

## A HYBRID PROJECTION ALGORITHM FOR FINDING FIXED POINTS OF BREGMAN QUASI-STRICT PSEUDO-CONTRACTIONS

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**Abstract.** In this paper, a hybrid projection algorithm is investigated for finding fixed points of Bregman quasi-strict pseudo-contractions. Strong convergence theorems are established in the framework of reflexive Banach spaces.

**Key Words and Phrases:** Bregman projection, monotone operator, Banach space, strong convergence, fixed point.

**2010 Mathematics Subject Classification:** 47H09, 65J15, 47H10.

### REFERENCES

- [1] G.A. Anastassiou, I.K. Argyros, *Fixed point schemes with applications in right multivariate fractional calculus*, *J. Nonlinear Funct. Anal.*, **2016**(2016), Art. ID 17.
- [2] H.H. Bauschke, J.M. Borwein, P.L. Combettes, *Essential smoothness, essential strict convexity, and Legendre functions in Banach spaces*, *Commun. Contemp. Math.*, **3**(2001), 615-664.
- [3] B.A. Bin Dehaish, A. Latif, H.O. Bakodah, X. Qin, *A regularization projection algorithm for various problems with nonlinear mappings in Hilbert spaces*, *J. Inequal. Appl.*, **2015**(2015), Art. ID 51.
- [4] B.A. Bin Dehaish, X. Qin, A. Latif, H.O. Bakodah, *Weak and strong convergence of algorithms for the sum of two accretive operators with applications*, *J. Nonlinear Convex Anal.*, **16**(2015), 1321-1336.
- [5] J.F. Bonnans, A. Shapiro, *Perturbation Analysis of Optimization Problems*, Springer Verlag, New York, 2000.
- [6] D. Butnariu, A.N. Iusem, *Totally Convex Functions for Fixed Points Computation and Infinite Dimensional Optimization*, Kluwer Academic Publ., Boston, Dordrecht, London, 2000.
- [7] D. Butnariu, E. Resmerita, *Bregman distances, totally convex functions and a method for solving operator equations in Banach spaces*, *Abstr. Appl. Anal.*, **2006**(2006), Art. ID 84919.
- [8] C. Byrne, *A unified treatment of some iterative algorithms in signal processing and image reconstruction*, *Inverse Probl.*, **20**(2008), 103-120.
- [9] S.S. Chang, C.F. Wen, J.C. Yao, *Common zero point for a finite family of inclusion problems of accretive mappings in Banach spaces*, *Optimization*, **67**(2018), 1183-1196.

- [10] S.S. Chang, C.F. Wen, J.C. Yao, *Zero point problem of accretive operators in Banach spaces*, Bull. Malaysian Math. Sci. Soc., **42**(2019), 105-118.
- [11] N. Fang, Y. Gong, *Viscosity iterative methods for split variational inclusion problems and fixed point problems of a nonexpansive mapping*, Commun. Optim. Theory, **2016**(2016), Art. ID 11.
- [12] H.O. Fattorini, *Infinite-Dimensional Optimization and Control Theory*, Cambridge University Press, Cambridge, 1999.
- [13] F. Kohsaka, W. Takahashi, *Proximal point algorithms with Bregman functions in Banach spaces*, J. Nonlinear Convex Anal., **6**(2005), 505-523.
- [14] S.Y. Matsushita, W. Takahashi, *A strong convergence theorem for relatively nonexpansive mappings in a Banach space*, J. Approx. Theory, **134**(2005), 257-266.
- [15] X. Qin, A. Petruşel, J.C. Yao, *CQ iterative algorithms for fixed points of nonexpansive mappings and split feasibility problems in Hilbert spaces*, J. Nonlinear Convex Anal. **19**(2018), 157-165.
- [16] X. Qin, J.C. Yao, *Projection splitting algorithms for nonself operators*, J. Nonlinear Convex Anal. **18**(2017), 925-935.
- [17] X. Qin, J.C. Yao, *Weak convergence of a Mann-like algorithm for nonexpansive and accretive operators*, J. Inequal. Appl., **2016**(2016), Art. ID 232.
- [18] S. Reich, S. Sabach, *A strong convergence theorem for a proximal-type algorithm in reflexive Banach spaces*, J. Nonlinear Convex Anal., **10**(2009), 471-485.
- [19] S. Reich, S. Sabach, *Two strong convergence theorems for a proximal method in reflexive Banach spaces*, Numer. Funct. Anal. Optim., **31**(2010), 22-44.
- [20] S. Reich, S. Sabach, *Two strong convergence theorems for Bregman strongly nonexpansive operators in reflexive Banach spaces*, Nonlinear Anal., **73**(2010), 122-135.
- [21] R.T. Rockafellar, *Characterization of the subdifferentials of convex functions*, Pacific J. Math., **17**(1966), 497-510.
- [22] G.C. Ugwunnadi et al., *Strong convergence theorem for quasi-Bregman strictly pseudocontractive mappings and equilibrium problems in Banach spaces*, Fixed Point Theory Appl., **2014**(2014), Art. ID 231.
- [23] Z.M. Wang, X. Zhang, *Shrinking projection methods for systems of mixed variational inequalities of Browder type, systems of mixed equilibrium problems and fixed point problems*, J. Nonlinear Funct. Anal., **2014**(2014), Art. ID 15.
- [24] C. Zălinescu, *Convex Analysis in General Vector Spaces*, World Scientific, River Edge, 2002.

*Received: September 30, 2016; Accepted: March 20, 2017.*