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Employing 2DoF PID Controllers to Improve Greenhouse Climate System Robustness

By: [Gurban, EH](#) (Gurban, Eugen Horatiu)^[1]; [Andreescu, GD](#) (Andreescu, Gheorghe-Daniel)^[1]

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Abstract

The mathematical models of the greenhouse environment are MIMO systems, characterized by a high coupling, nonlinearity, parameter variation and they are highly influenced by disturbances. This paper uses a well-known greenhouse climate model with measurable external disturbances and a feedback-feedforward linearization, decoupling and disturbance compensations technique. Greenhouse climate model parameters/disturbances, which are susceptible to wrong estimation, are identified, i.e., heat transfer coefficient (UA), shading and leaf area index coefficient (alpha), and intercepted solar radiant energy (Si). The system response, in the case of nominal model and considering different levels of model uncertainty, are compared. Significant quality indicator degradations for setpoint step responses leads to reconsider the control structure using two degree of freedom (2DoF) PID controllers. Four 2DoF PI/PID tuning technique are compared at nominal condition and under parameter variations showing good performance.

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Author Information

Reprint Address: [Gurban, EH](#) (reprint author)

Politehn Univ Timisoara, Dept Automat & Appl Informat, Timisoara, Romania.

Addresses:

[1] Politehn Univ Timisoara, Dept Automat & Appl Informat, Timisoara, Romania

E-mail Addresses: eugen.gurban@aut.upt.ro; daniel.andreescu@aut.upt.ro

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