SOME PRACTICAL ASPECTS OF MODEL PREDICTIVE CONTROL

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Predictive control algorithms calculate a series of the control signal values minimizing a quadratic cost function evaluating the difference between the reference signal and the predicted process output in a given future horizon. The future values of the reference signal can be given in a lot of applications (e.g. in robot control). The future values of the plant can be predicted from the model of the plant. The future output is affected partly by the past inputs, and partly by the actual and future inputs which are optimized. ¿From the calculated control signal series only the first value is applied at the input of the process and in the next sampling point the calculation is repeated (receding horizon strategy). Minimizing the cost function constraints can be considered. The tuning parameters of the algorithm are the starting point and the length of the prediction horizon, the control horizon (the supposed executive changes in the control signal) and the weighting factors in the cost function. The different predictive control algorithms differ mainly in the process model (linear or nonlinear, parametric or nonparametric). With predictive control strategy better control performance can be achieved than with usual control algorithms especially in case of known reference values and significant dead times. Receding horizon strategy will ensure appropriate disturbance rejection and will decrease the sensitivity to plant-model mismatch. Besides the PID control algorithms predictive control algorithms have reached a wide industrial acceptance. This trend is increasing as effective industrial program packages are available for predictive control. An important practical problem is reducing the calculations which have to be executed between the sampling points. Optimization considering constraints can be a time consuming operation especially in case of long prediction horizon. This problem becomes critical with small sampling periods. Real time applications would require techniques reducing the computation time significantly. The presentation will consider some possibilities to reduce the computation time of predictive control algorithms. It is shown that exponential allocation of the considered points (coincidence points) in the prediction horizon instead of equidistant allocation provides a drastic decrease in computation time. The computation time is influenced also by the appropriate choice of the allowed change points in the control signal (blocking technique). Another approach to decrease the calculations is using the Generalized Predictive Control (GPC) algorithm for unconstrained case and to handle the limitations set for the control signal afterwards. GPC gives a closed formula to calculate the optimal control sequence. GPC can be transformed into a two degree of freedom polynomial structure. For the case of stable plants this polynomial structure can be transformed into internal model control (IMC) structure as well. An effective *a posteriori* constraint handling is shown applying the controller dynamics in the feedback of the static saturation.

References

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