An actively adaptive control policy based on the prediction of posterior densities

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Abstract— For a linear system with unknown parameters the control action affects both the future behaviour of the system and the precision of the future state and parameter estimates. When the model parameters are known and a quadratic control objective is used the Certainty Equivalence Principle leads to classical LQG feedback control laws. This principle no longer holds true in the case of unknown parameters, and the corresponding stochastic dynamic programming problem cannot in general be solved analytically. Suboptimal policies have thus to be retained.

Most of them are *passively* adaptive, i.e. at stage k they take into account the information collected from previous measurements $y(1), \ldots, y(k)$ (a benefit of feedback), but do not take into account the influence of the present action on the precision of future estimations. Each new observation is thus considered to be the last one to be performed. On the opposite, prediction of precision is a basic idea in *optimal experiment design*. Using the information matrix, we can predict the future posterior uncertainty on the parameters and thus design an *actively adaptive* control policy. The case of autoregressive models is considered and illustrative examples are presented.

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