CONFfIDENCE: Contaminants in food and feed: Inexpensive detection for control of exposure

Near infrared hyperspectral imaging methodology as a control tool for the detection of ergot in cereals

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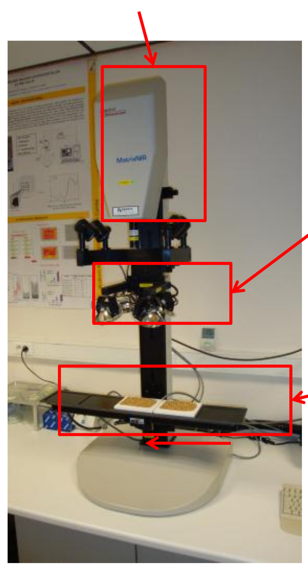
In the last years, hyperspectral imaging has proven its good performance for quality and safety control in the cereal sector. It allows the analysis at single kernel level, which is of great interest for cereal control laboratories. Contaminants in cereals concern, among others, impurities such as straw, grains coming from other botanical origins or insects but also undesirable substances such as ergot (sclerotium of *Claviceps purpurea)*. For the cereal sector, the presence of ergot involves high toxicity risk for animals and humans due to its high content of poisonous alkaloids. To reduce the risk of poisoning, European Directive 2002/32/EC on undesirable substances in animal feed fixed a limit of 0.1% for ergot in all feedingstuffs containing unground cereals. Regulation EEC No 689/92 restricted the concentration of ergot bodies in cereals for humans to 0.05%. Within the CONffIDENCE project (http://www.conffidence.eu), methodology was developed with the aim to detect and quantify the presence of ergot bodies in cereals using near infrared (NIR) hyperspectral imaging.

For this study, several instrumentation approaches (plane and line scan) and chemometric tools have been compared at laboratory level. Later selected methodology was transferred to an industrial setting for testing, validation and demonstration purposes**.**

NIR hyperspectral plane scan imaging system



NIR hyperspectral plane scan camera

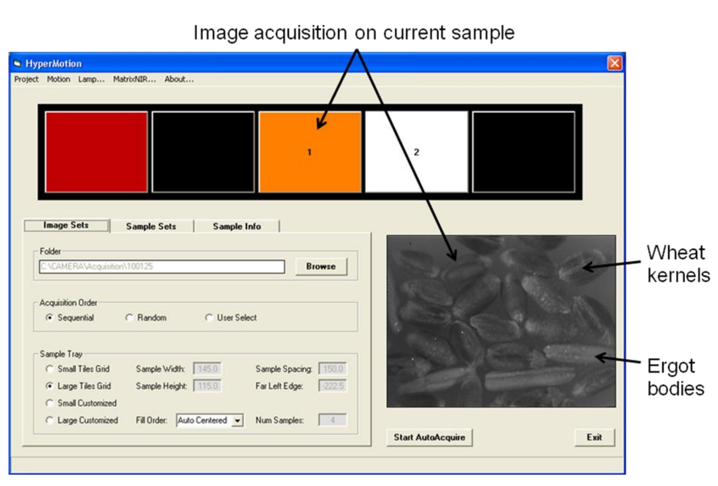
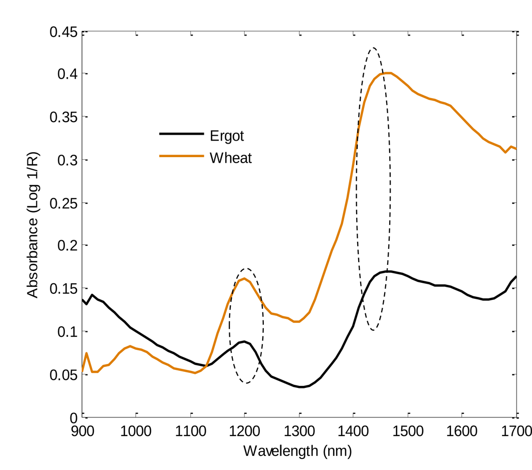
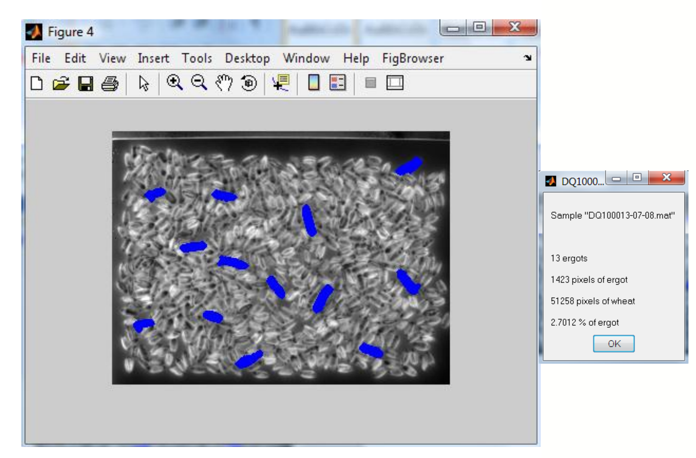


