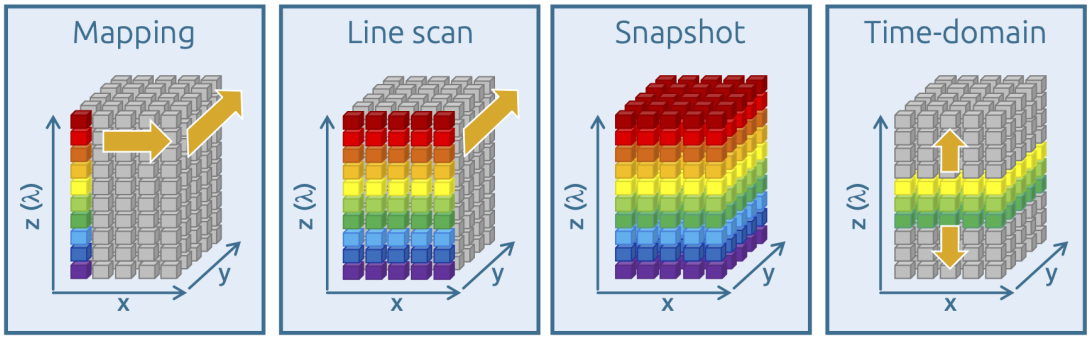
Introduction

Modern industrial processes require ever-improving optical inspection for the in-process evaluation and assessment of products. Over the past two decades, optical non-contact technologies have been developed which, under the collective term 'machine vision', have made a significant contribution to product or process evaluation. Nevertheless, many tasks remain unsolved, either because they could not be captured by grayscale or color cameras and are still assessed by trained employees using their eyes, or because only spectral single-channel sensors are used, for example, which cannot capture data from a larger area. Due to the increasing complexity in development and production, some requirements can no longer be solved satisfactorily with the existing methods of optical inspection and new approaches are required. One of these is (multi- or hyper-)spectral imaging. Integrated system solutions refer further to the industrial usage and are known commonly as Hyperspectral Vision.



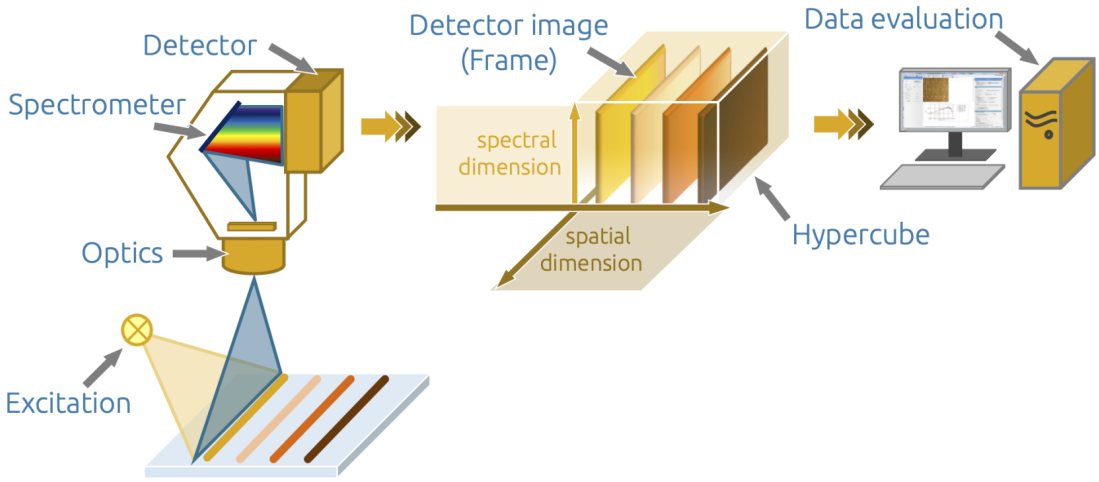
Spectral imaging options

Spectral imaging has been established since the late 1960s, initially in satellite and aircraft-based remote sensing (including LANDSAT missions, Sojus missions/MKF6). Whereas a few spectral channels were initially recorded through optical filters, over 1000 spectral channels can now be recorded simultaneously. With laboratory spectrometers, on the other hand, spectral images were assembled point-by-point by mapping when computer-aided analysis began in the 1980s. Today's systems work either by sequentially recording spectrally resolved lines (pushbroom imager) or by recording the complete, spectrally resolved image (snapshot imager).

In most cases, line scan systems can offer the higher spectral resolution (hyperspectral), while real imaging tends to work with a few spectral bands (multispectral). An exception is so-called 'time-domain imaging' or 'spectral scanning', in which the spectral image is recorded along the wavelength axis.
In German-speaking countries, a distinction is made between multispectral and hyperspectral imaging (multispectral imaging/MSI; hyperspectral imaging/HSI):

- multispectral ≤ 100 spectral channels
- hyperspectral > 100 spectral channels

A multi- or hyperspectral system consists of: Illumination, optics/input slit, spectrometer, detector, data processing. The resulting data matrix of spectrally resolved images is the so-called 'hypercube'. In this setup, either the sample or the HSI system must be moved to record the hypercube. Depending on the inspection task, however, one of these two options is often available per se.



Scheme of a hyperspectral line scan imaging - 'pushbroom imaging'

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