Model Predictive Control of Batch Production in Livestock Stables

Project Background

SKOV A/S is the world's largest manufacturer and developer of ventilation systems for livestock ventilation. Our existing product suite is limited to climate control, data acquisition and monitoring, but we are currently looking into using data to optimize the efficiency and animal welfare of livestock batch production by providing improvements to the climate control references.

This project is limited to optimization of broiler production, chicken for human meat consumption, as it is mature and developed in terms of data acquisition. Under optimal conditions it is possible to grow a 2050g broiler in just 34 days using 3132g feed. To aid the farmer, we continuously measure bird weight, cumulative feed and water consumption and regulate temperature, relative humidity, CO2 and lighting. It is up to the individual farmer to provide the optimal references for their local configuration – which separates the thriving and surviving broiler farmers!

Project Content

The main goal of this project is to further aid the broiler farmer by developing a black or gray box model based on production data and apply model predictive control (MPC) to lower the feed conversion rate (FCR = Animal Feed/Animal Weight) by regulating one or more climate control references – such as temperature as depicted below.
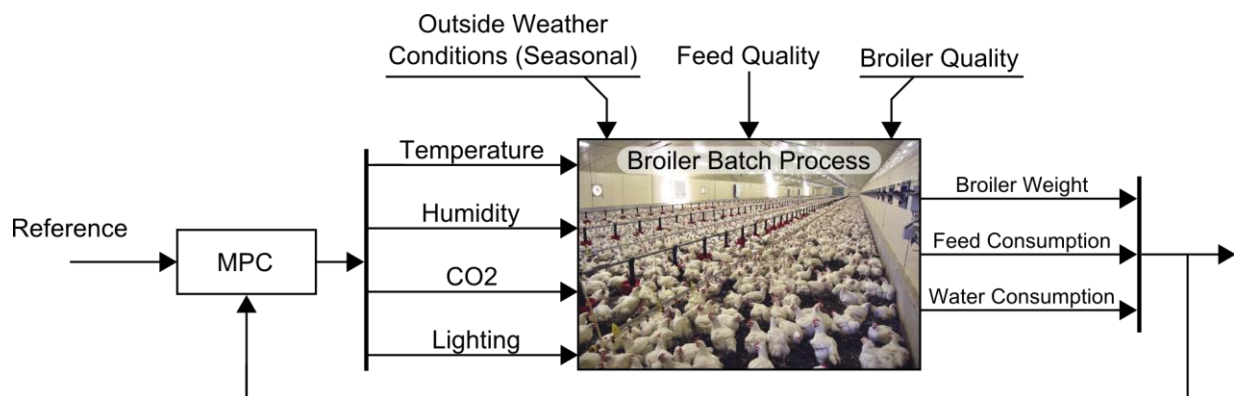
Since batches run for a minimum of 34 days, it is unlikely that proposed solutions can reach sufficient maturity to be tested on a live broiler stable within a single project period. Hence, a one-semester project during the fall is most likely going to be a simulation study. However, we offer the opportunity to engage in a long Master's Thesis project as well, during which live testing will be feasible and the method can be further refined. For instance, you might explore the benefit of using more advanced modeling techniques (e.g. linear parameter varying model) or control techniques (e.g. iterative learning control).

Practical Information

We have already prepared 2+ years of production data from 4 broiler houses distributed on 2 farm locations for you to work with in csv and mat (matlab workspace variables) files. The hardware development can be limited to sending an email to the farmer with your new tabulated climate control reference. To be a little cautious it must be approved by a (risk willing) SKOV A/S broiler application expert.

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