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Optimal control of conditioned processes

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Abstract: We consider a class of closed loop stochastic optimal control problems in finite time horizon, in which the cost is an expectation conditional on the event that the process has not exited a given bounded domain. An important difficulty is that the probability of the event that conditionates the strategy decays as time grows. The optimality conditions consist of a system of partial differential equations, including a Hamilton-Jacobi-Bellman equation (backward w.r.t. time) and a (forward w.r.t. time) Fokker-Planck equation for the law of the conditioned process. The two equations are supplemented with Dirichlet conditions.
Next, we discuss the asymptotic behavior as the time horizon tends to $+\infty$. This leads to a new kind of optimal control problem driven by an eigenvalue problem related to a continuity equation with Dirichlet conditions on the boundary. We prove existence for the latter.
We also propose numerical methods and supplement the various theoretical aspects with numerical simulations.

This is a joint work with M. Laurière (Princeton) and P-L Lions (Collège de France). The topic was introduced by P-L Lions in his lectures in Collège de France in 2016, and there is a preprint "Optimal control of conditioned processes with feedback controls." arXiv preprint arXiv:1912.08738 (2019)

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