CONTROL OF A SIMPLE NON-LINEAR SYSTEM USING PROBABILISTIC MIXTURES

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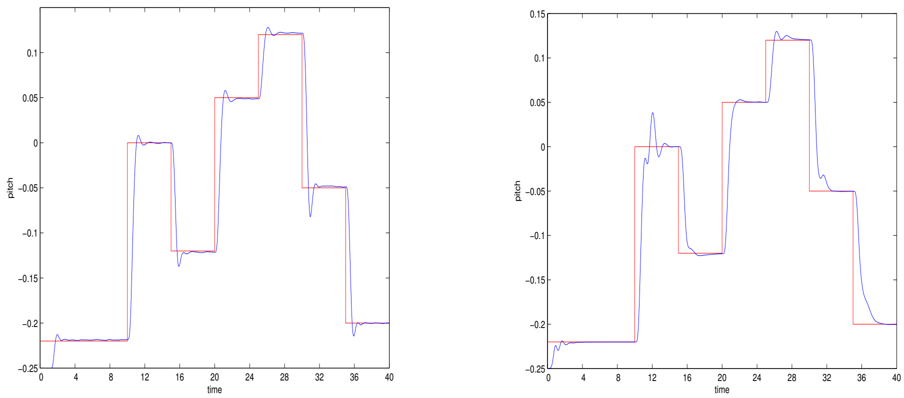
The paper shows application of a new mixture-based approach to control on a simple non-linear system. The general algorithm can be described in 3 steps. First the probabilistic mixture model must be obtained from the process data. Second, the desired values on the system must be convert to the form of a probabilistic density function (pdf). Then the approximation of the fully probabilistic design is performed, which results into the pdf describing the control variables. Mixture-based control can be interpreted as constructing several linear controllers and then switching them during the process. The successful usage of the mentioned approach by controlling a SIMULINK model is presented. The result is compared with control of the same model with an adaptive LQ controller.

The main idea is to consider a probabilistic model of the system in the form of a pdf $f(d(\mathring{t}))$ on all trajectories of the system. The target must be in the same way expressed as the user target pdf $^{[U]}f(d(\mathring{t}))$. Then the control law in the form of pdf $^{[I]}f(d(\mathring{t}))$ is obtained through minimization of Kullback-Leibler distance $\mathcal{D}\left({}^{[I]}f(d(\mathring{t}))||{}^{[U]}f(d(\mathring{t}))\right)$ considering the relationship between the system model $f(d(\mathring{t}))$ and $^{[I]}f(d(\mathring{t}))$.



Comparison between the LQ controller and the mixture-based controller.

The left figure shows result of control with a mixture based controller, whereas the right figures shows result of the same experiment controlled by an adaptive LQ controller.