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A Constrained Model Predictive Control Scheme for Simultaneous Control of Temperature and Hygrometry in Greenhouses

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Abstract : The objective of greenhouse climate control is to improve the culture development and to minimize the production costs. A greenhouse is an open system to external environment and the challenge is to regulate the internal climate despite the strong meteorological disturbances. The internal state of greenhouse considered in this work is defined by too relevant and coupled variables, namely inside temperature and hygrometry. These two variables are chosen to describe the internal state of greenhouses due to their importance in the development of plants and their sensitivity to external climatic conditions, sources of weather disturbances. A multivariable model is proposed and validated by considering a greenhouse as black-box system and the least square method is applied to parameters identification basing on collected experimental measures. To regulate the internal climate, we propose a Model Predictive Control (MPC) scheme. This one considers the measured meteorological disturbances and the physical and operational constraints on the control and state variables. A successful feasibility study of the proposed controller is presented, and simulation results show good performances despite the high interaction between internal and external variables and the strong external meteorological disturbances. The inside temperature and hygrometry are tracking nearly the desired trajectories. A comparison study with an On/Off control applied to the same greenhouse confirms the efficiency of the MPC approach to inside climate control.

Keywords : climate control, constraints, identification, greenhouse, model predictive control, optimization
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