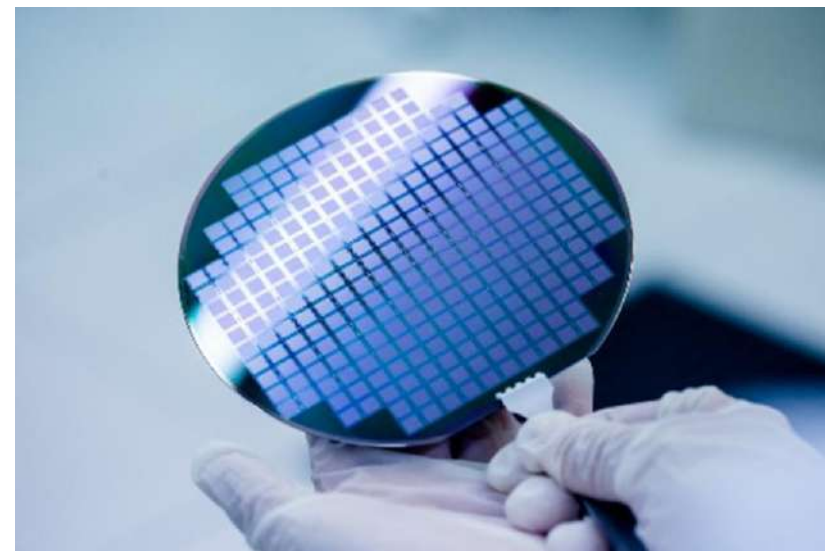


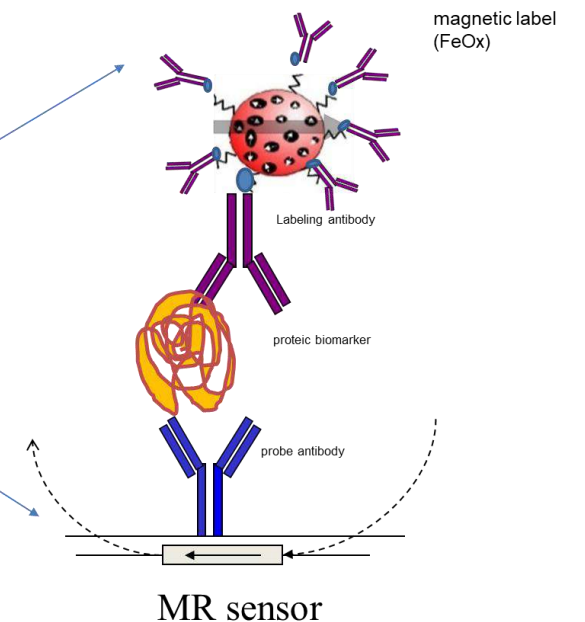
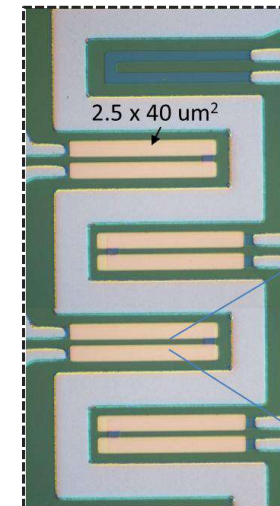
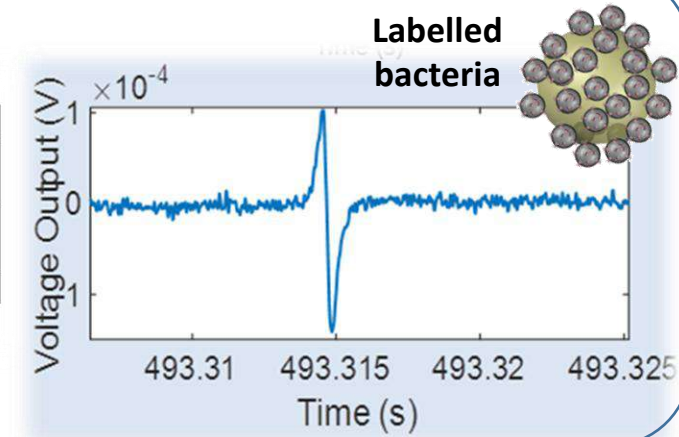
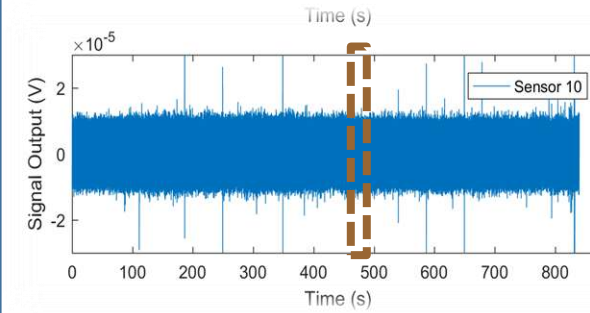
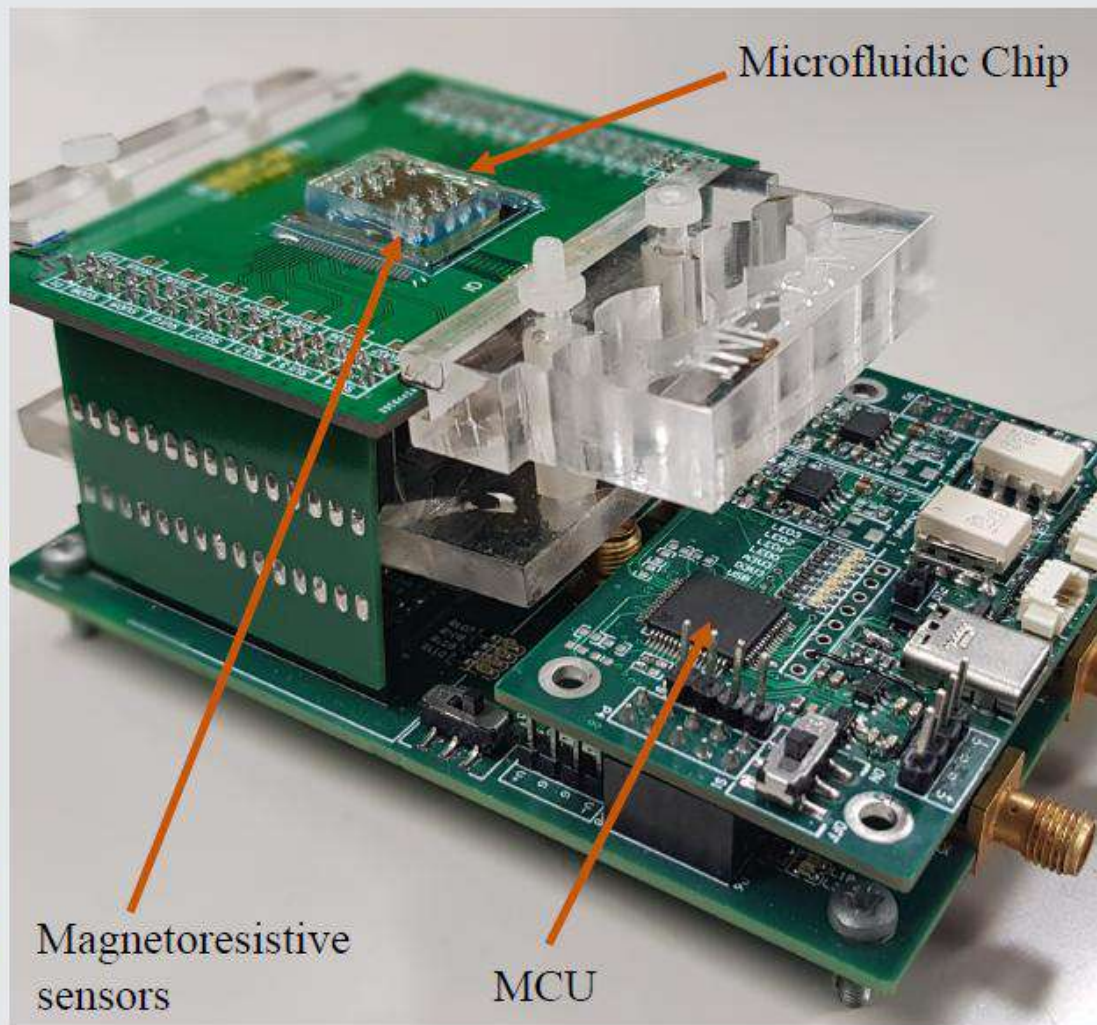
Biosensing platforms in health and defense applications

