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Digital Imaging for automatical Quality Assurance of Grain

The quality assurance of grain plays a major role in process of food-manufacturing. The acceptance of cereal in mills is based on a subjective visual inspection by a miller or a laboratory assistant. This kind of quality control is time consuming and error-prone. The manual analysis of elements in a grain sample is called “Besatz analysis of cereal” and is described in the ICC standard methods from the International Association for Cereal Science and Technology [1], [2]. The main fact of this method is to separate all groups of Besatz from the normal basic grains by sieving and manual selection. Besatz are all matters of a sample of grain which are other than the basic cereal of unimpaired quality. The unhealthy and noxious impurities (a part of the so called miscellaneous impurities), e.g. fungus-covered grain (in particular with fusarium) and ergot, have a specific relevance because of the negative effects of the metabolic waste products of fungi on humans and animals.

The aim of an automated digital imaging analysis of grain quality should be achieved with efficient, objective and fast optical analysis. An automated recognition routine for analysis of grain quality (especially vulgar wheat grain) was developed, especially the recognition and classification of normal basic grains and fractions of Besatz was investigated. Each fraction generates an object class (such as wheat, rye, stones,..). The automated analysis accomplishes a time saving of about 80 % compared to the manual analysis, using identical or even greater samples quantities. The confidence level increases significantly with greater samples quantities.

Two tasks, the recognition routine (software) and the technical concept (hardware) have to be solved [3]. This paper shows the technical concept, especially the investigations on hardware components. A precondition for a satisfying technical performance of the automated analysis is a good analyzable image. Images are captured with two colour line scan cameras from both sides during free fall (front and back). A combination of incident light and transmitted light was chosen for colour images. A 3-CCD colour line scan camera with divisor prism is generally most suitable for accelerated motion. But tests show that a cost-efficient trilinear colour line scan camera creates good analysable

images, too. A special method was developed to select the relevant image information out of the volume flow from the camera. The relevant image information the “single kernel images”, are extracted for the following recognition routine (see Figure 1 and 2). A wide sample-data-set is generated, which contains all object classes in a large number of object samples. All class samples should reflect the characteristic variety of the class. Many object classes from different cereal varieties (wheat, rye, durum, and oat), broken grains of wheat, different grain impurities of wheat, sprouted grains of wheat and different miscellaneous impurities were used in this work. During the recognition routine all properties of the objects (color, shape and texture features) are calculated and evaluated.

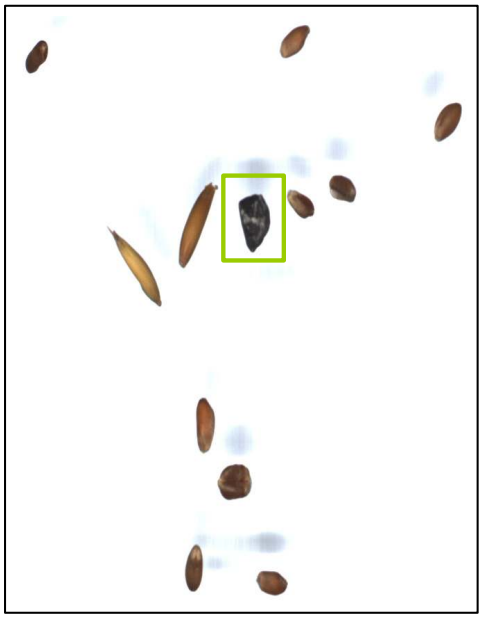

Figure 1: Online volume flow of the cereal sample in free fall under incident and transmitted light

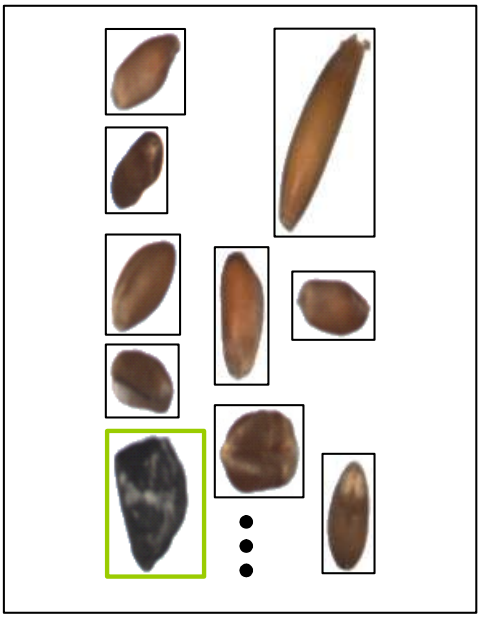

Figure 2: selected single kernel images

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