Using accelerometers for goat activity monitoring

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Using Accelerometers for goat activity monitoring

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Predicting behavior from acceleration signal

- **Objective:** study the link between behavior and parasitism
  - Does behavior changes during infestation to gastrointestinal intestinal nematodes?
  - Does behavior influences the risk of parasitism ingestion?
- Need to collect individual behavioral information, on the long term:

  \+ Accelerometers are well suited for individual data collection.

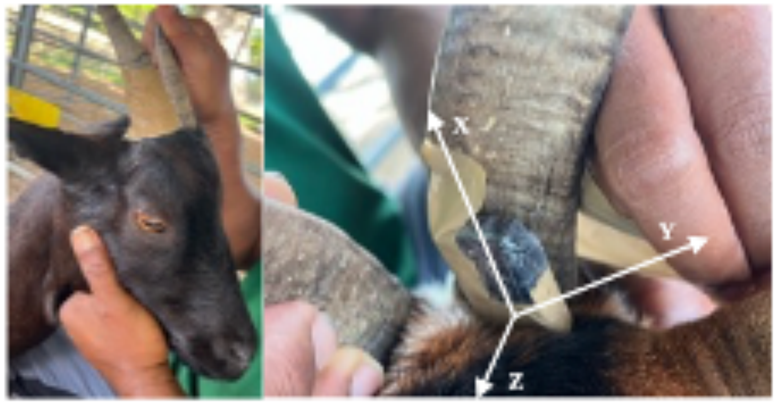
  \- No universal method to predict behavior from acceleration.

➡ Development of :

1. A sharable dataset of annotated acceleration data.
2. A hierarchical LSTM model to predict behavior.

Dataset creation : experimental setup

1. Set up animals with accelerometers on the left horn.



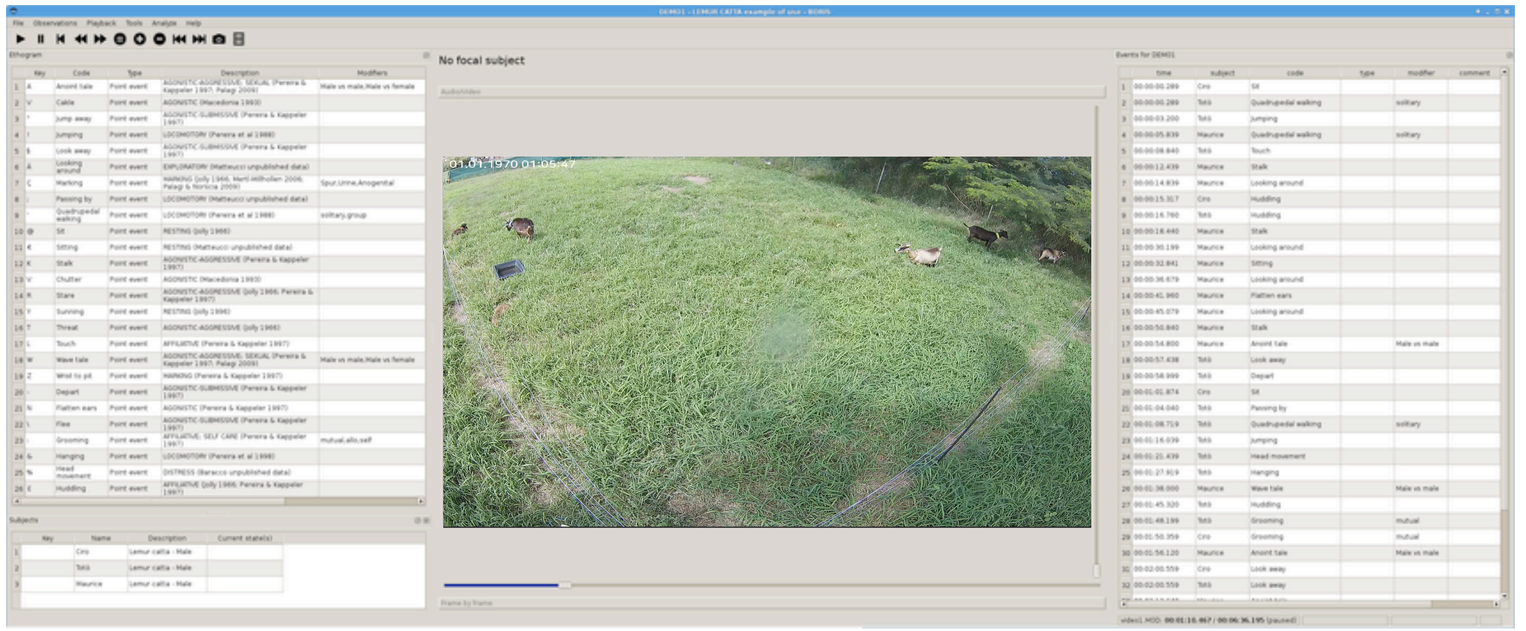
- Accelerometers AX3 from Axivity.