Paulo P. Freitas



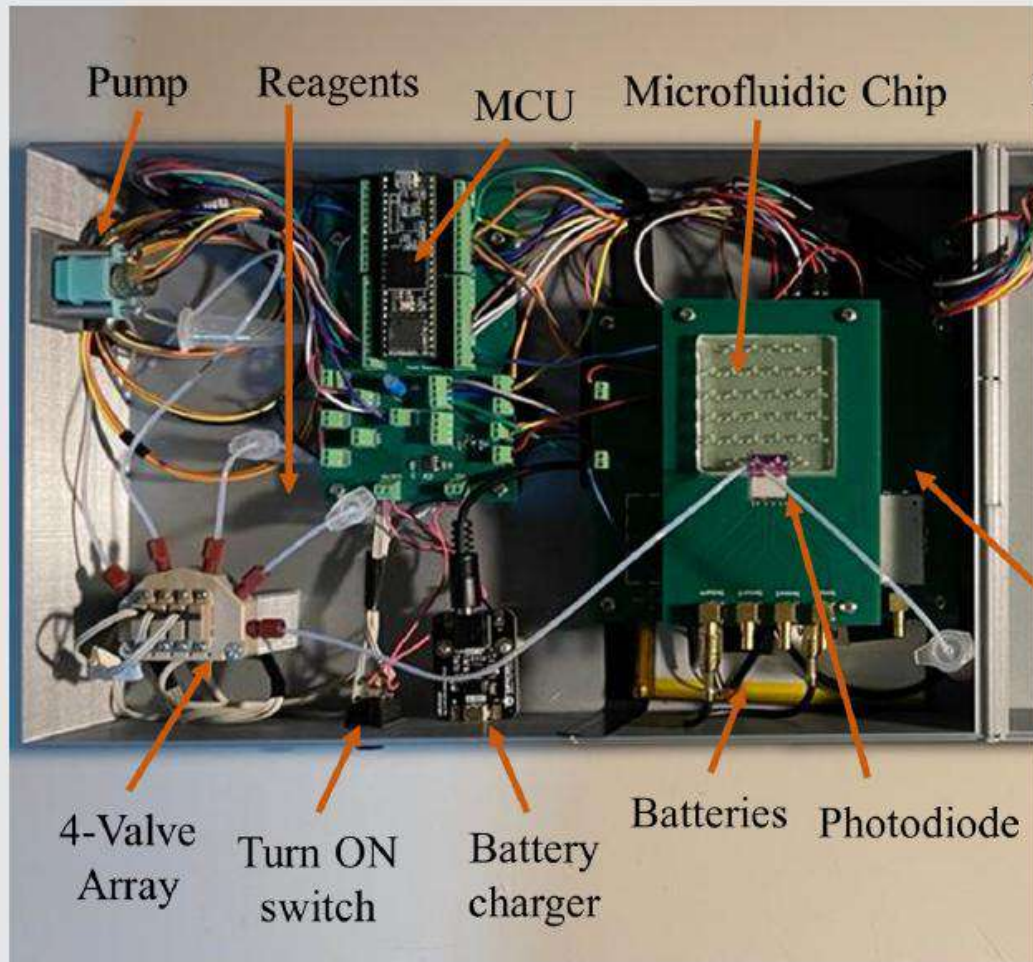
Magnetic-based biosensors

Magnetic Biosensing platforms



Health applications: biomarker detection (DNA, protein, vesicle, cell, virus, bacteria)

