Automated Detection of Chronic Pleurisy in Pigs & Validation of Computer Vision Outputs

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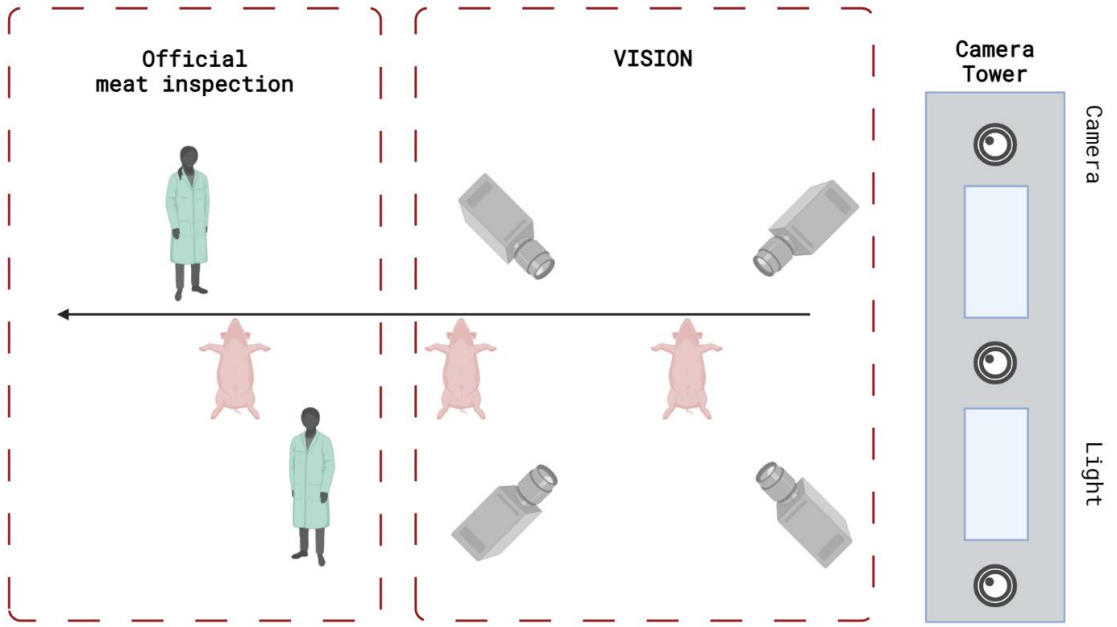
Background: Chronic Pleurisy

- A **common** post-mortem (PM) lesion found **in finishers**
- High proportion of cases indicates **poor respiratory health**
  - Enables farmers to take action
- **Abattoirs** can use these findings to **document product quality** of spareribs
- **In DK, healed cases of chronic pleurisy not considered relevant** in the official meat inspection **since June 2025**

Source: Colourbox

Background: The Computer Vision System (CVS)

- In DK, there is a CVS implemented **at the largest Danish abattoir**
- The Danish Technological Institute is **using three** Convolutional Neural Network **architectures**
- The system uses 16 individual images (eight from each carcass half) to detect chronic pleurisy



Source: Lund et al (2025)

Objective

Evaluating the Performance of 3 Convolutional Neural Networks in Detecting Chronic Pleurisy Compared to Meat Inspectors

