Approximation of PDEs on Wasserstein space and application to mean field control

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We present a finite-dimensional approximation for a class of partial differential equations on the space of probability measures. These equations are satisfied in the sense of viscosity solutions. Our main result states the convergence of the viscosity solutions of the finite-dimensional PDE to the viscosity solutions of the PDE on Wasserstein space, provided that uniqueness holds for the latter, and heavily relies on an adaptation of the Barles & Souganidis monotone scheme to our context. We then apply this result to the Hamilton-Jacobi-Bellman and Bellman-Isaacs equations arising in stochastic control and differential games, for which we show the convergence of the value function of the finite population problem to the value function of the mean field problem under rather weak regularity requirements.