Optical-based biosensors



R.R.G. Soares et al. / Procedia Engineering 168 (2016) 329 – 332

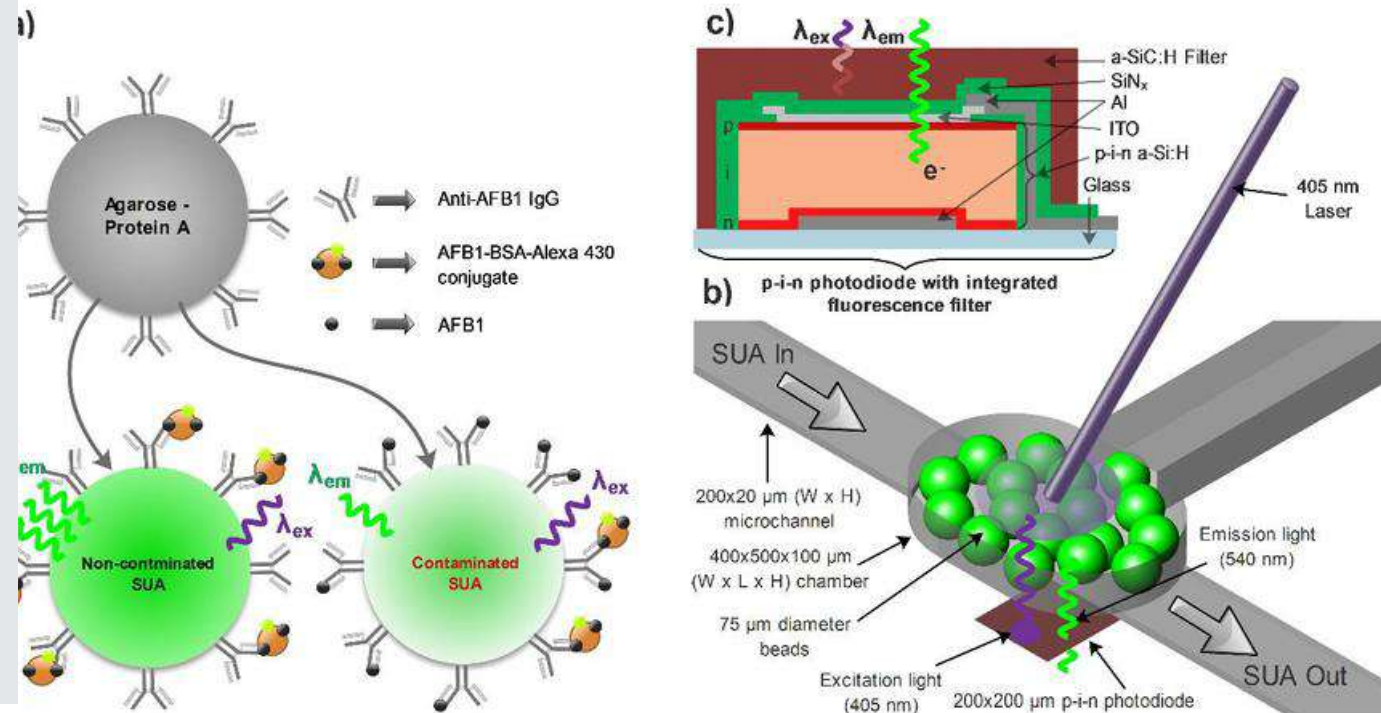


Fig. 1. Schematics of the immunoassay (a) and microfluidic device (b) used to confine the protein A agarose beads in a 20 nL chamber. The immunoassay schematized in (a) is competitive, meaning that the binding extent of the AFB1-BSA-Alexa 430 conjugate to the beads is inversely proportional to the AFB1 concentration in the SUA. The increase in fluorescence emission is monitored by an integrated a-Si:H p-i-n photodiode (c), aligned beneath the chamber. The increase in fluorescence emission is measured in real time while the sample-under-analysis (SUA) is flowed through the chamber.



Zika and dengue viruses

Combined detection of molecular and serological signatures of viral infections: The dual assay concept

Débora C. Albuquerque^{a,b,c,*}, Verónica C. Martins^b, Elisabete Fernandes^c, Líbia Zé-Zé^{d,e},
Maria João Alves^d, Susana Cardoso^{a,b}

^a IST - Instituto Superior Técnico, University of Lisbon, Lisboa, 1049-001, Portugal

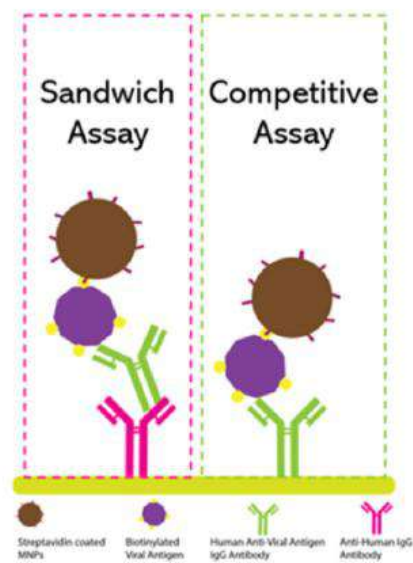
^b INESC-MN-Instituto de Engenharia de Sistemas E Computadores - Microsistemas e Nanotecnologias, Lisboa, 1000-029, Portugal

