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Method to Find a ε-Optimal Control of Stochastic Differential Equation Driven by a Brownian Motion

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Abstract : We present a general solution for finding the ε-optimal controls for non-Markovian stochastic systems as stochastic differential equations driven by Brownian motion, which is a problem recognized as a difficult solution. The contribution appears in the development of mathematical tools to deal with modeling and control of non-Markovian systems, whose applicability in different areas is well known. The methodology used consists to discretize the problem through a random discretization. In this way, we transform an infinite dimensional problem in a finite dimensional, thereafter we use measurable selection arguments, to find a control on an explicit form for the discretized problem. Then, we prove the control found for the discretized problem is a ε-optimal control for the original problem. Our theory provides a concrete description of a rather general class, among the principals, we can highlight financial problems such as portfolio control, hedging, super-hedging, pairs-trading and others. Therefore, our main contribution is the development of a tool to explicitly the ε-optimal control for non-Markovian stochastic systems. The pathwise analysis was made through a random discretization jointly with measurable selection arguments, has provided us with a structure to transform an infinite dimensional problem into a finite dimensional. The theory is applied to stochastic control problems based on path-dependent stochastic differential equations, where both drift and diffusion components are controlled. We are able to explicitly show optimal control with our method.

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