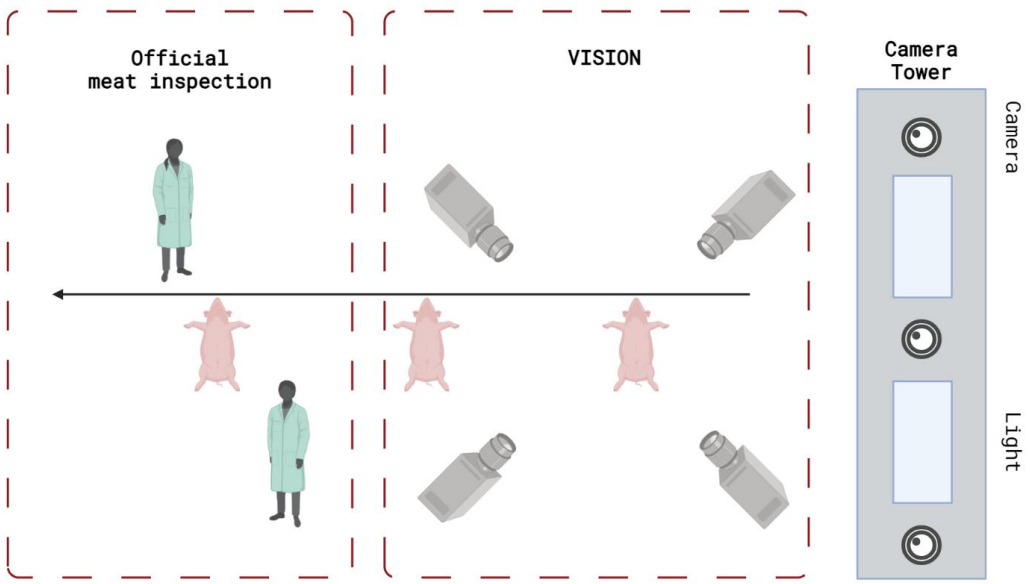
Source: Colourbox

Materials & Methods: Dataset

- Abattoir register data
  - **11 official meat inspection codes**
  - **85,413 CVS assessments** of **pig carcasses**

- **Meat inspection codes** recorded by meat inspectors **matched with CVS results using carcass ID**

- **CNN architectures** evaluated:
  - CVS152 Complex-StandardRes
  - CVS-Complex-HighRes
  - CVS-Simple



Source: Lund et al (2025)

Materials & Methods: Statistics & Validation

- **Bayesian latent class model (BLCM)**
  - Meat inspector and CNN: diagnostic tests
  - Each day: population (n=15)
  - **Sensitivity (Se), Specificity**
  - **True prevalence of chronic pleurisy**

The runjags package

Matthew J. Denwood (2016)

- **BLCM** model run on each CNN output
  - **Three separate model runs**

- **Model validation:**
  - **Assess model assumptions** (constant Se, Sp, varying prevalence - across 15 populations/days)
  - Convergence & sensitivity analyses

Results: Which is the best CNN?

	CVS		Meat Inspectors	
CVS model	Sensitivity	Specificity	Sensitivity	Specificity
CVS-Complex-HighRes	90.3% [89.0%-92.3%]	97.8% [96.9%-98.9%]	79.4% [74.8%-83.7%]	99.8% [99.5%-100%]
CVS-Complex-StandardRes	84.7% [82.9%-87.6%]	97.9% [96.0%-98.1%]	82.0% [76.6%-87.5%]	99.7% [99.2%-100%]
CVS-Simple-UltraRes	89.9% [88.8%-91.7%]	97.6% [96.7%-98.5%]	83.0% [78.6%-87.6%]	99.9% [99.6%-100%]

Source: Lund et al (2025)

- **CVS** exhibited a **superior median sensitivity** regardless of model
- **Specificity of meat inspectors close to 100%** whereas of CVS models ~98%
- **Complex-HighRes** with the highest resolution – **performed best!**

Conclusions

- **Latent class modelling** offers a robust & flexible **framework for evaluating** CVS **performance without the need for a gold standard**
- Lower Se of meat inspectors compared to the CVS models suggests **CVS** would **improve the ability to detect chronic pleurisy**

Source: Colourbox

Why is this work important?

Different CVS for use in meat inspection have been presented to the **EU Commission's Expert Group on Food Hygiene and Control of Food of Animal Origin**

- **Remote AM inspection of bovines** (3 February 2025)
- Similar to the present work, **detection of fecal contamination** (23 May 2025)
- **CVS work on poultry** (most recent, 2nd time, 7 November 2025)

Requirements for allowing CVS as part of meat inspection should be:

- CVS is **validated, e.g., using latent class modeling**
- **Validation** should **show acceptable results** compared to the existing meat inspection
- Results should **be published** in a peer-reviewed journal
- Next, pilot **projects or national adoption projects** can be undertaken

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Comparing computer vision models for detecting chronic pleurisy in pigs

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Using latent class modelling to evaluate the performance of a computer vision system for pig carcass contamination

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THANK YOU FOR YOUR KIND ATTENTION