



Gembloux Agro-Bio Tech
Université de Liège

Le Corps professoral de
Gembloux Agro-Bio Tech - Université de Liège vous prie
de lui faire l'honneur d'assister à la défense publique de la dissertation originale que

Monsieur ANDRIAMANDROSO Andriamasinoro Lalaina Herinaina,

**titulaire d'un diplôme d'ingénieur agronome, option élevage,
titulaire d'un master en sciences agronomiques et industrie du vivant,
à finalité approfondie,**

présentera en vue de l'obtention du grade et du diplôme de

DOCTEUR EN SCIENCES AGRONOMIQUES ET INGENIERIE BIOLOGIQUE,

le 24 avril 2017, à 10h30 précises (personne ne sera admis après cette heure),

en l'auditorium ZT1 (Zootechnie, bâtiment 1),

Passage des Déportés, 2 à 5030 **GEMBLoux**.

Cette dissertation originale a pour titre :

« **Cattle grazing dynamics under contrasted pasture characteristics at temporal
and spatial scales** ».

Le jury est composé comme suit :

Présidente : Prof. M.-L. FAUCONNIER, Présidente du Département AGROBIOCHEM,

Membres : Prof. J. BINDELLE (promoteur), Prof. F. LEBEAU (promoteur), Prof. Y.BECKERS,
Dr E. FROIDMONT (CRA-W), Prof. S. MAHMOUDI (UMons).



Abstract

Grassland constitutes an important and a low-cost food source for grazing livestock. Optimal management should consider both forage resource productivity and animal needs. For cattle, grazing is a normal behavior displayed in an attempt to eat the amount of forage to fulfill their nutritive requirements for maintenance and production. It is the most time-consuming activity of cows reared in pasture-based systems. With the increase of herd size, on one hand, farmers have been constrained to integrate innovative tools and techniques, such as milking robot, to improve the production system in particular to reduce the labor cost. On the other hand, such change might reduce time allocated for grazing on pasture. However pasture-based systems constitute a real pillar for sustainability as they are socially acceptable and environmentally profitable as they play an important role on ecosystem services and biodiversity provision. Studying grazing processes at individual level, which finally is the key point of animal-plant interactions, is a valuable research domain to enhance the knowledge about this mechanism and to feed decision support tools.

This thesis aimed at linking the changes in pasture characteristics to the grazing behavior of cattle in order to better understand the grazing strategy under different pasture characteristics and forage allowances. To allow an individual monitoring, sensor technology has integrated within farms and livestock researches to monitor many physical variables, inducing the emergence of precision livestock farming approach. Different types of sensors were designed, and already commercialized for some, primarily for physiological status detections such as heat, parturition or diseases. Grazing behaviors could be monitored using pressure, electromyography, acoustic or accelerometric sensors by classifying posture and movements of the animal into unitary behaviors (grazing, ruminating, resting, walking, etc.) and finer behavior such as chews and bites through jaw movements' detection. When compared to real observation, detection accuracies of these behaviors were variable according to the type of sensor, its position on the animal during data acquisition on pasture, the data recording frequency, the time-window and the method dedicated to the post-recording data analysis. State-of-the-art analysis demonstrated a great performance of accelerometers for unitary behaviors and bites detection.

An inertial measurement unit, integrating accelerometer, gyroscope and location sensors, was used for recording cattle movements during grazing at high sampling rate (100Hz). It allows a correct detection of grass intake and rumination behaviors with an average accuracy of 91% using 1-second time-window when calibrating and validating the detection algorithm.

Deeper analysis of accelerometric signal allowed us to detected bites and chews performed during grazing and ruminating. Effects of pasture heights on grazing bites characteristics were differentiated by a higher frequency when pasture is at a lower height. Finally when combined to geographical information, a similar pattern was observed for cattle grazing on the same spot confirming their herd movement during grazing in terms of bites location. Differences were visible under different pasture heights but not significant.

Such bites location, combined with continuous monitoring of cattle behaviors, through use of sensors, should be furtherly linked with more pasture characteristics, if possible with the same accuracy, and monitored on longer period in order to obtain a complete coverage of cattle grazing strategy and the effect of contrasted environment in order to purpose valuable tool for a better grazing management.