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IMPROVED METHODS TO SOLVE THE STOCHASTIC NASH GAMES FOR WEAKLY COUPLED LARGE-SCALE SYSTEMS ITERATIVELY

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Abstract. In this paper, the stochastic Nash games for weakly coupled large-scale systems with state-dependent noise are considered. The considered stochastic algebraic Riccati equations are quite different from the existing results in the sense that the equations have the additional linear term. The numerical algorithm based on the Newton method for solving the set of cross-coupled stochastic algebraic Riccati equations is derived by Mukaidani (Automatica 45(2009) 1272-1279). We modify this iteration and propose two new recursive equations with linear rate of convergence solving the considered set of Riccati equations. We carry out numerical experiments to illustrate the effectiveness of the considered iterations.

Keywords. cross-coupled stochastic algebraic Riccati equations, Newton's method, algebraic Lyapunov equation, positive definite solution, numerical solution.

AMS (MOS) subject classification: 15A24, 15A45, 65F35.

1 Introduction

Linear quadratic Nash games and their applications have been widely investigated as a concept for decision making in various control fields. Recently, the indefinite linear quadratic differential games under a deterministic disturbance input affecting the systems have been discussed in [1,2]. Using the results in [1,2] it is easy to obtain a strategy pair by solving the cross-coupled algebraic Riccati equations in the deterministic case.

Mukaidani [11] has extended the results of [1,2] to the soft-constrained stochastic Nash games governed by Itô's differential equations with state-dependent noise. Numerical computation of robust equilibria to soft constrained stochastic Nash games with state dependent noise in weakly coupled large-scale systems have been studied in two parallel investigations by Mukaidani [11,12]. The robust equilibria comes from the solution a set of cross-coupled stochastic algebraic Riccati equations. The stochastic Lyapunov iteration for numerical computation of the soft-constrained stochastic Nash equilibrium strategy pair is proposed in [11] where the two-player soft-constrained stochastic Nash games are formulated for the first time. Linear