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LQG Risk-Sensitive Mean Field Games with a Major Agent

Risk sensitivity plays an important role in the study of finance and economics as risk-neutral models cannot capture and justify all economic behaviors observed in reality. Risk-sensitive mean field game theory was developed recently for systems where there exists a large number of indistinguishable, asymptotically negligible and heterogeneous risk-sensitive players, who are coupled via the empirical distribution of state across population (average state of the population in the LQG case). In this work, we extend the theory of LQG risk-sensitive MFGs to the setup where there exists one major agent as well as a large number of minor agents. The major agent has a significant impact on each minor agent and its impact does not collapse with the increase in the number of minor agents. Each agent is subject to linear dynamics with an exponential-of-integral quadratic cost functional. Moreover, all agents interact via the average state of minor agents (so-called empirical mean field) and the major agent's state. We use a change of measure technique together with a variational analysis to derive the best response strategies of agents in the limiting case where the number of agents goes to infinity. We establish that the set of obtained best-response strategies yields a Nash equilibrium in the limiting case and an ϵ -Nash equilibrium in the finite player case.