digital image analysis and metrology

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The step from visual comparison of pictorial data to quantitative discrimination is not straight forward. The extraction of quantitative features from digital picture data exceeding the estimation of mere amounts necessitates the tight collaboration of scientists and image analysts. Perceptions and conjectures have to be translated into feature extraction procedures, and the resulting feature values are then statistically tested. Experienced image analysts and statisticians are working and collaborating at the Institute of Biomathematics and Biometry on a multitude of projects to develop those new analysis methods.

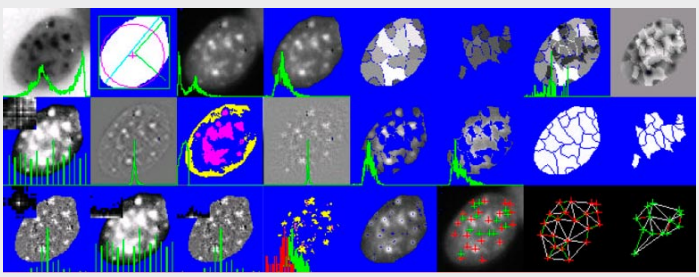
Cytometry: As one of the oldest fields of digital image analysis the quantification of cellular or nuclear properties, nowadays called cytometry, is widely used in pathology and cell biology.

µHistometry: As an example of quantitative morphology applied to sections of animal nerves, we outlined some possibilities of morphometry of single nerve fiber sections. This includes definitions of meta structures showing neighborhoods of nerve fibers in bundles.

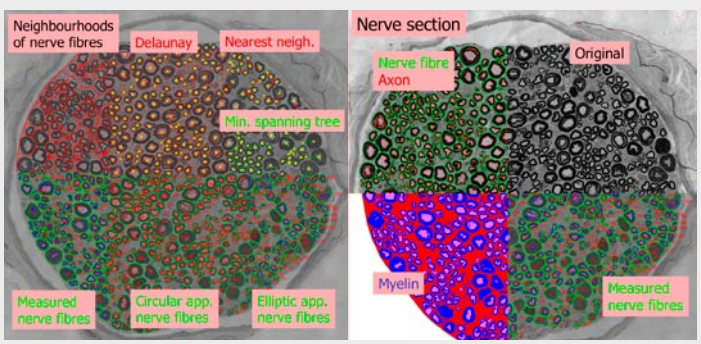
Fluorimetry and Colorimetry: With progress in biochemical and molecular biological marker technology, the quantification of fluorescent and/or colour signals in terms of amount and location (intensity, distribution and spatial arrangement) has become important for the adequate evaluation of data. An example from molecular pathology: Here, the images were originally gathered in 3D by optical sections from a confocal laser scanning microscope (stained e.g. by FISH). Marker locations have shown their value in the grading of diseases.

Plankton Analysis: An automatic system for data gathering and image analysis to estimate the community structure has been developed. Morphometric (shape), photometric (optical density), colorimetric and fluorimetric features of detected objects allow to automatically recognize plankton organisms. For training purposes a graphical user interface (GUI) was realized to display single organisms, groups, as well as quantitative features under different aspects.

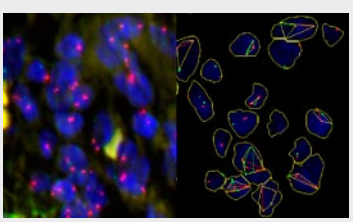
In summary, the examples illustrate how image analysis and metrology yield both support for simple estimations of amounts in images as well as complicated and complex estimation tasks.



Feature extraction for one cell nucleus (osteoblast), original upper left corner, mostly dedicated to intra-nuclear texture



FISH signals: An automatically processed image with nuclear DNA in blue and the FISH signals in red and green. Segmentation of signals allows beside counting a quantification of the spatial arrangement of the FISH signals. Convex hulls of all/ red/green signal locations are outlined.



The accessory nerve of the horse allows systematic morphometric studies of nerve function and growth

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