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# Identifying and characterizing disturbances from high-throughput phenotyping data

Vincent LE, Tom ROHMER, Ingrid DAVID

## Introduction

Precision farming systems:  
Longitudinal data



Qualify the robustness  
(response to disturbances),  
need to know the nature of  
disturbances



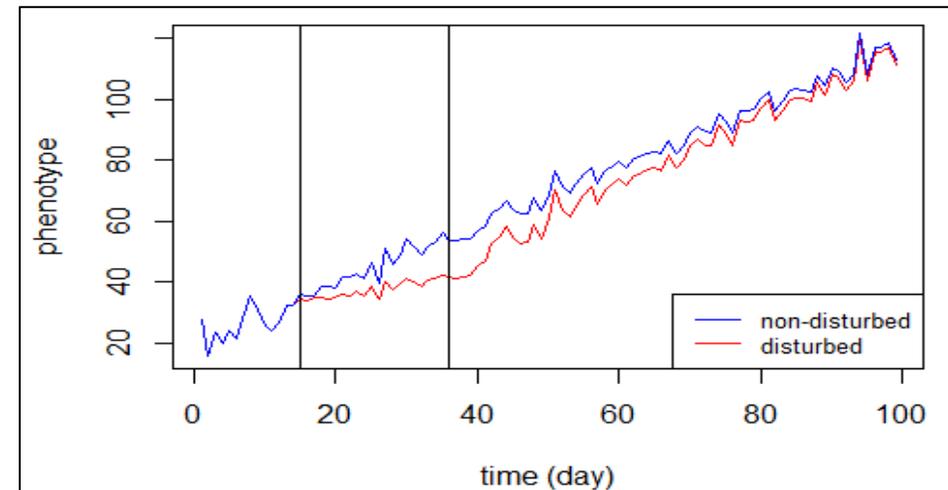
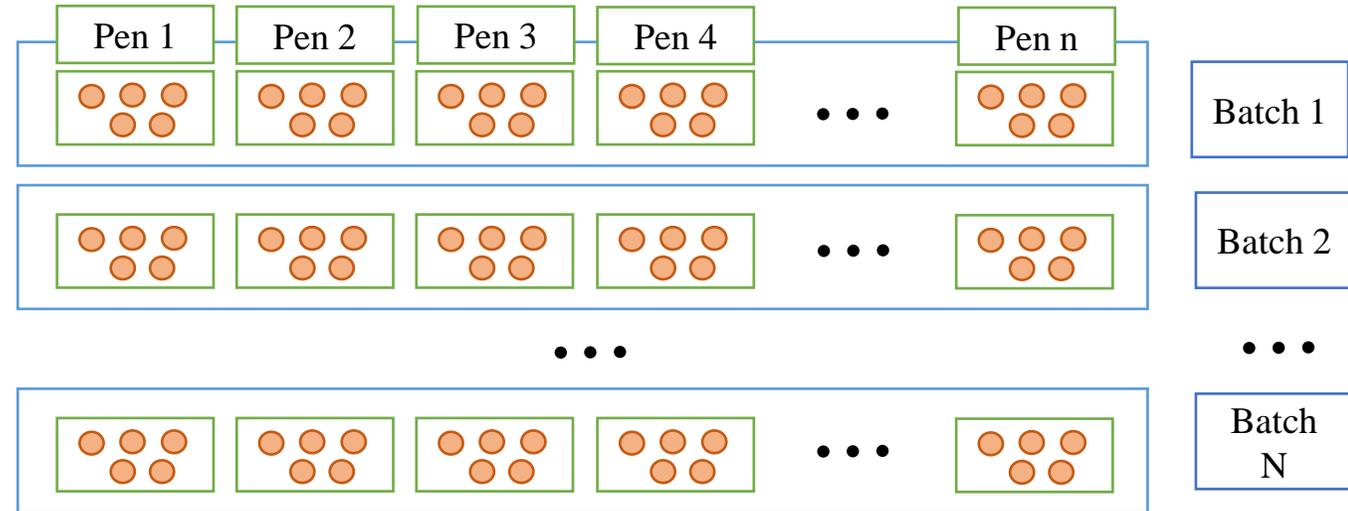
Disturbance unknow



