M.A. Noor, *Projection-splitting algorithms for general mixed variational inequalities*, J. Comput. Anal. Appl., **4**(2002), 47-61.
- [14] M.A. Noor, *Some development in general variational inequalities*, Appl. Math. Comput., **152**(2004), 199-277.
- [15] X. Qin et al., *Approximation of solutions to a system of variational inclusions in Banach spaces*, J. Ineq. Appl., Volume 2010, Article ID 916806, 16 pages, doi:10.1155/2010/916806.
- [16] X. Qin, M. Shang, H. Zhou, *Strong convergence of a general iterative method for variational inequality problems and fixed point problems in Hilbert spaces*, Appl. Math. Comput., **200**(2008), 242-253.
- [17] T. Suzuki, *Strong convergence of Krasnoselskii and Manns type sequences for one parameter nonexpansive semigroups without Bochner integrals*, J. Math. Anal. Appl., **305**(2005), 227-239.
- [18] H.K. Xu, *Inequalities in Banach spaces with applications*, Nonlinear Anal., **16**(1991), 1127-1138.
- [19] H.K. Xu, *Viscosity approximation methods for nonexpansive mappings*, J. Math. Anal. Appl., **298**(2004), 279-291.
- [20] Y. Yao et al., *Modified extragradient methods for a system of variational inequalities in Banach spaces*, Acta. Appl. Math., **110**(2010), 1211-1224.

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