2. Record behavior with a camera

- Experimental paddock 20 x 10 m.
- 2 to 5 adult lactating or pregnant Creole goats.
- Free to graze for 6 to 8 hours.
- Animals are changed every day.

Dataset creation : experimental setup

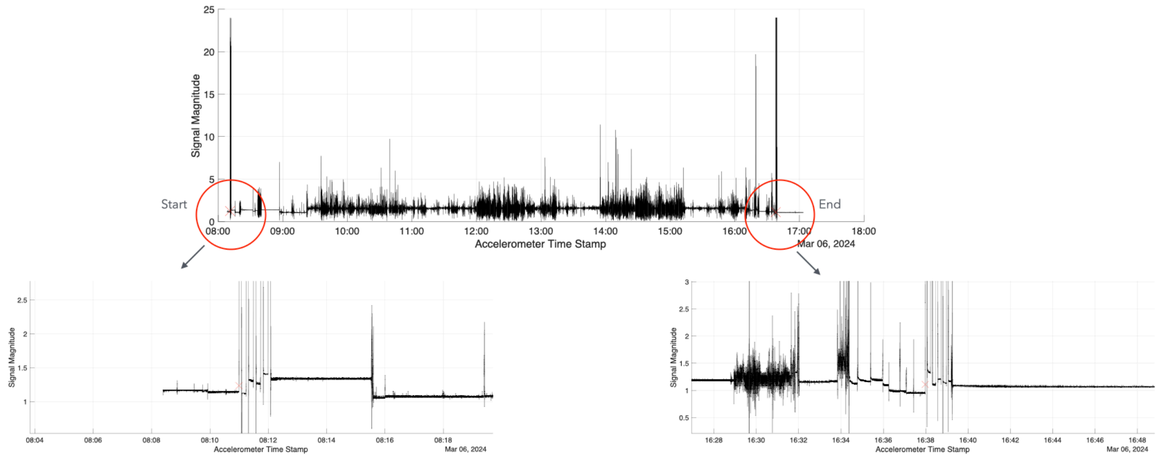
3. Use Boris to watch the videos and record the associated behavior for each animal



- Five behaviors:
  - Grazing, Displacement, Ruminating/Chewing, Resting, Other (bleating, social, scratching…)
- Annotation only when possible:
  - Identification of the animal and behavior.

Dataset creation : experimental setup

4. Time synchronization between accelerometers and video frames



4.1 Synchronize camera to UTC time:

- Film smartphone time connected to internet.

4.2 Synchronize accelerometers to UTC time:

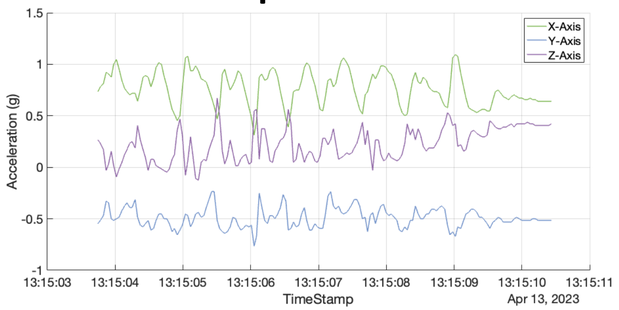
- Create a distinctive acceleration pattern.

