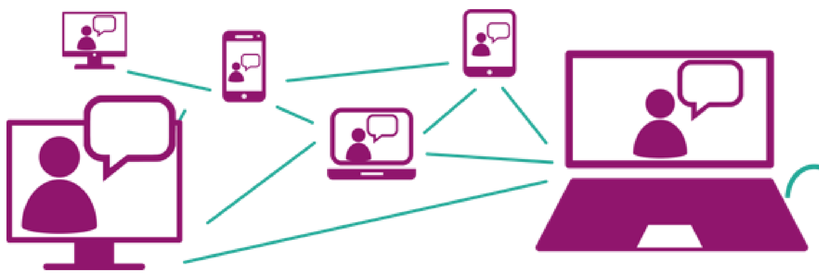

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BIOSENSORS FOR PANDEMICS

# Optimizing Lateral Flow Assays for diagnostic applications

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## Abstract

The major drawback of paper-based lateral flow assays is sensitivity [1], which has been shown to vary greatly, i.e. for SARS-CoV-2 diagnostics from 0-98% [2]. Tremendous efforts have been put towards enhancing the sensitivity. In our work, we have investigated several aspects of sensitivity enhancement of LFAs, including orienting the capturing biomolecule, signal enhancement using larger nanoparticles, inducing geometric changes to manipulate the flow rate, as well as a digital readout.

## Label

**Intensity vs capture antibody concentration for two label particle sizes**: the lower the pixel intensity the higher the color signal.

Highest intensity: 40 nm particles at 2 mg/ml

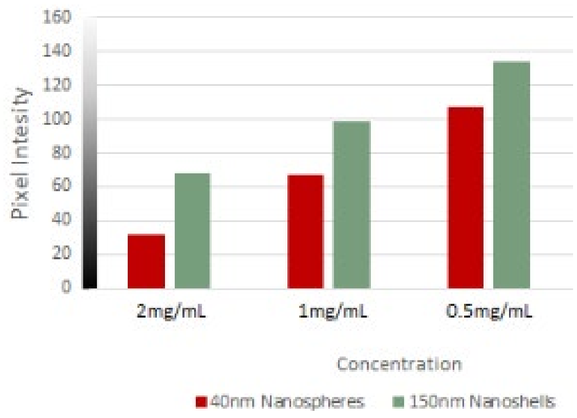
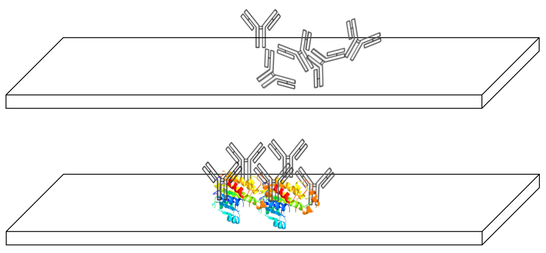



**Illustration of signal dependency** on concentration using **150 nm shells** or **40 nm gold particles**.

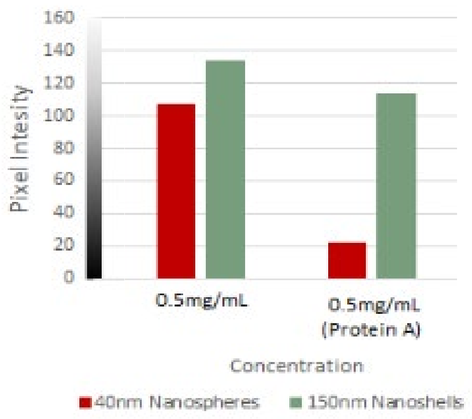

(a) High concentration of primary antibody (b) Low concentration of primary antibody

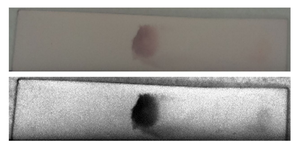
## ORIENTATION



ProteinA providing oriented capture biomolecule

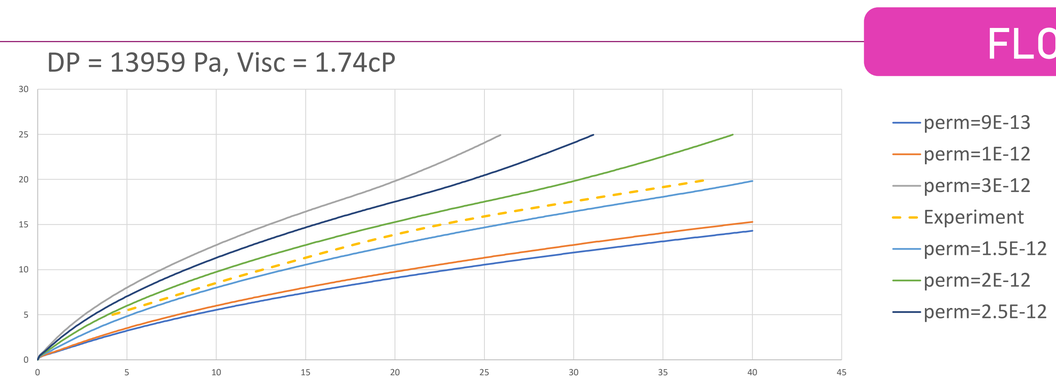
**Control** of capture antibody orientation by proteinA: 5-fold signal enhancement (the lower the pixel intensity the higher the color signal)



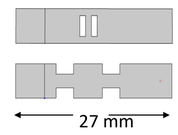
Digital translation of the colorimetric response.