^c INL, International Nanotechnology Laboratory, Braga, 4715-330, Portugal

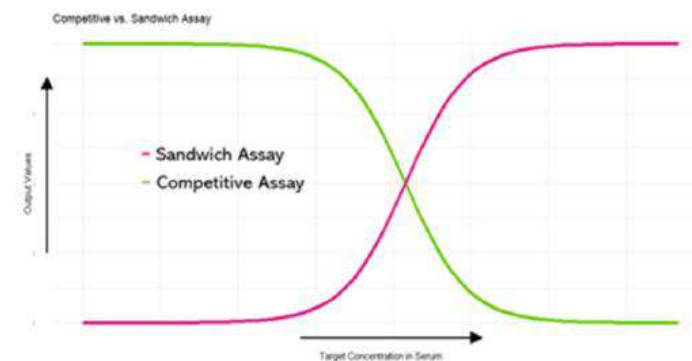
^d INSA- National Institute of Health Doutor Ricardo Jorge, Centre for Vectors and Infectious Diseases Research, Águas de Moura, 2965-575, Portugal

^e BiolSI - Biosystems and Integrative Sciences Institute, Edifício TecLabs, Campus da FCUL, Campo Grande, Lisboa, 1749-016, Portugal

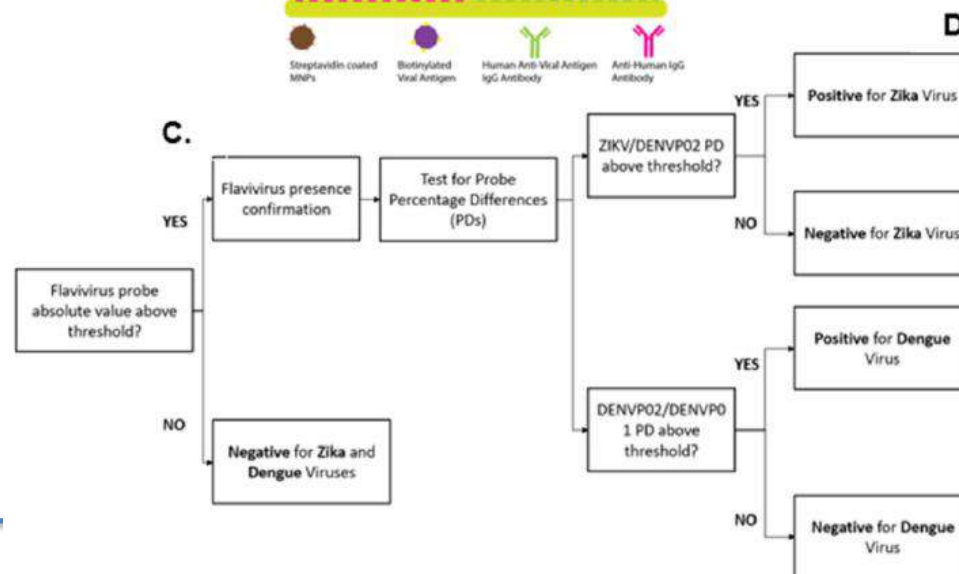
A.



B.

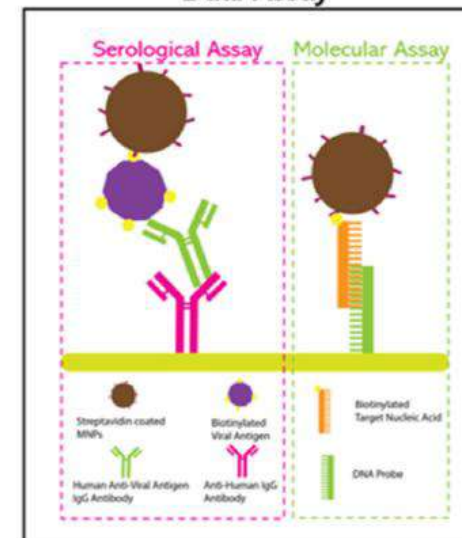


C.

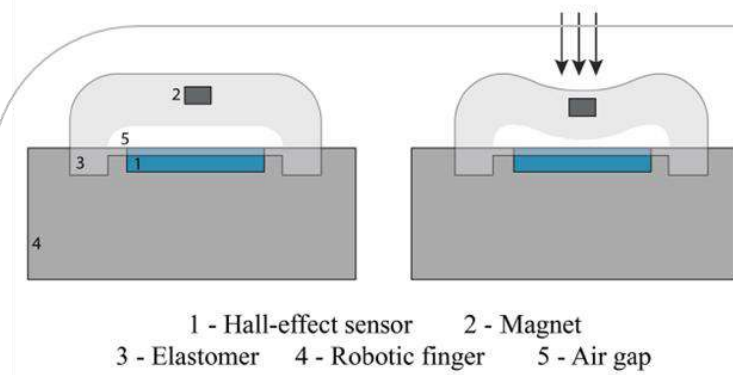
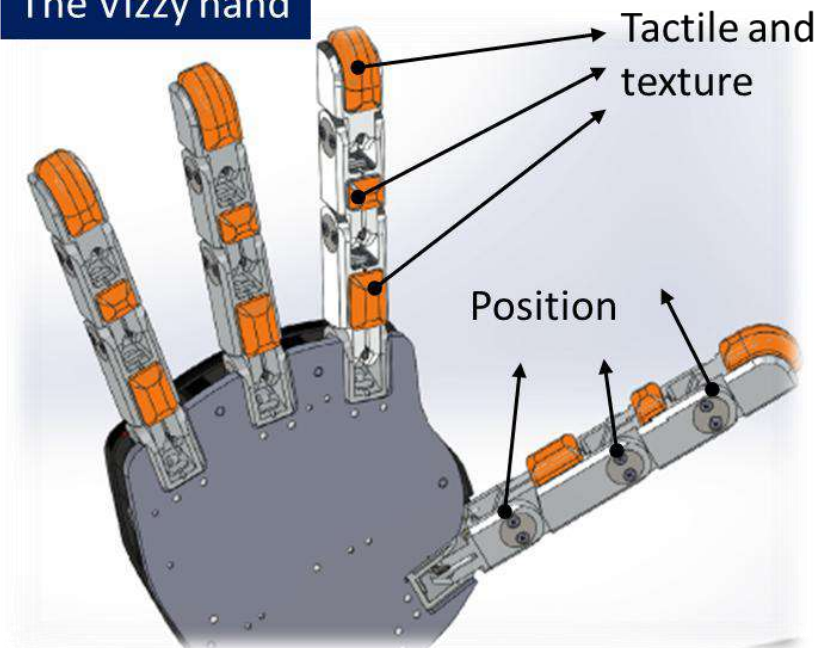


D.