4.3 Account for time drift:

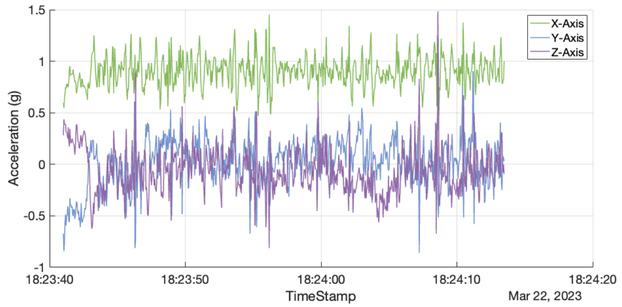
- 1h of sensor records are not necessarily one hour in reality…
- Compute and add drift to the sensors time.

Final dataset : some examples

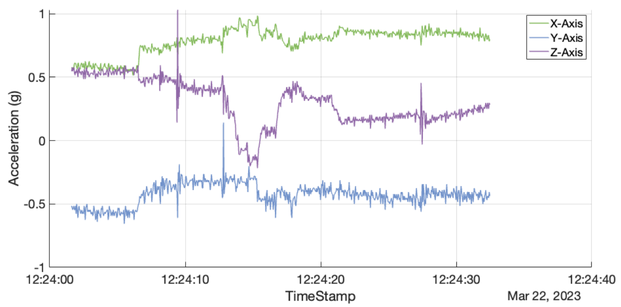
Displacement



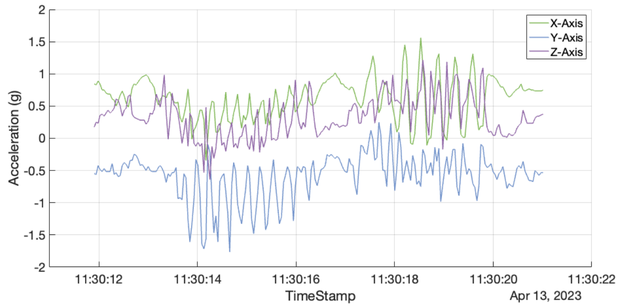
Grazing



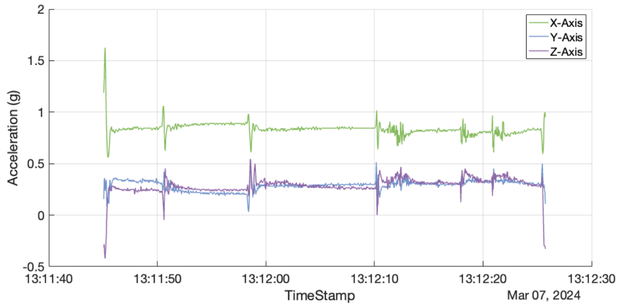
Ruminating/Chewing



Other



Resting



Final dataset

- 144 hours of annotated videos.
- 59 different animals.
- High heterogeneity of labelling time and sequence duration….
  - Had to be accounted for when designing the prediction method !

Behaviors	Cumulated time (h)	Mean sequences duration (s)
Displacement	0.61	7.03
Grazing	67.67	32.93
Ruminating / Chewing	10.58	29.73
Other	6.23	9.23
Resting	59.55	42.2

- Sharable dataset:
  - Data paper submitted to Data In Brief

Behavior prediction: Challenges

- Long Short Term Memory (LSTM) neural networks are well suited for prediction using time series.
- High heterogeneity of behavior sequences:
  - Difficult to use one model suited for all behavior type.
  - Development of a hierarchical model.

