

Indoor Climate Control for a Livestock Stable

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Master Thesis Project

Cooperated between Aalborg University Esbjerg and SKOV A/S

1. OBJECTIVE

The climate in a livestock stable is critical for breeding animals in terms of the growth rate, animal welfare and slaughter quality etc. In a standard stable, the climate can be controlled by controlling the temperature, humidity, air flow, CO₂ and ammonia as well. SKOV A/S has developed individual P and PI controllers to regulate inlets, outlet chimneys, heating and moistening systems. In order to improve the efficiency and reliability of the current climate control systems, this project focused on the design of a reliable MIMO controller and test it on a real-sized stable facility.

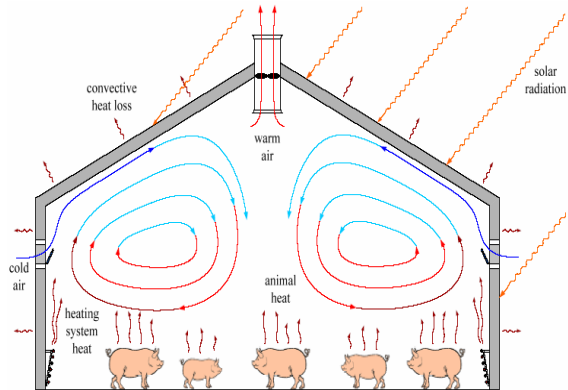


Fig.2 Heat Flow Diagram inside a Livestock Stable

3. RESULTS

The developed controller succeeds in controlling the indoor temperature within a reasonable range, see Fig.3. Meanwhile the possible faults of inlet, outlet and heating system can be distinguished based on different residuals.

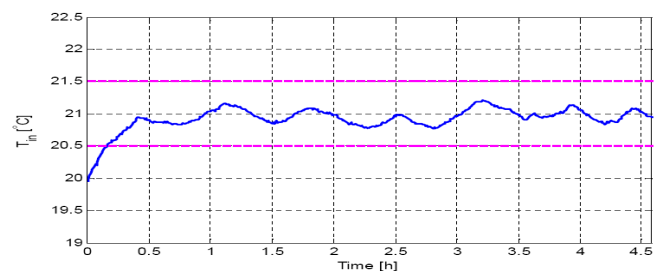


Fig.3 Controlled Indoor Temp regarding to a Set-point

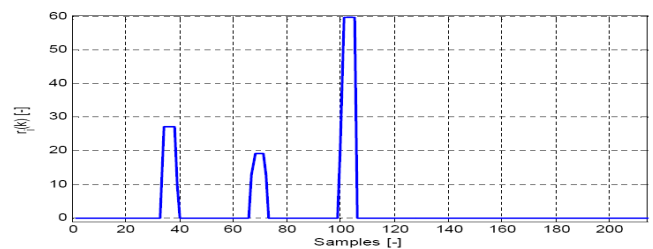


Fig.4 Residuals Generated due to Actuator Faults



Fig.1 Testing Facility in Syvsten, Denmark

2. STRATEGY

The Model Predictive Control (MPC) strategy is employed for the control development, and the model based parity space method is employed for the fault detection and diagnosis in case of actuator/sensor faults. The developed control module is tested on a real-sized stable system, as shown in Fig.1.