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Multiphase Adaptive Control based on Strong Robustness

M.Cadic
Faculty of Mathematical Sciences
University of Twente
P.O. Box 217, 7500 AE Enschede
m.cadic@math.utwente.nl

J.W. Polderman
Faculty of Mathematical Sciences
University of Twente
P.O. Box 217, 7500 AE Enschede
j.w.polderman@math.utwente.nl

1 abstract

Most adaptive control systems have been derived from the certainty equivalence principle: at each new iteration of the design, a model of the plant is obtained from the previous model, and a new controller is designed on the basis of this updated model. Unfortunately, in case the uncertainty about the system parameters is too large, the stability of the real plant controlled by the model-based controller can not be guaranteed. However, if the uncertainty about the true system is such that no matter where we believe that the true system is and no matter where it actually is, the controller based on the model stabilizes the actual plant, then we can safely apply a certainty equivalence type of strategy.

Therefore, we propose to build a test checking at each iteration whether the parameter uncertainty set is such that for any models P_1, P_2 in this set, the controller based on P_1 stabilizes P_2. If this condition holds, the uncertainty set is then said to be strongly robust [**?**]. Hence, our adaptive scheme splits in two phases depicted in Figure 1. In the first phase, we put effort on identification of the system to be controlled, and once the condition of Strong Robustness is verified, we switch to the second phase where the emphasis is gradually put on control.

Our objective is to present the general structure of our algorithm, irrespectively of computational issues. In particular, we show that, for the class of systems we specify, if we can compute an input sequence such that the parameter uncertainty set is converging to the point set $\{\theta^0\}$, where $\{\theta^0\}$ denotes the true parameter vector, then there exists a finite time at which the condition of strong robustness is fulfilled, dismissing the situation where we would stay in the first phase indefinitely. Next, assuming that the condition of Strong Robustness is verified in finite time, since the stability of the controlled system is now guaranteed, we can proceed as in classical adaptive control, i.e. we can design the controller on the basis of the updated model. At each new data measurement, the model is updated into a new model closer to the real system, leading to an updated controller expected to show better performance. Although this is still under investigation, the main improvement brought by the introduction of our multiphase adaptive control system is expected to be the decrease of undesired transients of the control system.

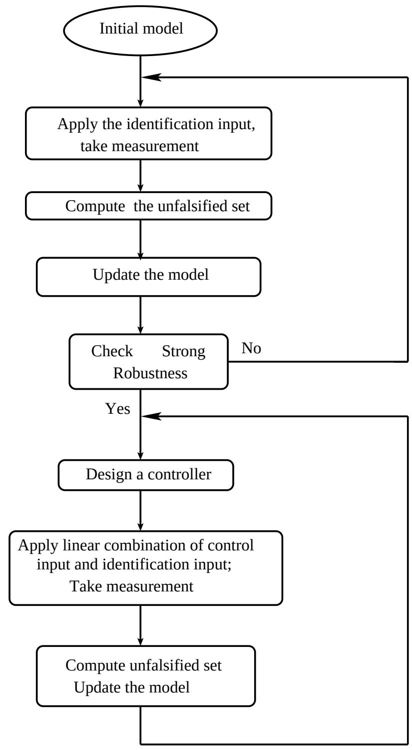

Figure 1: Iterative scheme.

References

[1] M.Cadic, J.W.Polderman, Strong Robustness in Adaptive Control, *Proc. 4th NCN Workshop, Sheffield, UK*, 2001.