Imaging flow cytometry

Imaging flow cytometry (IFC) has become a powerful tool for diverse applications in biomedicine by virtue of its ability to image single cells in a high-throughput manner. However, there remains a challenge posed by the fundamental trade-off between throughput, sensitivity, and spatial resolution.

Huang et al. presented deep-learning-enhanced imaging flow cytometry (dIFC) that circumvents this trade-off by implementing an image restoration algorithm on a virtual-freezing fluorescence imaging (VIFFI) flow cytometry platform, enabling higher throughput without sacrificing sensitivity and spatial resolution. A key component of dIFC is a high-resolution (HR) image generator that synthesizes “virtual” HR images from the corresponding low-resolution (LR) images acquired with a low-magnification lens (10×/0.4-NA). For IFC, a low-magnification lens is favorable because of reduced image blur of cells flowing at a higher speed, which allows higher throughput. We trained and developed the HR image generator with an architecture containing two generative adversarial networks (GANs). Furthermore, we developed dIFC as a method by combining the trained generator and IFC. We characterized dIFC using Chlamydomonas reinhardtii cell images, fluorescence in situ hybridization (FISH) images of Jurkat cells, and Saccharomyces cerevisiae (budding yeast) cell images, showing high similarities of dIFC images to images obtained with a high-magnification lens (40×/0.95-NA), at a high flow speed of 2 m s-1. We lastly employed dIFC to show enhancements in the accuracy of FISH-spot counting and neck-width measurement of budding yeast cells. These results pave the way for statistical analysis of cells with high-dimensional spatial information [1].

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see also Multiparameter flow cytometry.

All brain biopsies performed between 2010 and 2015 at Brain Tumor Center, University Medical Center Rotterdam and analyzed by both immunohistochemistry and flow cytometry were included in a retrospective study. Immunohistochemistry was considered the gold standard.

In a total of 77 biopsies from 71 patients, 49 lymphomas were diagnosed by immunohistochemistry, flow cytometry results were concordant in 71 biopsies (92,2%). van der Meulen et al., found a specificity and sensitivity of flow cytometry of 100% and 87,8%, respectively. The time between the biopsy and reporting the result (turnaround time) was significantly shorter for flow cytometry, compared to immunohistochemistry (median: 1 versus 5 days).

Flow cytometry has a high specificity and can confirm the diagnosis of a lymphoma significantly faster than immunohistochemistry. This allows for rapid initiation of treatment in this highly aggressive tumor. However, since its sensitivity is less than 100%, van der Meulen et al., recommend to perform histology plus immunohistochemistry in parallel to flow cytometry [2].

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Huang K, Matsumura H, Zhao Y, Herbig M, Yuan D, Mineharu Y, Harmon J, Findinier J, Yamagishi M, Ohnuki S, Nitta N, Grossman AR, Ohya Y, Mikami H, Isozaki A, Goda K. Deep imaging flow cytometry. Lab Chip. 2022 Feb 10. doi: 10.1039/d1lc01043c. Epub ahead of print. PMID: 35142325.
2)
van der Meulen M, Bromberg JEC, Lam KH, Dammers R, Langerak AW, Doorduijn JK, Kros JM, van den Bent MJ, van der Velden VHJ. Flow cytometry shows added value in diagnosing lymphoma in brain biopsies. Cytometry B Clin Cytom. 2018 May 10. doi: 10.1002/cyto.b.21641. [Epub ahead of print] PubMed PMID: 29747221.