Detection and characterization of the response of growing pigs to perturbations by using feed intake
(A modelling approach)

Hieu Nguyen Ba, Masoomeh Taghipoor and Jaap van Milgen
INRA (PEGASE & MoSAR) – France

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1. Introduction

Robustness:

- Attempts were made:
  - Heat Tolerance\(^1\)
  - Disease resistance\(^2\)
- Includes multiple elements\(^3, 4\):
  - Response to and recover from perturbations
- Complex & difficult to quantify

\(^1\)Renaudeau et al., 2012, \(^2\)Guy et al., 2012, \(^3\)N.C. Friggens et al., 2017, \(^4\)I.G. Colditz and B.C. Hine, 2016
Daily feed intake can be recorded automatically and frequently.
1. Introduction

Objectives:

Develop a generic model to:

- Detect perturbations
- Quantify the response:
  - Resistance
  - Resilience
- Uses daily feed intake as (the only) response variable
2. Detecting perturbations

![Graph showing cumulative feed intake vs. age in days]

Cumulative feed intake, kg

Age, d

30/08/2018
2. Detecting perturbations

The origin of a perturbation is not always known...

...but the response of the pig can be observed
Adapting the feed, the animal and the feeding techniques to improve the efficiency and sustainability of monogastric livestock production systems

2. Detecting perturbations

Target trajectory of feed intake that the pig desires to consume
2. Detecting perturbations

Fit a quadratic function to CFI data
2. Detecting perturbations

Temporarily exclude data with negative residuals
2. Detecting perturbations

Fit again the quadratic function to new dataset
2. Detecting perturbations

Temporarily exclude data with negative residuals
2. Detecting perturbations

Fit again the quadratic function to new dataset

Cumulative feed intake, kg

Age, d

30/08/2018
2. Detecting perturbations

Temporarily exclude data with negative residuals

Cumulative feed intake, kg

Age, d
2. Detecting perturbations

Fit again the quadratic function to new dataset (Stop)
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2. Detecting perturbations

Fit the chosen function to all data

Cumulative feed intake, kg

Age, d

0 50 100 150 200 250

0 80 100 120 140 160 180 200

Observations
Data used to estimate the target
Target trajectory

30/08/2018
3. Modelling the response to a perturbation

\[
\text{Actual DFI} \quad \downarrow \quad \text{Actual CFI} \quad \downarrow \quad \text{Target DFI} \\
\text{Perturbation} \quad \downarrow \quad \text{Resilience and Compensatory feed intake} \quad \downarrow \quad \text{Target CFI} \\
\]

Ratio
Adapting the feed, the animal and the feeding techniques to improve the efficiency and sustainability of monogastric livestock production systems

3. Modelling the response to a perturbation

Actual DFI = Perturbation

Actual CFI

Target DFI

Target CFI

Resilience and Compensatory feed intake

Ratio

30/08/2018
3. Modelling the response to a perturbation
Adapting the feed, the animal and the feeding techniques to improve the efficiency and sustainability of monogastric livestock production systems.

3. Modelling the response to a perturbation

Results:

<table>
<thead>
<tr>
<th>Change in Daily Feed Intake (%)</th>
<th>0%</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, d</td>
<td>65</td>
<td>85</td>
<td>105</td>
<td>125</td>
</tr>
</tbody>
</table>

- **Resistance (-80%)**
  - \( f(\text{perturbation, animal}) \)

- **Resilience (2.3)**
  - \( f(\text{animal}) \)

**Target**

- Start (85.4) \( f(\text{perturbation}) \)
- End (132.0) \( f(\text{perturbation}) \)

30/08/2018
3. Modelling the response to a perturbation

Results:
4. Discussion and conclusion

The model:
- Is able to detect perturbations from changes in feed intake
- Quantifies resistance and resilience

The future?
- Compare the response of pigs in the same environment
- Estimate heritability of resistance and resilience
Adapting the feed, the animal and the feeding techniques to improve the efficiency and sustainability of monogastric livestock production systems

THANK YOU FOR YOUR ATTENTION

hieu.nguyen-ba@inra.fr