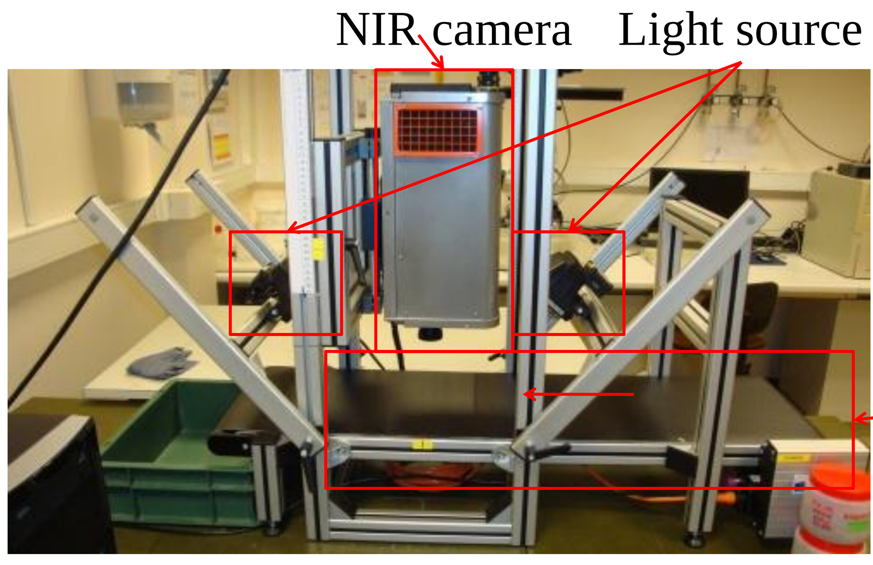
Image acquisition



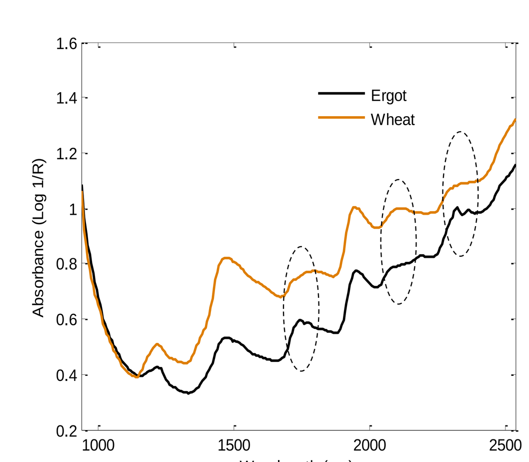


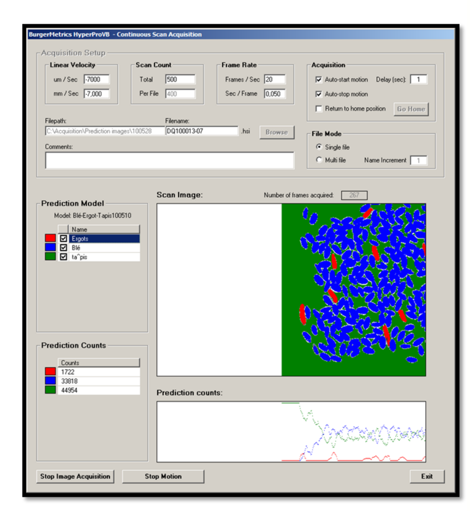
The first image shows the typical spectra for wheat kernels and ergot bodies. The second image shows the results of the prediction using a SVM (Support Vector Machine) discrimination model for a wheat sample adulterated with ergot. After applying the density-based clustering method (DBSCAN), wheat grains are in grey, ergot bodies in blue and background in black. The number of ergots and the number of pixels counted for each class of the model is also provided.

