Exploration noise for learning Linear Quadratic Mean Field Games

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Abstract: The goal of this talk is to demonstrate that common noise may server as an exploration noise for learning the solution of a mean field game. This concept is here exemplified through a toy model, for which a suitable form of common noise has already being proven to restore existence and uniqueness. We go one step further and prove that the same form of common noise may force the convergence of the learning algorithm called "fictitious play" without any assumption of potential or monotone structure.

Starting from a LQMFG without common noise, we introduce common noise as action noise. We conceptualise learning as a scheme of the form

computation of a best action/update of the state variable

Since classical Picard iterations fail we relay on fictitious play to update the states in a slower manner while implementing the best response. Common noise helps decouple the FBSDE system and thus we can prove convergence of our fictitious play under mere Lipschitz assumptions. As our major result we compare the law of the output of the scheme with the law of the equilibrium.

Last but not least, we present several numerical examples which serve as proof of concept for our theoretical results.

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