Abstract:

Turning Images into Knowledge: Cognition Network Technology for the Analysis of Life Sciences Image Data

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Progress in imaging modalities, staining technology and microscope automation have created a situation in which digital images and digital slides of rich information content are available like ever before. Imaging in fields like histology has long been established, but until now the tools available to automatically extract meaningful information have been rather simple. The problem is compounded by the sheer volume of images that are starting to accumulate in numerous research areas. Until now, image analysis solutions available are generally pixel- and filter-based, which limits the kinds of information that can be extracted. An ideal platform technology for image analysis may not impose restrictions on detection, classification and quantification of histological structures but should however allow freedom to ask complex questions about the interactions and relationships between such structures. Central to this is the precise and robust segmentation of all relevant structures of interest in a digital slide. This challenge involves bringing structure, morphology and context into play.

Based on its completely new Cognition Network Technology™ for image analysis, Definiens has deployed automated solutions in numerous application fields in histopathology, cytology and medical imaging. Images are interpreted and processed based on the attributes of networked image objects, which results in a number of methodical advantages. This object-oriented, knowledge-based and context-driven approach enables the user to bring in detailed expert knowledge and allows even complicated analyses to be performed completely automatically. This especially relates to image data with a bad signal-to-noise ratio, with shading in-homogeneities resulting from staining or illumination, or analysis tasks that address heterogeneous or variable structures of interest. These effects are all typical for many image analysis problems in the Life Sciences. The technology comes with own meta language (Cognition Network Language, CNL) that can be used through a graphical editor to adapt the system to new image analysis problems. Fast prototyping is supported.

The extracted structures of interest are the basis for detailed morphometric, structural and relational measurements which can be exported for each single structure. These data can be used for decision support or they can be correlated against experimental or molecular data.
An overview about the technology is provided with a number of industrial use cases from a number of different fields ranging from 2D cell-based assays over 2D tissue-based assays up to 3D medical imaging samples.

Application Sample: Fully automated extraction of a number of structural indicators for lung inflammation. Data courtesy Pfizer.