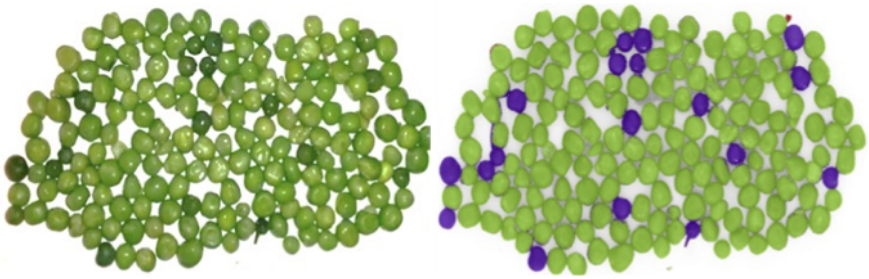
Classification and sorting

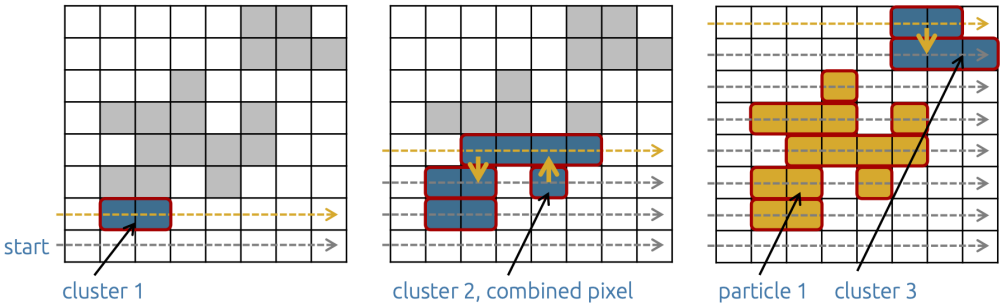
Detection and classification was one of the first applications of hyperspectral imaging in stationary use. Applications for plastics, ore/rock or food sorting are particularly well known. NIR and SWIR HSI systems are particularly suitable here, as chemical information is used for classification.



Classification example: solanum in peas

In addition, powder mixtures (e.g. purity, mixing ratios) can also be evaluated, the active ingredient content in tablets can be determined and the condition of impregnated wood (degree of coverage and localization) can be examined. The procedure is very similar to that of classic process analysis. When creating the model, the significant wavelengths are first determined using PCA (particularly high or low loading values on the first main components) and a variable selection is carried out. Based on this variable selection or the entire spectrum, a classification is carried out and the corresponding model is trained according to manually assigned classes (supervised learning). The methods of discriminant analysis (DA) and support vector methods (SVM) are often used. It should be noted that all statistical models have a certain accuracy (quality of model creation or probability that a spectrum is correctly classified) and the predictions made from them have a certain accuracy.

Depending on the sample size, several individual spectra per particle or sample piece can be classified for sorting tasks, thus increasing the accuracy of the classification.



Schematic of particle detection by line-by-line 'scan' of the classification matrix

The model quality and the number of spectra per sample can be used to calculate an overall statistical probability, which is also the quality of the sorting or the quality criterion of the process:

$$P = 1 - \left[\binom{n}{k}(1-p)^k p^{n-k}\right]$$

with P - total probability, p - individual probability (model quality), n - number of spectra per sample, k - number of spectra in a class

Further approaches and possibilities for recognition and improved classification also arise if parameters resulting from the evaluation of the spatial distribution of spectral features are also included in the creation of a classification model.

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