Working times classification through CAN-BUS data analysis

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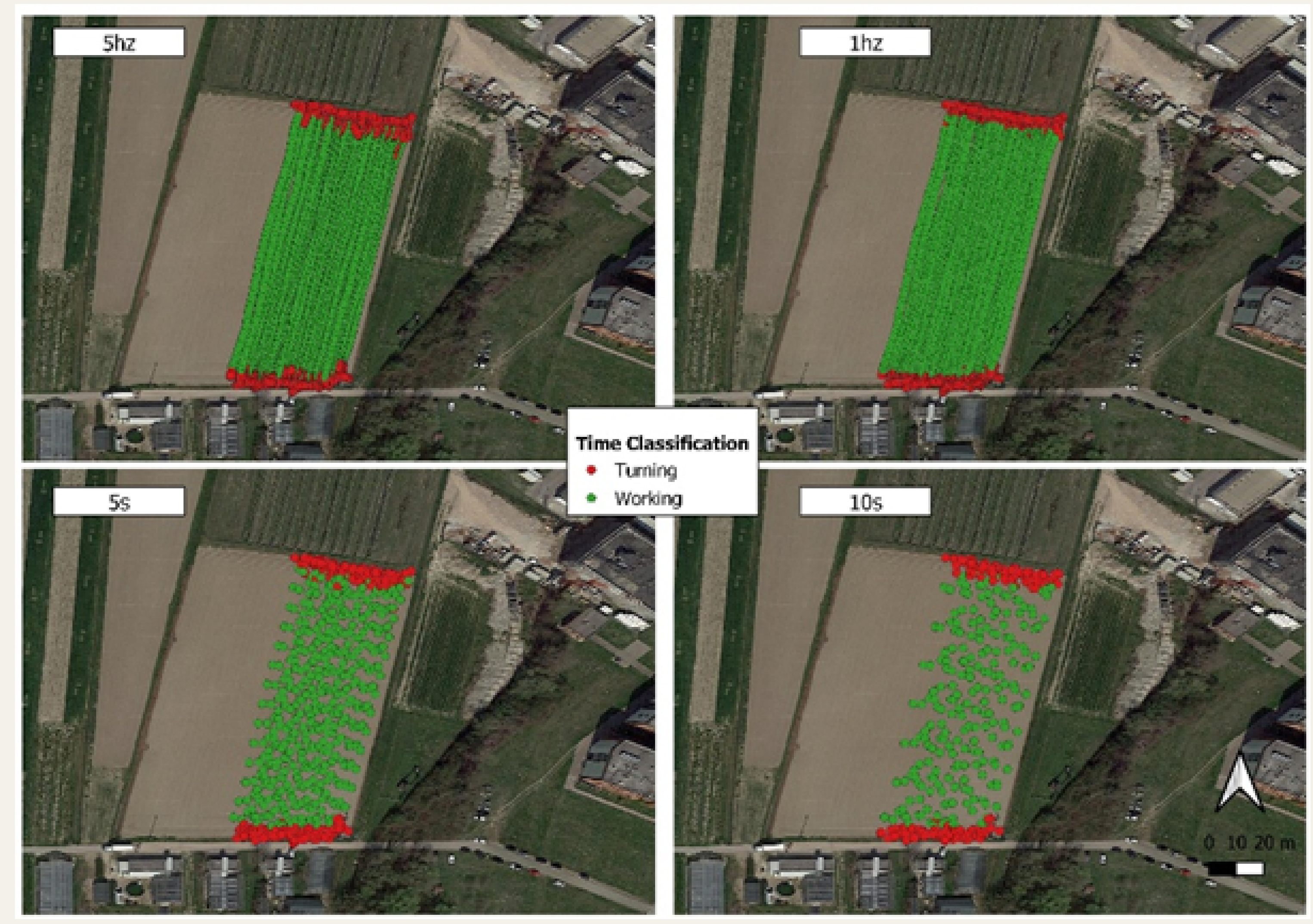
INTRODUCTION

With modern agricultural machinery, large amounts of data are produced during each operation by several sensors, but most of the time remain unused unless for very technical or specific reasons. Understanding the CAN (Controller Area Network) data has big potential, helping to improve the efficient use of different machinery in different working conditions and comprehend which is the most suitable approach to optimise the operations.

OBJECTIVES

- The first objective was to estimate working times classification by combining the data collected from the CAN and a GNSS module
- The second objective was to evaluate if all the data produced are necessary or if it is possible to slim down the list since many parameters are collected
- The third objective was to find the most appropriate sampling frequency of the data since they can be exported at different frequencies, influencing the amount of data in terms of megabytes produced
- In addition, another classification was performed using only the data coming from the GNSS module, in this case only Speed values, to check whether there was a difference between the classification performed with CAN + GNSS data and the one achieved with only GNSS



MATERIALS AND METHODS

- A ploughing operation was monitored in a 0.6 ha field of the experimental farm of the University of Padova
- the tractor used was a New Holland T7 165s (110kW) working with a two-furrow plough, equipped with a data logger to collect the data coming from the CAN and a GNSS module (CANedge 2, CSS electronics).

The logs of the operation were converted using the appropriate library and then resampled at different frequencies, respectively (5hz, 3hz, 1hz, 3s, 5s, 10s, 30s)

The classification was performed with Python using different algorithms, which allowed us to divide the sampling into two clusters: working time and turning time, then, the files were visualised using GIS software for a visual validation of the classification.

Working and turning times were also monitored by an operator in the headland. The time classification carried out by using the operator timestamps was used to train a random forest algorithm on the 5hz telemetry data, based on the parameters selected . The random forest algorithm was then used to classify data with different frequencies from the CAN and GNSS module.

RESULTS

The results showed no notable difference between the various sampling frequencies obtained with the combination of data from the CAN+GNSS.

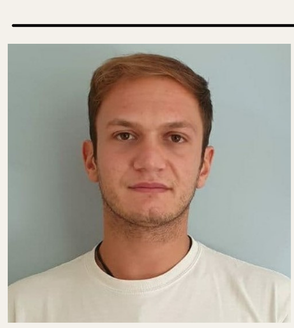
It is also important to mention that the results obtained using only the Speed from the GPS module are close to those produced with the CAN+GNSS.

CONCLUSION

According to the results, both methodologies are suitable for the classification of working and turning times during tillage operations; there is no difference between higher sampling frequencies, such as 5hz and lower, like 5s, indicating that is possible to achieve the same accuracy producing a lower amount of data, which are easier to process.

It is also interesting to underline that it is possible to perform the same task using only the speed data produced by any low-cost GNSS.

In future research, those aspects will be investigated, and the study will be extended to several tillage operations.



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ECPA BOLOGNA 2023

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