Title: Informed Machine Learning on Sparse Data and Information in the context of barn climate and emissions

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Abstract:
Livestock plays an important role for the supply of high quality food and has a high economic and social relevance. However, it is also a significant contributor of pollutants, which negatively affect our environment and health (e.g. greenhouse gases, ammonia, airborne pathogens). There is an urgent need to mitigate these pollutant emissions. To do so, accurate measurements of emissions and barn climate are a fundamental requirement.

Due to extensive costs, actual measurements are usually limited to only few sensors inside and around livestock housing systems. The measured variables are non-linear and show a high temporal-spatial variability. This leads to large information gaps between the sensors and therefore to high uncertainties in the measurement results.

The goal of this project is to overcome these limitations by combining different approaches and sources of information. Computational fluid dynamics (CFD) will be applied for a variety of boundary conditions to generate ground truth information. This information will be used in a hybrid Artificial Intelligence (AI) approach, where data-driven as well as informed machine learning will be applied, making use of the provided domain knowledge, e.g., via CFD and the respective simulations. The AI will then be coupled with the sensor data with the goal of generating most accurate data on emission and barn climate in real time.

After validation, the combined approach will be applied on a larger number of housing systems, thus further enabling the discovery of new knowledge and previously unknown correlations using data science and machine learning approaches.