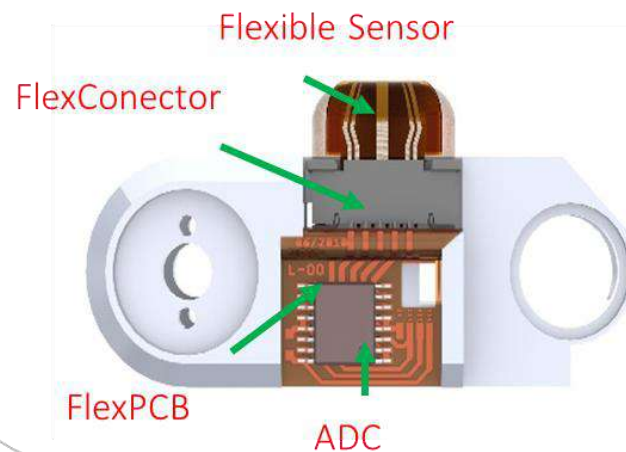
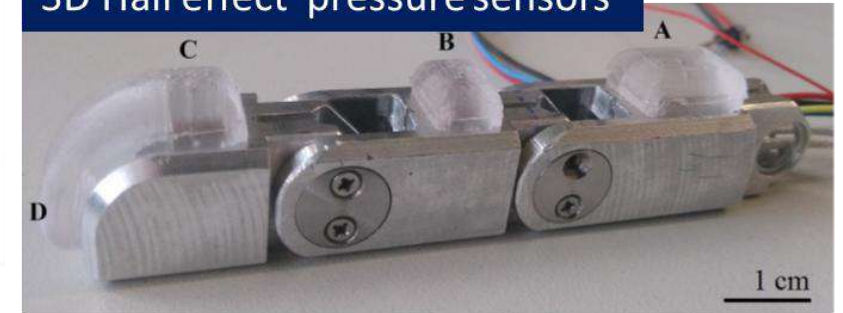
Dual Assay



The Vizzy hand



3D Hall effect pressure sensors



Flexible 2D GMR pressure sensors

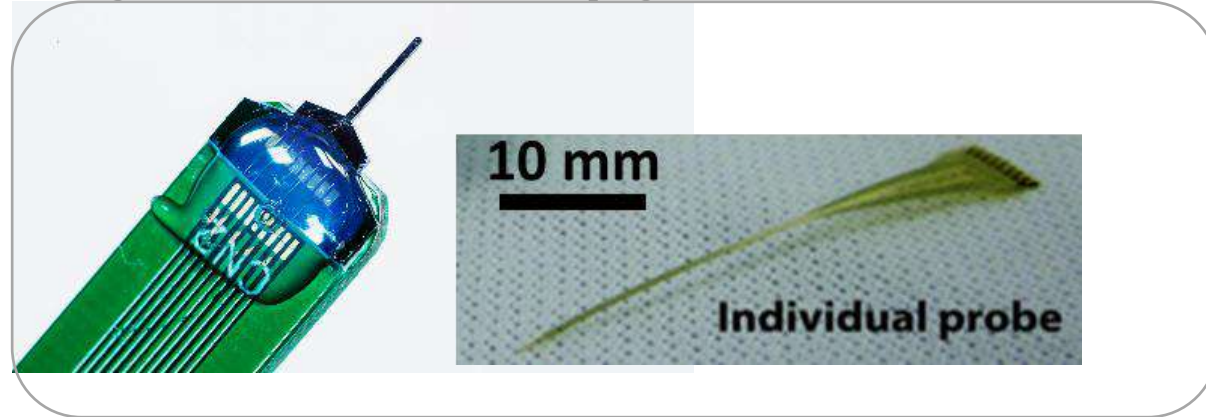


Key enabling technologies

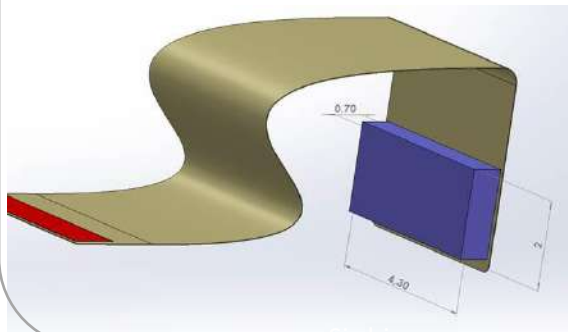
INESC MN

Microsistemas e
Nanotecnologias

Integration in needles (rigid and flexible)



Integration rigid - flexible interconnectors



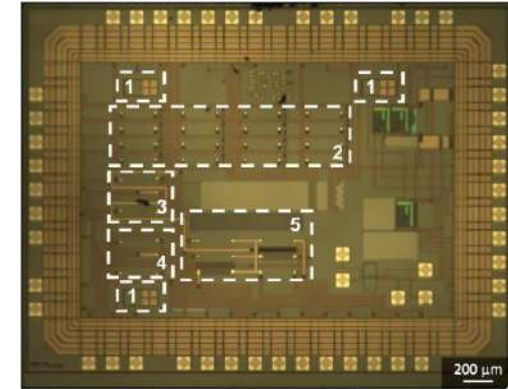
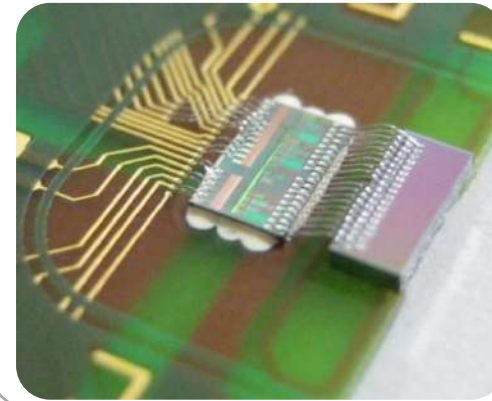
Integration in flexible substrates