### Up & Down Method

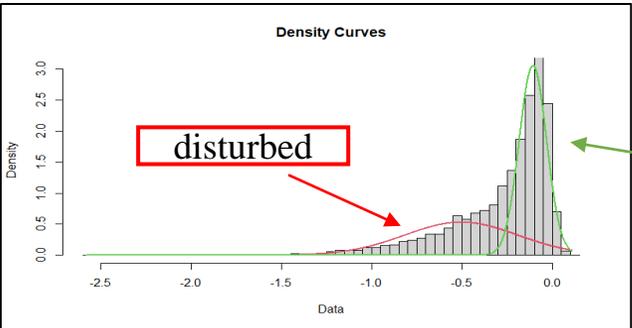
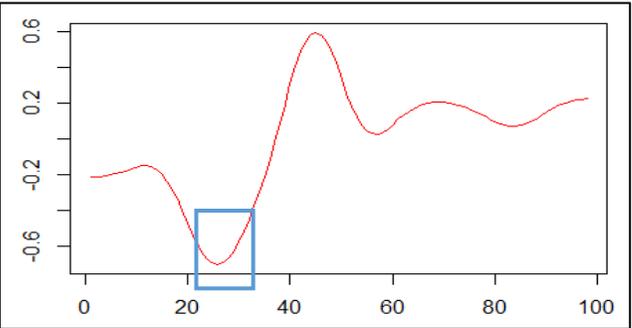
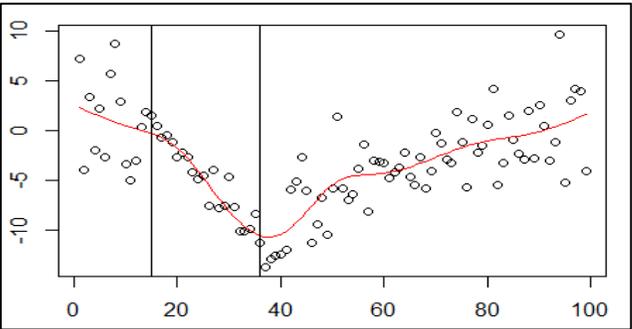
(On the data of individuals which are distributed  
in different batches and pens)

- Identify disturbances in different level
- Characterize and validate disturbances detected



# Method Up & Down

Corrected phenotype



Smoothing

Extract the minimum of the slope (first derivative)

Mixture model to separate in 2 populations

UP

DOWN

Batch (Median of pens within batch)

Batch



Pen (Median of individuals within pen)

Pen

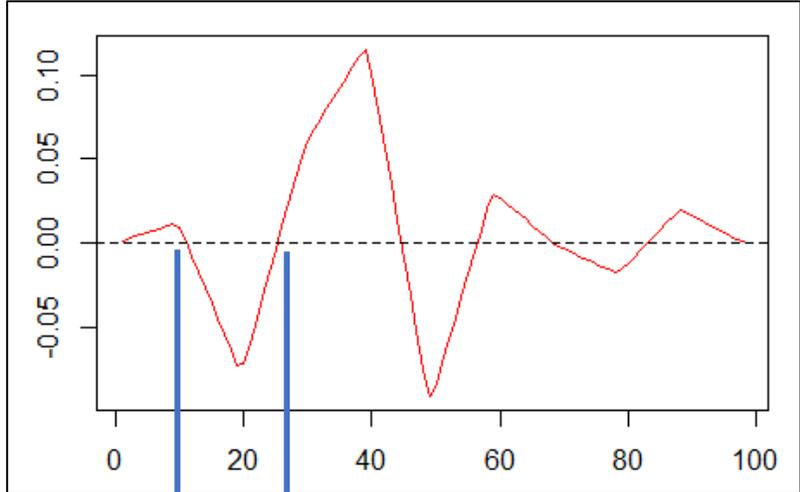


Individual

Individual

Detect the moment of the disturbance(s) that the pen (or individual) had to face thanks to the second derivative combined with the value of the slope at that time

Second derivative



Moment of perturbation 1

Moment of perturbation 2

This part allows:

- To validate detected disturbances
- To show the number of disturbances that the element had to face



# Results

Qualification – Non-parametric smoothing method Nadaraya-Watson  
(300 simulations)

|            | Specificity | Sensibility |
|------------|-------------|-------------|
| Batch      | 0.98        | 0.9         |
| Pen        | 0.92        | 0.71        |
| Individual | 0.96        | 0.39        |

- **Sensibility:** the probability to detect an element when it is really disturbed
- **Specificity:** the probability to not detect an element when it is really not disturbed

## Simulations

- 20% of perturbation in each level (individual, pen and batch)
- Intensity of a disturbance varies from 0.5 to 2.5
- Duration of a disturbance varies from 1 to 25 days



## Others tested strategies to identify disturbed animals/pens/batches

- Work on Residuals (Variance & Autocorrelation & Symmetry)
- Work on Coefficient of variation

# Conclusion & Perspectives

- The Up & Down method is promising for simulated data
- Work on real data