From Calculus to Stochastic Optimal Control Modeling

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Abstract

We begin with a typical linear quadratic regulator, where we present four basic questions, namely, identification, controllability, stabilization and observability. Also, we mention more general models. Next, we comment on the two main arguments for solving optimal control problems, i.e., the Pontryagin maximum principle and the Bellman dynamic programming. At this point, we want to incorporate some degree of uncertainty to model and we remark a dramatic change in the mathematical setting. When modeling the noise of the system, we model the evolution of the state as a Stochastic Differential Equation (SDE), where new notions of differentiation and integration are needed. The technical difficulties are so deep, that several chapters are required to deal with the SDE, as an example, we note the technical aspect of the so-called controlled diffusion with jumps in a d-dimensional space. Finally, we present a simple linear quadratic Gaussian model (based on recent joint papers), where a simple practical change in the initial model produces serious consequences in the mathematical arguments.

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