Real Time Optofluidic Microscopy

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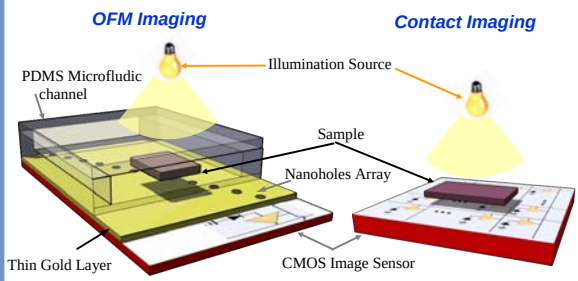
What is OFM?

OptoFluidic Microscopy (OFM) is a new imaging technique that enables high resolution imaging of biological samples flowing in a microfluidic channel without using any bulky optics (lenses). OFM promises for a wide range of applications such as rapid blood cells monitoring and rapid detection of very tiny worms in fluids.



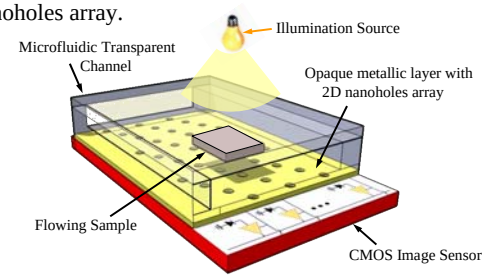
Principles of OFM Imaging

OFM Imaging is a form of contact imaging. However, it offers higher resolution for the following reasons:

- Relative motion between sample and image sensor.
- Utilization of linear nanoholes array.

Real Time OFM Design

- We utilize a 2D nanoholes array in a special structure that contains multiple repetition distance along sample's flow direction.
- We utilize a CMOS image sensor with a non regular 2D pixel array and small pixel size to match with the 2D nanoholes array.

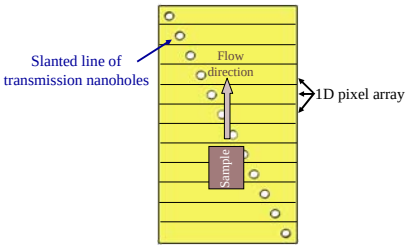


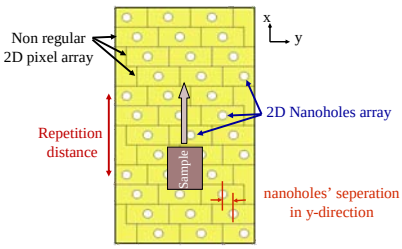
Design

- We utilize a 2D nanoholes array in a special structure that contains multiple repetition distance along sample's flow direction.
- We utilize a CMOS image sensor with a non regular 2D pixel array and small pixel size to match with the 2D nanoholes array.

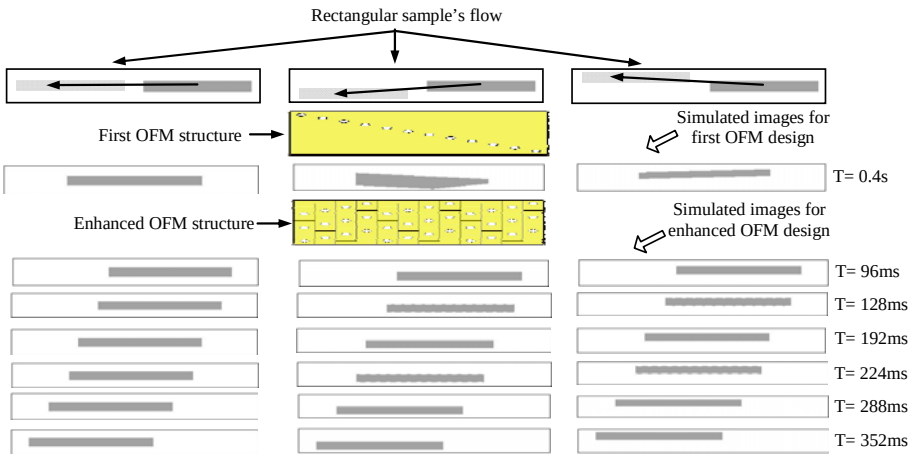
$$\text{Actual Resolution} = \text{Sample's Speed} \times \text{Sensor' acquistion time}$$

$$\text{Repetition distance} = \frac{\text{Pixel's Area}}{\text{nanoholes' separation in y-direction}}$$



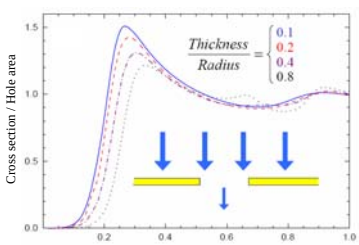


Simulation Results



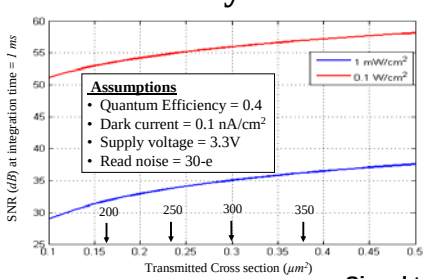
OFM Design	Scan Time	Scan Distance	Frame Rate
First OFM Design (pixel's size of $5\times5\mu m^2$)	830 *ms*	250 μm	NA
Enhanced OFM Design (pixel's size of $5\times5\mu m^2$)	130 *ms*	40 μm	7 *frames/sec*
Enhanced OFM Design (pixel's size of $2.4\times2.4\mu m^2$)	32 *ms*	9.6 μm	30 *frames/sec*

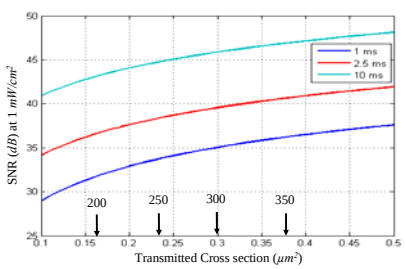
Feasibility



Hole Radius (*nm*)	Transmitted cross section (μm^2)
200	0.1633
250	0.233
300	0.302
350	0.37
400	0.462

Nanohole Transmission





Signal to Noise Ratio

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