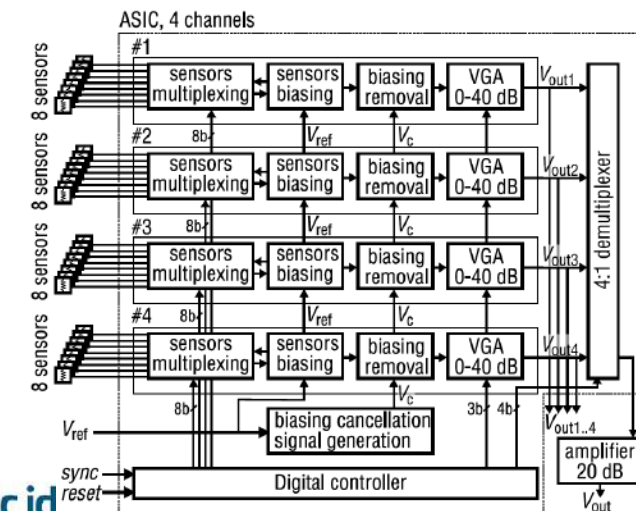
Appl. Phys.A: Mat. Science & Processing, 111, pp.407–412 (2013)
IEEE Trans Magn. Vol.53 (4), 5300204 (2017),
IEEE Sensors Journal 19 (24), pp.12363 (2019)

J.Magn Magn Materials 168153 (2021)
Sensors, 21, 5098. (2021)
IEEE Trans Magn. vol. 51 (11) 4401104 (2015)

Monolithic or hybrid integration with ASIC

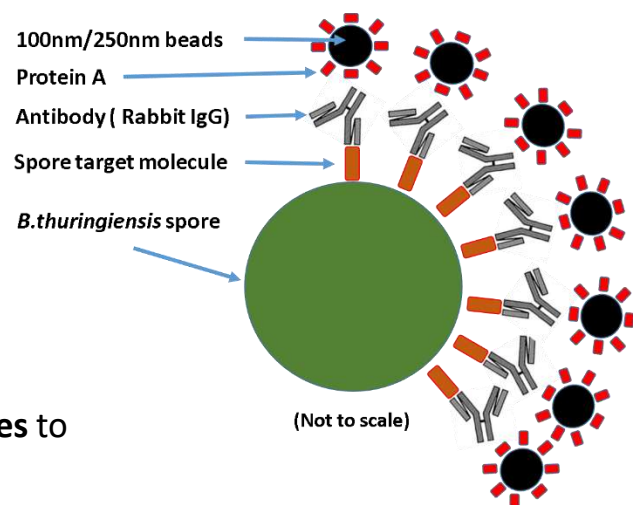


ASIC design



Portable biosensor for real-time detection of aerosolized *Bacillus anthracis*

Portable aerosol collector with magnetic biochip



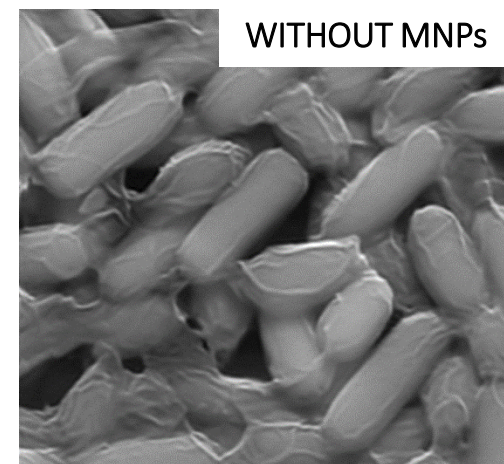
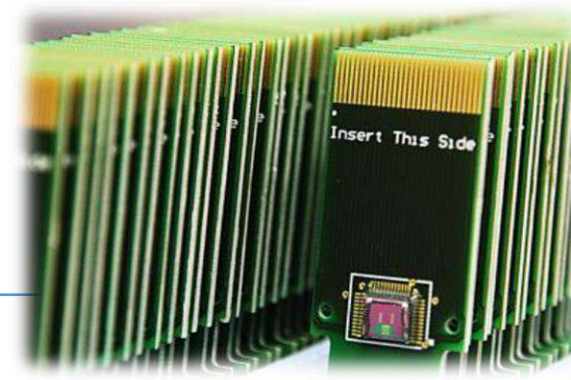
Binding of **antibody-nanoparticle complexes** to *B. thuringiensis* spores

WITH MNPs

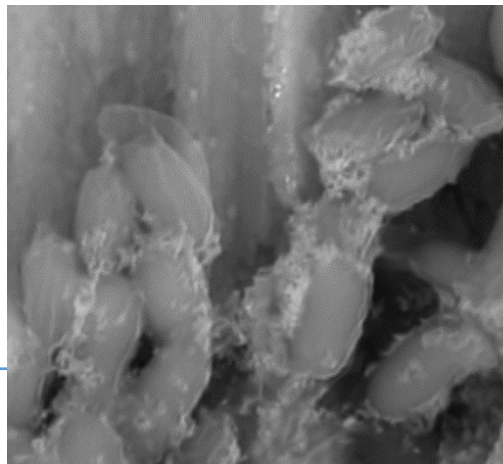
20+ years experience on biosensing platforms

