A Constrained MPC 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. To achieve this objective, first 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. Second, in order to regulate the internal climate, we propose a Model Predictive Control (MPC) scheme. This one considers in the design control the measured meteorological disturbances and the physical and operational constraints on control inputs 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. A comparison results with an On/Off control applied to the same greenhouse confirms the superiority of the proposed approach.

Image

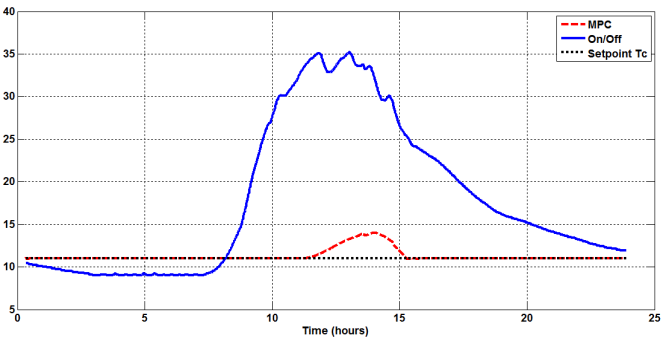


FIG. 6 Evolution of internal temperature and comparison between MPC/On-Off controls during one day.

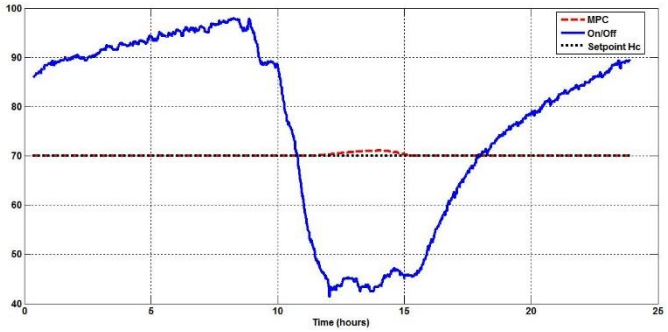


FIG. 7 Evolution of internal hygrometry and comparison between MPC/On-Off controls during one day.

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3. N. Bennis, J. Duplaix, G. Enea, M. Haloua, H. Youlal (2008), "Greenhouse climate modelling and robust control," computers and electronics in agriculture., vol. 61, pp. 96–107.
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Biography

Najib BENNIS received his D.E.S. degree in Automatic control of distributed systems in 1986 from the University of Nantes in France. He received the " Doctorat d'Etat" (Ph.D.) degree in Automatic control from the University Mohammed V, Rabat, Morocco (2014). His areas of interest include LMI optimization, large scale systems control, Greenhouse Climate control, decentralized control, and their applications. He is attached to research team in Energy Optimization, DIagnosis and Control at High School of Technical Education (ENSET of Rabat), University Mohamed V of Rabat, Morocco. Actually, he is teacher at ENSET of Rabat, Morocco.

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