Model Predictive control in the chemical process industry hosted by industrial controllers

Linear Model Predictive Controllers (MPC) have been used in the chemical process industry for over forty years. They are currently implemented in a growing number of branches of the industry. The theoretical background of linear MPC is thoroughly investigated and recent evolutions focus on the speeding-up of algorithms to solve the quadratic optimization problem (QP), the heart of these controllers. Hence, MPC can be employed for fast systems as well as for embedded applications. The aim of this PhD is to employ the recent online QP algorithms in order to minimize the use of computational power and memory to solve the MPC problem. Typical controllers used in industry, i.e., Programmable Automation Controllers (PACs) and Programmable Logic controllers (PLCs) have limited computational power and available memory. An in-depth investigation was performed to see if it is possible to run MPC hosted by a PLC. To this end, two practical set-ups were used, i.e., a mini set-up consisting of a fan and heating resistor, and a pilot-scale distillation column set-up. The complete chain starting from black-box linear system identification, simulations, hardware-in-the-loop experiments, up to experiments on the actual set-ups were carried out. On the mini set-up it has been proven that a PLC is able to solve the quadratic optimization problem accompanied by a model predictive controller. For the pilot-scale distillation column, it has been demonstrated that a PLC is not powerful enough to solve the QP problem with recent QP solver s. Nevertheless, a classical algorithm successfully passed hardware-in-the-loop simulations and experiments on the set-up . For PAC devices on the other hand, it has been verified that, on this pilot scale set-up, all investigated Q P solvers can easily solve the optimization problem part of the MPC algorithm