NIR hyperspectral line scan imaging system using a conveyor belt



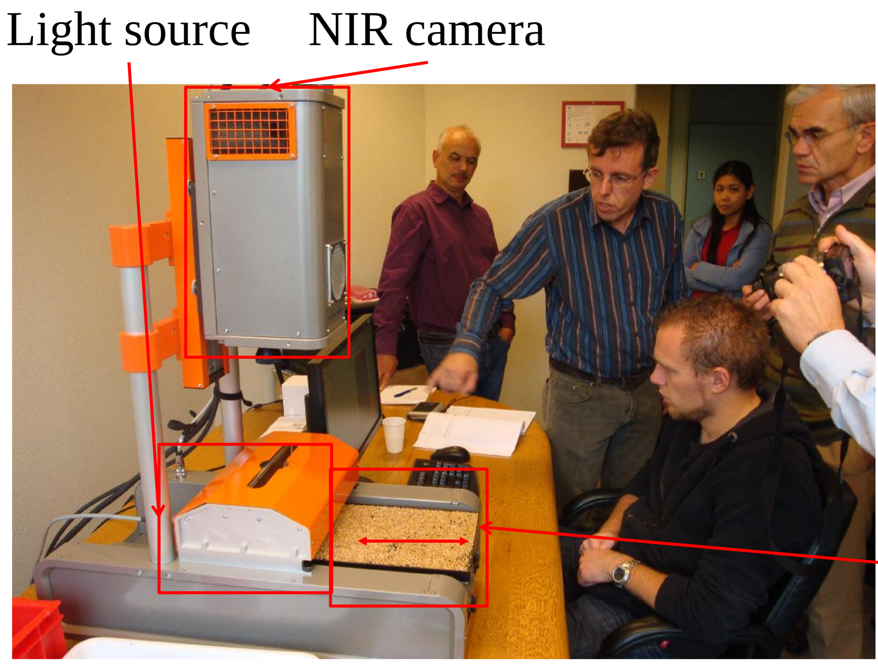
NIR hyperspectral line scan camera





The first image shows the typical spectra for wheat kernels and ergot bodies. The second image shows the analytical parameters used and the on-line prediction results of the PLSDA (Partial Least Squares Discriminant Analysis) model for an adulterated wheat sample on the conveyor belt. Wheat grains are in blue, ergot bodies in red and background in green. The number of pixels counted for each class of the model is also provided.

NIR hyperspectral line scan imaging system using a moving tray



NIR hyperspectral line scan camera tested at NUTRECO

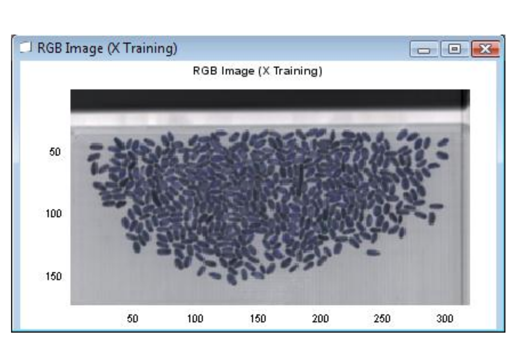
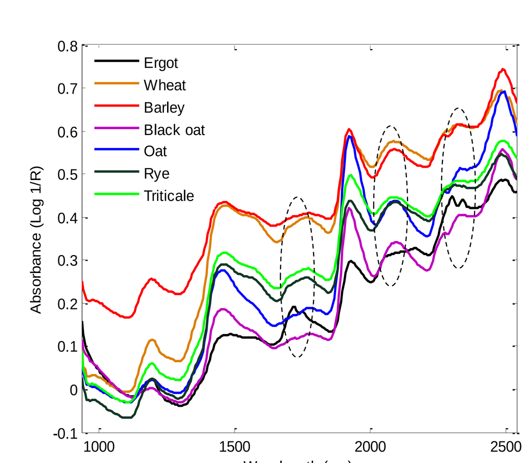
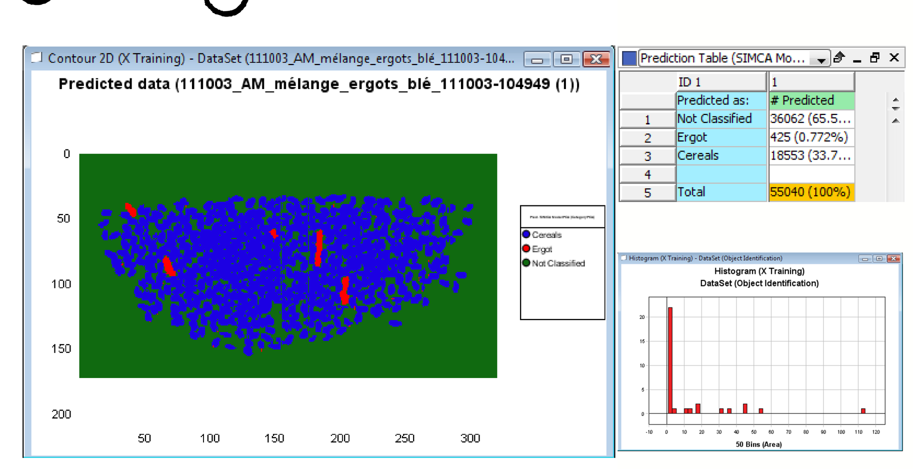


Image acquisition





The first image shows the typical spectra for several cereals kernels and ergot bodies. The second image shows the prediction results of the SIMCA (Soft Independent Method of Class Analogy) model for an adulterated wheat sample on the tray. Wheat grains are in blue, ergot bodies in red and background in green. The number of pixels counted for each class of the model and the distribution of groups of pixels detected as ergot are also provided.

Conclusion

The results obtained have shown that NIR hyperspectral imaging and chemometric tools can be used as control method to assess the presence and the quantity of contaminants such as ergot bodies in cereals, and that this methodology can be easily integrated in an automatic cereal control scheme. The instrumentation also allows multi contaminants detection.

References

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