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Mean Field Games: An Overview

Mean Field Game (MFG) theory studies the existence of Nash equilibria in games involving a large number of asymptotically negligible agents modelled by controlled stochastic dynamical systems. The strategy for a single agent in the infinite population problem is given via the solution of (i) an optimal control Hamilton-Jacobi-Bellman (HJB) equation, and (ii) a Fokker-Planck-Kolmogorov (FPK) equation (or an equivalent stochastic differential equation) linked by the distribution of the state of a generic agent, otherwise known as the system's mean field. These strategies depend only upon an agent's state and the mean field, and in the finite population setting yield approximate Nash equilibria. Potential applications of MFG theory lie in engineering (e.g. communication networks and the power grid), finance, economics and social dynamics, among other fields, while theoretical work addresses, for instance, the solution of the MFG equations, the analysis of major-minor (MM) agent systems containing asymptotically non-negligible agents, and non-linear estimation theory (i.e. state estimation) for MM-MFG systems.

In this talk we shall motivate MFG theory through a limited number of examples, introduce the principal results and indicate some of the current and future avenues of research.

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