

Microfluidics on an Ultra-Wide Field Scale: Massive Tracking of Cell Division Processes

Ultra-Wide Field Acquisition of Single Cancer Cell Proliferation on a Dedicated Microfluidic Device

At D-Tails, we are committed to making ultra-wide field imaging accessible to researchers, enabling scalable, high-content experimental workflows.

iFLUOR is built around a relay lens architecture capable of acquiring multicellular structures across a $10 \times 10 \text{ mm}^2$ field of view, supporting multiple sample holders and microfluidic configurations.

Designed as a flexible and integrable platform, iFLUOR combines transmission and dual-channel fluorescence imaging with the option to equip up to four independently controlled microfluidic pumps.

The system includes a micro-incubator adapter and integrated all-in-one software for timelapse experiments, programmable fluid delivery (timed or ramped), acquisition control, and streamlined data analysis.

In this Application Note, we demonstrate that iFLUOR can acquire a $10 \times 10 \text{ mm}^2$ field of view containing 350 experimental replicates at $2.5 \mu\text{m}$ pixel resolution. The platform allows for detailed inspection of selected regions of interest within the acquired full-field image.



iFLUOR Imaging of Mother Machine Devices for High-Throughput Progeny Tracking

To validate large-scale single-cell monitoring capabilities, we utilized custom-made Mother Machine microfluidic devices designed to trap individual cancer cells within narrow channels and monitor their proliferation dynamics over time in a controlled, high-throughput manner. Human leukemia cells (Jurkat T-cells) were introduced into the device via syringe pump at a flow rate of $1 \mu\text{L/s}$ to facilitate cell loading into the trapping channels. After loading, the nutrient flux was reduced to $0.3 \mu\text{L/s}$, and cell proliferation was monitored for up to 72 hours, with images acquired every 3 minutes using iFLUOR. Cells were excited using a 470 nm LED source compatible with standard GFP/FITC-like fluorophores, and ultra-wide field images ($10 \times 10 \text{ mm}^2$) were acquired at $2.5 \mu\text{m}$ pixel resolution.

As shown in Figure 1, iFLUOR enables 1:1 acquisition of the entire microfluidic device across a $10 \times 10 \text{ mm}^2$ field of view, capturing hundreds of $15 \mu\text{m}$ -wide trapping channels in a single frame. This expansive field of view allows simultaneous monitoring of hundreds of individual cells while preserving sufficient structural detail to clearly identify and track division events over time. The wide-area acquisition enables a seamless transition from population-level overviews to direct inspection of individual channels within the same image, supporting robust analysis of cell division dynamics and cell size variation.

This application highlights iFLUOR as a powerful tool for scalable, high-content microfluidic workflows, bridging macro-scale acquisition and single-cell analysis in a single integrated platform. Dedicated, tailored one-to-one application support is available upon request to facilitate implementation in specific experimental settings.

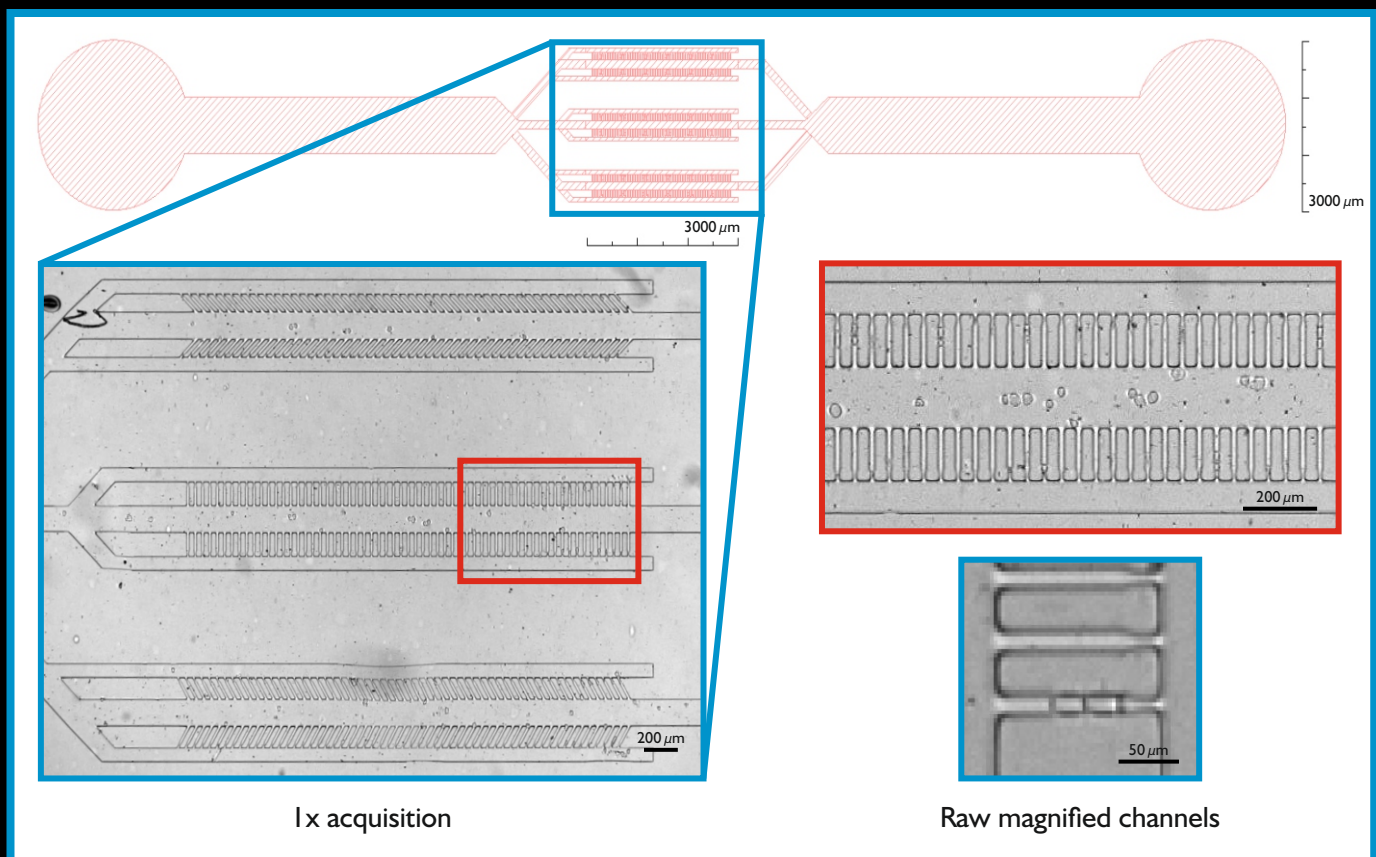


Figure 1. Design of the Mother Machine microfluidic system (top). iFLUOR enables 1:1 imaging of the entire device (left), allowing simultaneous visualization of hundreds of trapping channels. Inspection of individual channels preserves sufficient structural detail for clear identification of cell division events.