High Content Cell Classification and Tracking Improvement by Morphology and Quantitative Phase Feature combination

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High content screening consists in acquiring a large number of samples to obtain statistically significant information on cell populations and their changes.
Quantitative phase imaging (QPI) is used in microscopy for label-free imaging of semi-transparent samples [1]. Phase information is relevant as it allows classical morphological parameters determination (i.e. surface, perimeter, circularity…) but also quantitative measurements (i.e. density, mass, mass distribution…) on segmented cells. Machine Learning techniques [2] are powerful tools for mass data classification. However the performance of such algorithms strongly relies on features selection.

The contribution of this paper is twofold. First, we show that adding quantitative phase features to standard morphology features greatly improves the performance of cell classification algorithms. Second, we study the evolution of these features for long time periods at the individual cell level and deduce new cell features.

We use QuadriWave Lateral Shearing Interferometry as the QPI technique, available as a commercial product by PHASICS (SID4Bio, Phasics SA, Palaiseau, France). We built an imaging platform able to keep cells in growing conditions for several days. The principle of the experiment is to acquire a statistically large amount of data by screening different cell populations for more than 48h. After cell segmentation, we use Machine Learning techniques to classify them.

We describe the use of this method as a diagnostic tool to differentiate between different cells populations or cells populations in different experimental conditions. Results on different populations treated or not with Staurosporine (STS), an apoptose inducer, will be shown. We will also apply this strategy to automated determination of cell position within its cycle (from G1 to mitosis).

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