Computational Aspects of Controller Design and Quality Evaluation

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Computational efficiency is an important factor of controller design using Monte Carlo method. Controller tuning is a process aiming at the correct controller set-up to fulfill given constraints and requirements. A controller depends on certain parameters, called tuning knobs, which have to be set properly to obtain desired control loop behavior. Model-based predictive controllers are, in some sense, optimal. However, the optimality is conditioned by the perfect model fit to the controlled plant. And, the optimality from user's point of view need not match the kind of optimality acceptable for the controller. The reasons for controller tuning are:

1. The assumed controller uses a system model that does not fit to the reality due to incorrectly identified model parameters, or even the structure or type of model is not perfect. The tuning knobs have to be set to suppress control error caused by the model mismatch. In another words the controller setting influences its robustness.

2. The optimality criterion of the controller is not able to express the user's desired kind of optimality. The selected controller requires a different formulation of the task. The tuning process converts the desired optimality into the form acceptable by controller.

The tuning is an optimization task searching the best tuning knob values. The controller behavior is evaluated from predicted closed loop performance. The prediction is calculated using simulation of a model identified from data measured on real plant and user supplied prior information.

However, nested optimization and simulation procedures brings significant computational demands. Thus it is necessary to make computation as short as possible while keeping satisfactory precision. This problem is solved by introducing on-line stopping rules which decide how long the simulation has to be to obtain stabilized results. The decision is made on-line, so instead of making some global estimate, the simulation length fits to the actually simulated data.

Acknowledgment

This work was partially supported by grants GA ČR No. 102/05/0271, GA ČR No. 102/03/0049, and AV ČR S1075351.

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