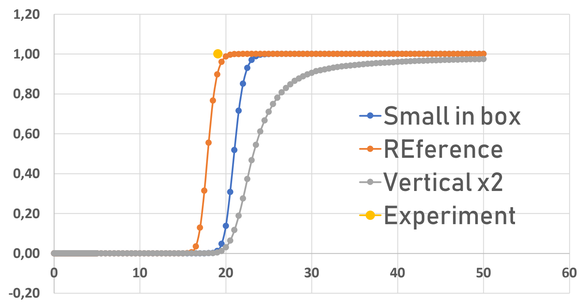
## FLOW RATE

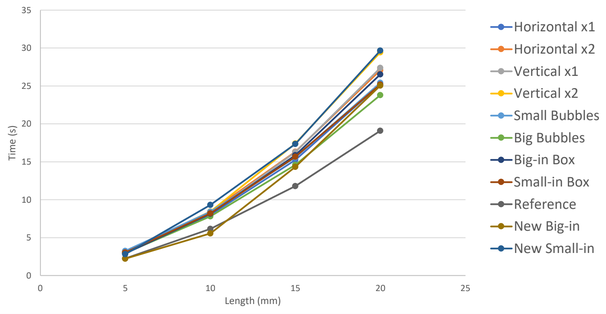



Combination of experimental data and Darcy theory for **porous media theoretical paper models** in COMSOL

**Fluid flow** simulation (left) and experimental data (right) of geometrically modified membrane (i.e. top right) shows reduced flow rate

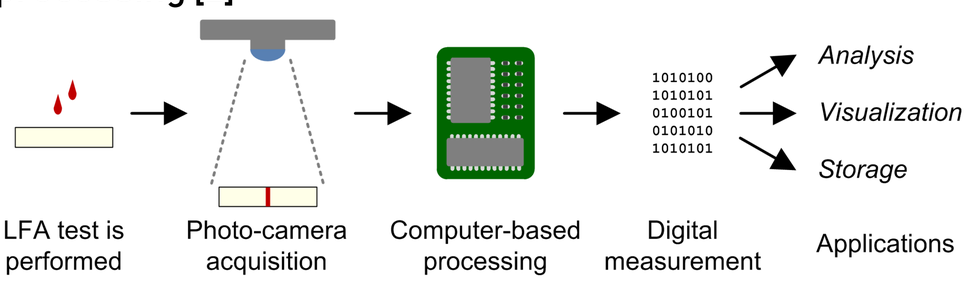


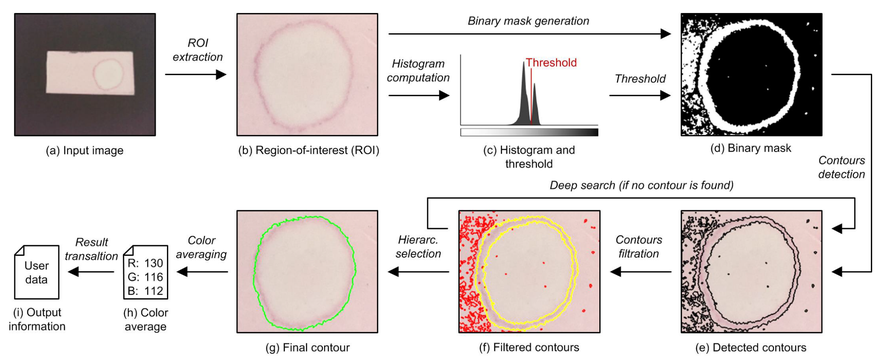




## DIGITALIZATION

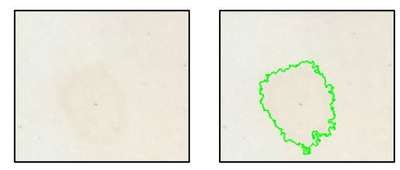
**Overall Digitalization process** using photo camera to image the test result and a raspberry pie for image processing [2]




**Algoritm** process for obtaining the region of interest [2]

Example of Algoritm automated **detection of a barely visible colorimetric signal**



## CONTACT PERSON

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## REFERENCES

[1] J. D. Bishop, H. v. Hsieh, D. J. Gasperino, and B. H. Weigl, Lab on a Chip, vol. 19, no. 15 (2019) pp. 2486–2499
[2] L. Pezzarossa, S. I. Preus, W. E. Svendsen and J. Madsen, "A Computer Vision Algorithm for the Digitalization of Colorimetric Lateral Flow Assay Readouts," 2020 Symposium on Design, Test, Integration & Packaging of MEMS and MOEMS (DTIP), Lyon, France, 2020, pp. 1-6, doi: 10.1109/DTIP51112.2020.9139138.

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