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Mean Field Stochastic Differential Games Involving A Major Player

We consider linear-quadratic-Gaussian (LQG) games with a major player and a large number of minor players. The major player has significant influence on others. The minor players individually have negligible impact, but they collectively contribute mean field coupling terms in the individual dynamics and costs. To overcome the dimensionality difficulty and obtain decentralized strategies, the so-called Nash certainty equivalence methodology is applied. The control synthesis is preceded by a state space augmentation via a set of aggregate quantities giving mean field approximation. Subsequently, within the population limit the original game is decomposed into a family of two-player limiting games as each locally seen by a representative minor player. Next, when solving these two-player limiting games, we impose certain interaction consistency conditions such that the aggregate quantities initially assumed coincide with the ones replicated by the closed-loop of a large number of minor players. This procedure leads to decentralized strategies for the original LQG game, and it is shown that the set of strategies is a decentralized ϵ-Nash equilibrium.