

## REVIEW ARTICLE

# Advanced Image Acquisition and Analytical Techniques for Studies of Living Cells and Tissue Sections

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**Abstract:** Studies on fixed samples or genome-wide analysis of nuclear processes are useful for generating snapshots of a cell population at a particular time point. However, these experimental approaches do not provide information at the single-cell level. Genome-wide studies cannot assess variability between individual cells that are cultured *in vitro* or originate from different pathological stages. Immunohistochemistry and immunofluorescence are fundamental experimental approaches in clinical laboratories and are also widely used in basic research. However, the fixation procedure may generate artifacts and prevents monitoring of the dynamics of nuclear processes. Therefore, live-cell imaging is critical for studying the kinetics of basic nuclear events, such as DNA replication, transcription, splicing, and DNA repair. This review is focused on the advanced microscopy analyses of the cells, with a particular focus on live cells. We note some methodological innovations and new options for microscope systems that can also be used to study tissue sections. Conventional methods for the biophysical research of living cells, such as fluorescence recovery after photobleaching and fluorescence resonance energy transfer, are also discussed, as are studies on the effects of radiation at the individual cellular level.

**Key words:** Live-cell studies, microscopy, fluorescent proteins, chromatin, tissue sections