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Deep Neural Networks to Automate Scoring Of The Imaging Flow Cytometry In-Vitro Micronucleus Assay

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The *in vitro* micronucleus assay is a globally used technique for the quantification of DNA damage required for regulatory compound safety testing in addition to inter-individual monitoring of environmental, lifestyle and occupational factors. However, it relies on time-consuming and user-subjective manual scoring. This presentation will discuss progress towards fully automating the scoring of the assay to provide a robust and reliable technique which can be applied at any laboratory without any requirement for parameter tuning.

We focus on using imaging flow cytometry to provide single-cell, brightfield and nuclear stained images in a high-throughput manner. Images were captured for the cytokinesis-block micronucleus method using methyl methane sulphonate and carbendazim exposures to TK6 cells at three different laboratories. The images were scored manually into mono, bi, tri and tetra -nucleated categories alongside the same phenotypes exhibiting micronuclei. Apoptotic cells, metaphase spreads and cellular debris events were also scored. This human-curated data provided a large training set enabling assessment of wide-ranging automated scoring algorithms.

The large number of single-cell images acquired using imaging flow cytometry (> 10,000 / replicate) makes this type of data ideal for the application of deep learning neural networks. We will discuss the use of several different types of deep learning algorithms and the optimisation of the analysis pipelines to increase the accuracy of detection. We will also discuss the generalisation of these methods to traditional microscopy images.