Improving Automatic Detection of Abnormal Milk

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State of the Art

When cows are milked with automatic milking systems or in high capacity milking parlors, milk quality cannot be checked sufficiently without sensors. The most commonly used parameters are electrical conductivity (EC), color of the milk and milk yield, mostly determined at quarter level. In order to get information from these measurements, relatively straightforward algorithms are used before alerts lists are generated. Subsequently, the farmer has to check or pay extra attention to the alerted cows or quarters. A major complaint, however, is that these alerts list produce far too many false-positive alerts.

Ways to Improve

In a large research project, we investigated different ways to improve the detection of abnormal milk. Firstly, different sensors that are available, but not always implemented in practice were used. Secondly, we tried to improve the use of the data generated by the sensors through improving the algorithms. Thirdly, other data that is available at the farm was used to see whether this will improve detection performance.

Adding New Sensors

Milk yield, color and EC can be measured in-line, i.e. in the milking tube, without taking away milk for the analysis, with relatively cheap sensors. Other sensors used for detection of abnormal milk, like somatic cell count (Whyte et al., 2004) or LDH (Chagunda et al., 2006) assessment need milk to be taken out of the milk stream and reagents to be added. Both milk and reagents are costs that must be taken into account for every individual sample. Using these additional sensors must therefore result in a sufficient increase of detection performance in order to be cost effective. We already showed that somatic cell count assessment at cow milking level improves detection (Kamphuis et al., 2008b). Another study on the additional value of somatic cell count assessment at quarter level revealed that it is, at least technically, superior to cow level assessment, even when combined with quarter level EC (Mollenhorst et al., unpublished data).

Improving Algorithms

Until now, most detection algorithms use the maximum or average value within a quarter milking. Furthermore, extracted variables are compared with previous milkings of the same quarter or with other quarters within the same milking. Limiting the descriptive variables to averages and maximum values, however, may exclude valuable information from the available data patterns (Norberg et al., 2004). A study by Kamphuis et al. (2008a) showed that more descriptive variables are related to abnormal milk and clinical mastitis (CM). Proper pre-processing of the available sensor data, therefore, seems an important part of developing

improved detection models for abnormal milk. In another study, we used decision tree induction on a large number of descriptive variables to detect CM and showed that these models are able to improve detection (Kamphuis et al., 2009).

Adding External Information

Somatic cell count history (monthly milk recordings), CM history, parity and stage of lactation influence the chance of CM and are, therefore, suggested to be useful for improving detection (Steeneveld et al., 2008). Chagunda et al. (2006) even used cow factors in their model for detection of CM, but the additional value besides currently used sensor data is still under investigation. First results indicate that this additional value is limited (Steeneveld et al., unpublished data).

What to Detect

When evaluating detection performance of sensors, it is always important to precisely define what milk you want to detect. Detection of CM for treatment requires other performance with respect to sensitivity and specificity than detection of abnormal milk that has to be separated automatically in an automatic milking system. First results from an evaluation of different detection methods against different definitions of abnormal milk based on data from the same milkings will be presented at the conference.

Conclusions

Possibilities to improve detection of abnormal milk are still available. Some are already in the stage of implementation (e.g., improving algorithms); others still have to be further investigated. When evaluating new methods, however, it has to be clear which milkings you want to detect and what the costs and benefits are.

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