Abstract: Digital Cytomorphology

Deep Learning on an Image Data Set of Cell Morphologies in Acute Myeloid Leukemia

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Examination of Leukocyte cytomorphology using light microscopy, a method dating back to the nineteenth century, remains an important cornerstone in present-day Leukemia diagnostics.

In contrast to other laboratory tests, cytomorphological examination has so far defied automation and to this day is usually performed by trained human examiners. Hence, the diagnostic yield of that method is highly operator-dependent and hard to correlate quantitatively with other diagnostic modalities or clinical data.

We digitised a set of 100 blood smears without pathological findings and 80 blood smears taken from patients with different stages of Acute Myeloid Leukemia (AML) from the University Hospital of Munich Laboratory for Leukemia Diagnostics during 2014-2016.

All blood smears come from routine diagnostics, were stained using Pappenheim's stain and scanned at 100-fold magnification and oil immersion with a digital microscope - scanner. Finally, at least 100 Leukocytes per smear were classified into a 20-category scheme by trained cytomorphology examiners.

This dataset is used for training and validation of a convolutional neural network in order to allow independent recognition of malignant and non-malignant cell populations relevant in AML diagnostics.

We review the technical strengths and challenges of the digital image acquisition and examination process from the perspective of the routine clinical workflow. We furthermore show first results of the training and validation process of the convolutional neural network and assess the performance of that methodology as applied to our cell classification problem.