Magnetic Biochip - Citometer

Biosensor cartridges



WITHOUT MNPs





SOLARIS

SOLARIS- P2020- 15-SI-2020- 68746



Microsistemas e Nanotecnologias

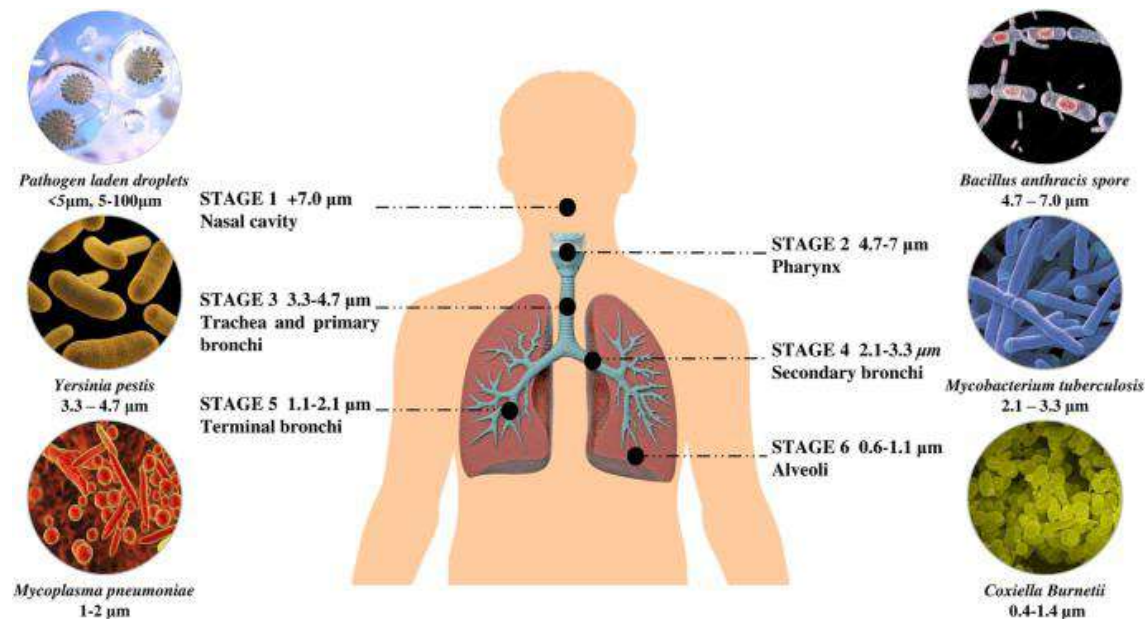


OPTIMAL DEFENCE



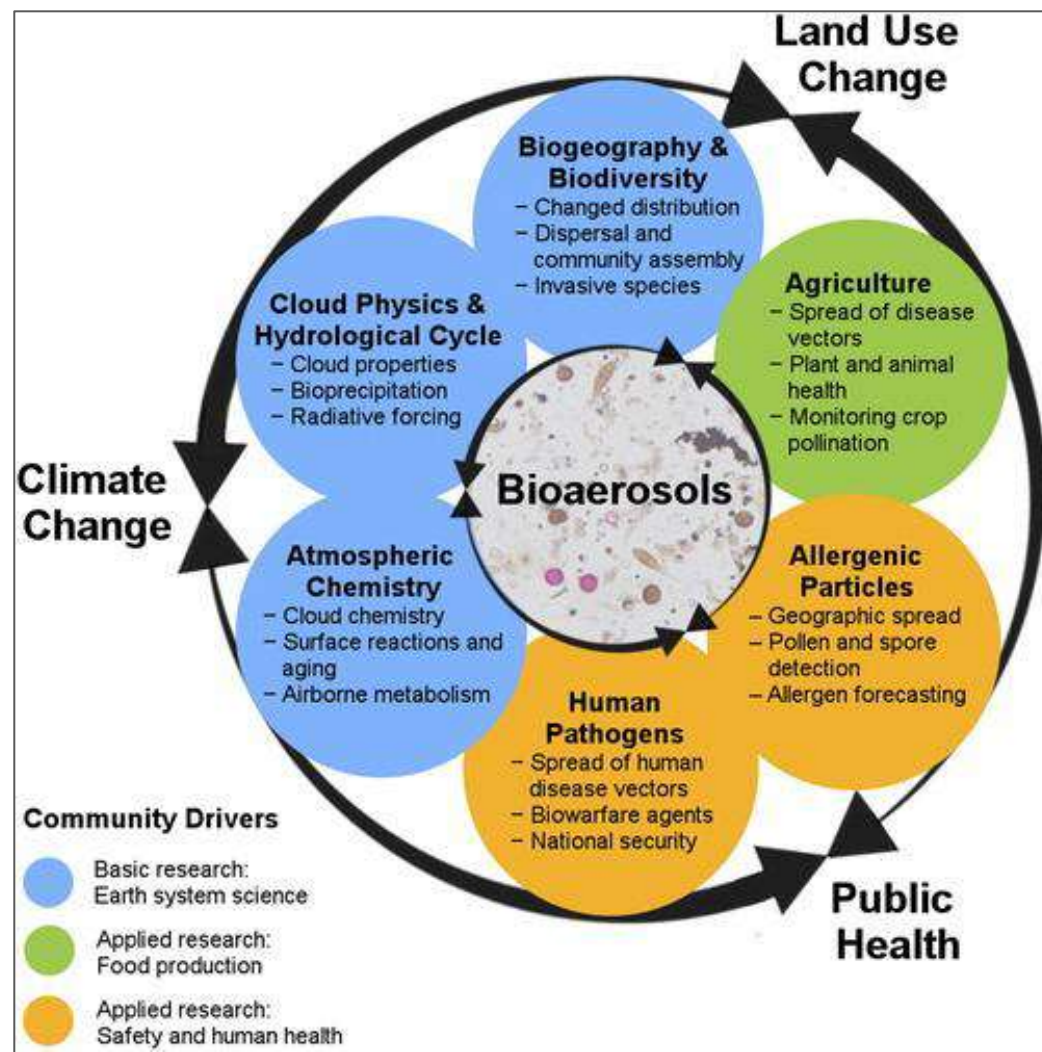
Unidade Militar Laboratorial de Defesa
Biológica e Química

