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A TWO-STAGE PROXIMAL ALGORITHM WITH BREGMAN DIVERGENCE[1]

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Let C be a nonempty closed convex subset of a real Hilbert space H and $F: C \times C \to \mathbb{R}$ be a bifunction with $F(x,x)=0$ for all $x \in C$. Consider the following equilibrium problem:

$$\text{find } x \in C \text{ such that } \quad F(x,y) \geq 0 \quad \forall y \in C .$$

We propose a new iterative two-stage proximal algorithm for solving the problem of equilibrium programming in a Hilbert space. This method is a result of extension of L. D. Popov's modification of Arrow-Hurwicz scheme for approximation of saddle points of convex-concave functions. More precisely, we propose and analyze the following algorithm: for x_1, $y_1 \in C$ generate the sequences $x_n \in C$, $y_n \in C$ with the iterative scheme

$$x_{n+1} \in \arg\min_{y \in C} \left(F(y_n, y) + \tfrac{1}{\lambda} D(y, x_n) \right),$$

$$y_{n+1} \in \arg\min_{y \in C} \left(F(y_n, y) + \tfrac{1}{\lambda} D(y, x_{n+1}) \right),$$

where $\lambda > 0$, D is Bregman divergence.

The convergence of the algorithm is proved under the assumption that the solution exists and the bifunction is pseudo-monotone and Lipschitz-type.

Our method, like other mirror descent schemes, can effectively take into account the structure of the feasible set of the problem. Several preliminary numerical experiments have been also performed to illustrate the convergence of the method.

In conclusion we note that, in our opinion, the proposed Algorithm is promising for the further investigation and can be used in practical applications.

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