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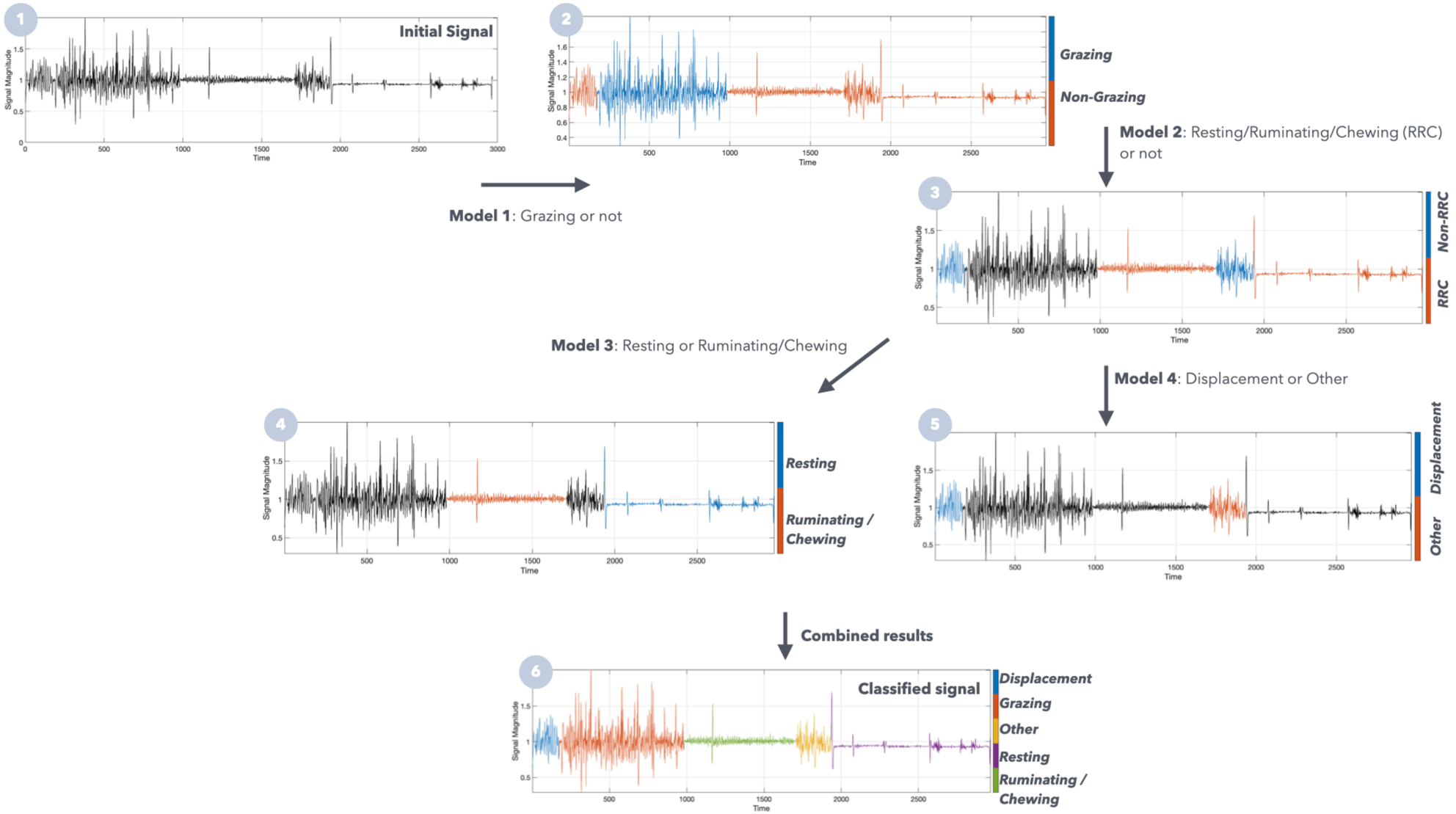
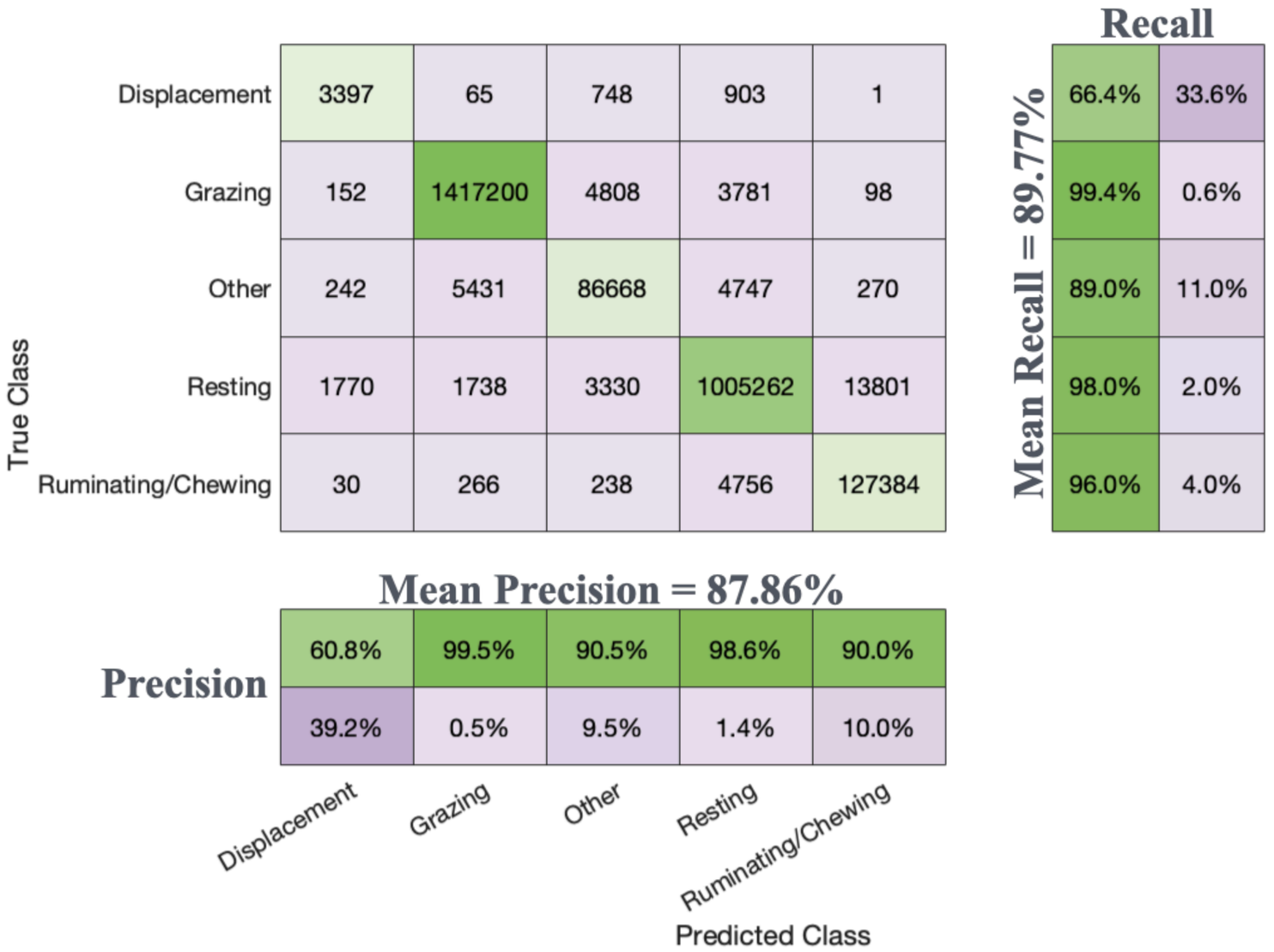
Hierarchical LSTM model for prediction



Hierarchical LSTM models for prediction

- 7 animals for test (21%).
- 52 animals for training (79%).



Hierarchical LSTM models for goats behavior prediction

Thank you !

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