Generalized control systems in the space of probability measures

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Abstract: We formulate an optimal control problem in the space of probability measures. The main motivation is to face situations in finite-dimensional control systems evolving deterministically where the initial position of the controlled particle is not exactly known, but can be expressed by a probability measure on $\mathbb{R}^d$. We propose for this problem a generalized version of some concepts from classical control theory in finite dimensional systems (namely, target set, dynamic, minimum time function...) providing sufficient conditions for controllability. We prove also some representation results linking the classical concept to the corresponding generalized ones. The main tool used is a superposition principle due to Ambrosio-Gigli-Savaré, which provides a probabilistic representation of the solution of the continuity equation as a weighted superposition of absolutely continuous characteristic curves.