Precision Livestock Farming for Animal Health, Welfare and Production
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**Precision Livestock Farming**

*The application of the principles and techniques of process engineering to livestock farming to monitor, model and manage animal production*
Farmer’s view

Sustainable livestock production requires tight product specification to be met profitably by skilled stockmen with minimal environmental impact and a high standard of health and welfare …

Consumer’s view

…… food must be safe, tasty and cheap
ISAH 3

Light Activity Model

\[ y(k) = \frac{B(z^{-1})}{A(z^{-1})} u(k - d) \]

PLF
Control of livestock processes

- FEED
- ENVIRONMENT
- PRODUCTS
- POLLUTANTS
- BEHAVIOUR
- MODEL
- TARGET & TRAJECTORY
- FEEDBACK
- MODEL-BASED CONTROLLER
Where’s the chequered flag?

Lewis Hamilton
Heat production of broilers following step changes in temperature (36 to 18 °C) and light intensity (0 – 36 lux)
Aerts et al, IFAC-CAEA workshop, 1998
Targets and Trajectories
## Applications of PLF in broiler farming

<table>
<thead>
<tr>
<th>Input</th>
<th>Process</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed quantity</td>
<td>Growth</td>
<td>Weight</td>
</tr>
<tr>
<td>Light intensity</td>
<td>Behaviour</td>
<td>Activity and rest</td>
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<tr>
<td>Absolute humidity</td>
<td>Ammonia emission</td>
<td>Litter water activity</td>
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Lessons from The Pioneers of PLF

**FLOCKMAN™**
- Monitoring feed intake and bird weight
- Novel diet blending
- Environmental management
- Control of food supply

**Silsoe PLF**
- Video imaging of pig size
- Models of growth, food intake and carcass composition
- Control of food supply

**Aerts and Berckmans**
- Platform weigher for broiler weight
- Dynamic predictive model of growth
- Automatic control of food quantity

**Common lessons**
- Growth – First application
- Poor commercial success
- Insufficient development
- Software too sophisticated

Too far, too soon?
Linear approach or Egg-timer?
“Monitoring and control in livestock production is relatively undeveloped compared to most industries” Frost et al., 1997
SMART Workshop 2006
Sensors for Livestock

Cattle
- Rumen pH & Blood & Milk fat
- Temperature: rumen + vulva
- Lameness & Location
- Calving behaviour

Pigs
- Vocalisations & Activity
- Farrowing behaviour
- Growth & Body composition

Poultry
- Birds: Liveweight
- Eggs: Temperature + albumen
  + Ph + Nitric oxide release

Sponsors:
- Fancom, Petersime
- and De Laval
You can’t fatten a pig by weighing it
Reasons why electronic monitoring is uncommon on livestock farms

1. Lack of involvement of manufacturing companies and unclear specifications
2. Lack of proving trials at farm scale with full scale demonstration
3. Unknown market demand by farmers

But……
Pieces in the agricultural jigsaw

- Production
- Environment
- Economics
- Food safety and quality

A licence to farm?
Automatic monitoring

On the farm

- Pollutant emissions
- Zoonoses
- Markers of meat quality

During transport and at the abattoir

- Welfare
- Texture and tenderness
Barriers for PLF to overcome:

Robust, low cost technology

Appropriately applied

Developed and demonstrated