Visual Blood Count

Degree programme: Master of Science in Engineering | Specialisation: Data Science
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Blood holds a lot of information about a patient‘s well-being and is used to asses the health status. In particular, the blood cell count is so commenly performed world-wide, that a point-of-care application would be beneficial. This thesis describes how the values for the red blood cells, namely haematocrit, cell volume and haemoglobin content of a cell, can be calculated from a video taken from cells flowing through a microfluidic channel.

Point-of-Care Device

Reading out the amount and specifications of blood cells, a doctor can assess a patient‘s general health status. However, to get the blood count, a flow cytometer is needed. To make this blood test more accessible, a small, portable point-of-care microscope has been developed at the HuCE Institute. It uses a microfluidic chip, which takes a small droplet of blood and pulls it in via capillary force. A video is taken of the red blood cell stream and analysed for haematocrit, mean cell volume, and mean cell haemoglobin.

Haematocrit

The haematocrit is the volume of red blood cells relative to the whole blood volume. The channel is illuminated with blue light, which is absorbed by the haemoglobin in the cells. The pixels of the blood stream are compared to the reference background of the chip, which is proportional to the haematocrit.

Mean Corpuscular Haemoglobin and Volume

Like the haematocrit, the haemoglobin and the volume per cell are also measured using absorption. For the cell volume calculations the blood plasma is stained blue, so that it absorbs red light, whereas the haemoglobin in the cell absorbs blue light. The background is calculated from the bloodstream to get the blood plasma reference brightness. Then the volume and haemoglobin are calculated by comparing the cell pixel intensity to the plasma pixel intensity, using the Beer-Lambert law. For multiple cells, the average is taken to get the mean cell volume and haemoglobin content.

Calibration and Validation

To validate the algorithms, values were compared to those from a flow cytometer from Inselspital in Bern. Blood which has been previously analysed by the hospital was analysed with our device and the values compared. This process permitted to calibrate and validate the algorithms.

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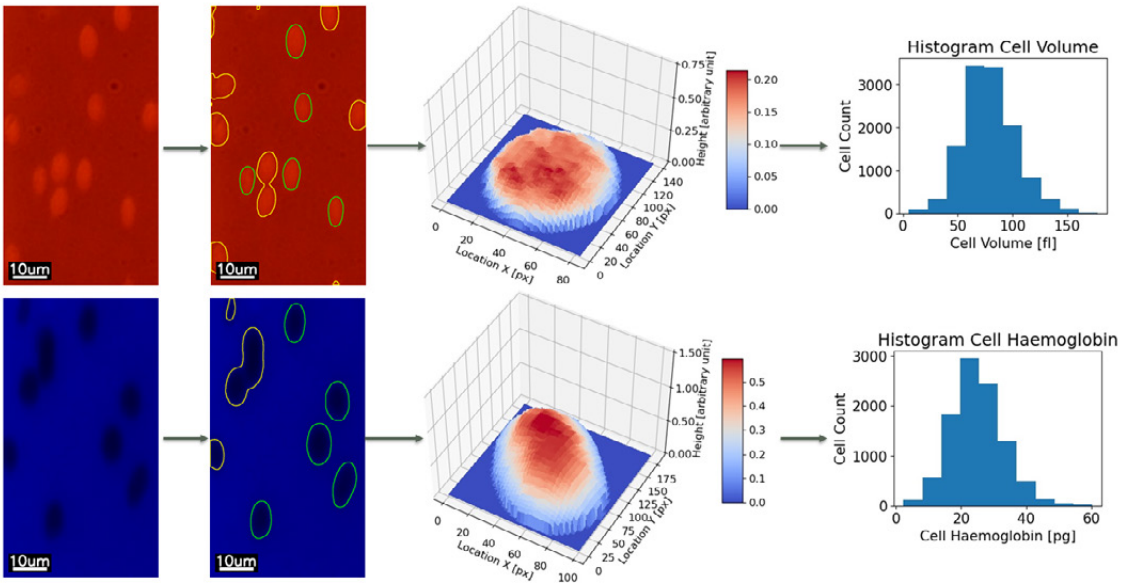

Process of the Mean Corpuscular Volume (red) and Haemoglobin (blue) Calculations [left to right: initial frame, contour detection, individual cell height, histogram of cells]