SISTEMA OPERACIONAL DE
COLHEITA PORTÁTIL DE
BIOAEROSSÓIS



need for robust biomonitoring and
biosurveillance systems

Aerosol collector

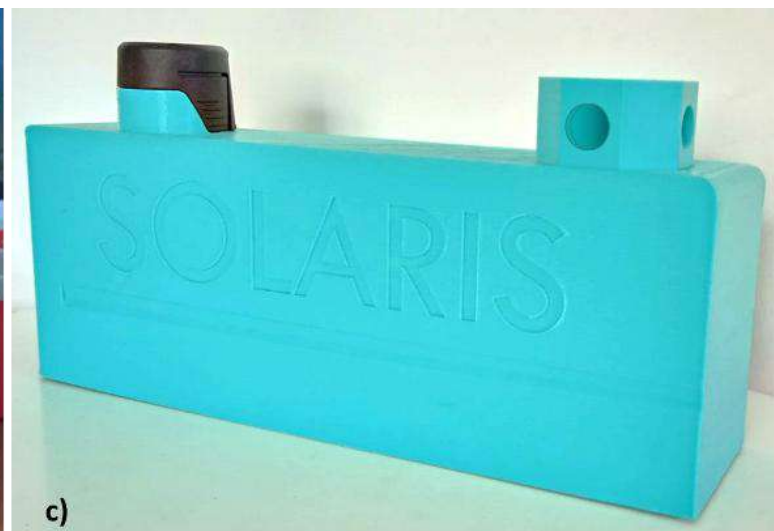
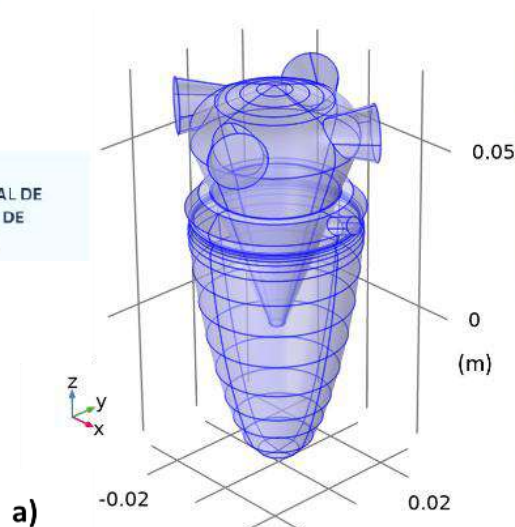




Solaris field testing

SOLARIS- P2020- 15-SI-2020- 68746

SISTEMA OPERACIONAL DE
COLHEITA PORTÁTIL DE
BIOAEROSSÓIS



SOLARIS was field tested at **Estação Zootécnica Nacional**

Bioaerosol samples were collected
at the **swine maternity** to assess *C. difficile*
C. perfringens

Identificação de Legionella em Bio-aerossóis por Recolha Aérea

Problema?

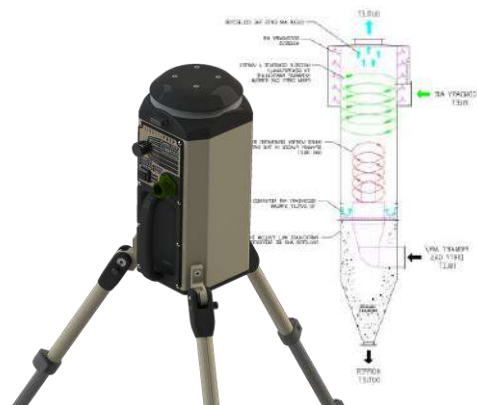
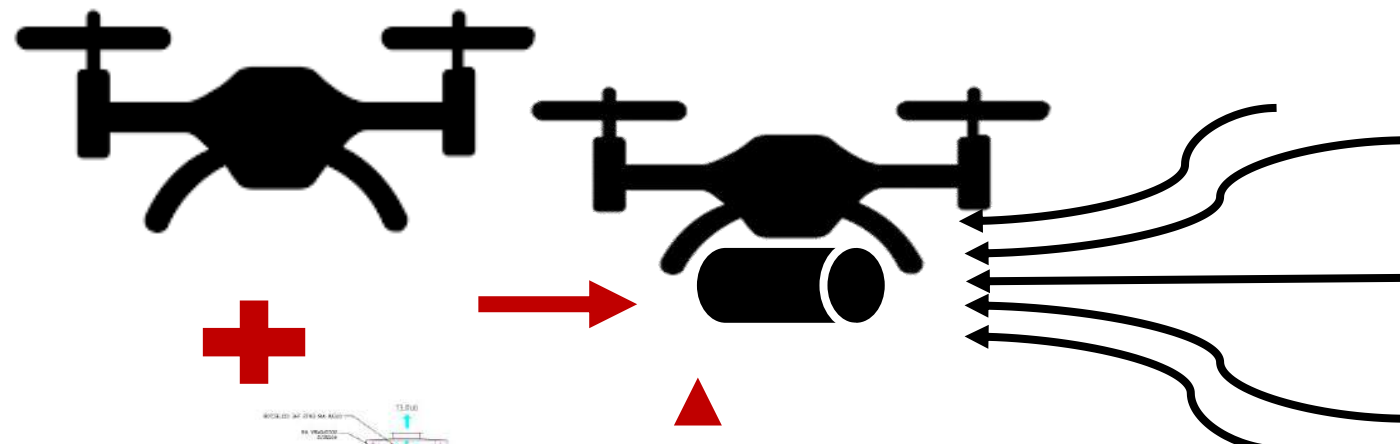


Nuvens de industrias não controladas

Agentes Bio e Qui

SoA

Integração

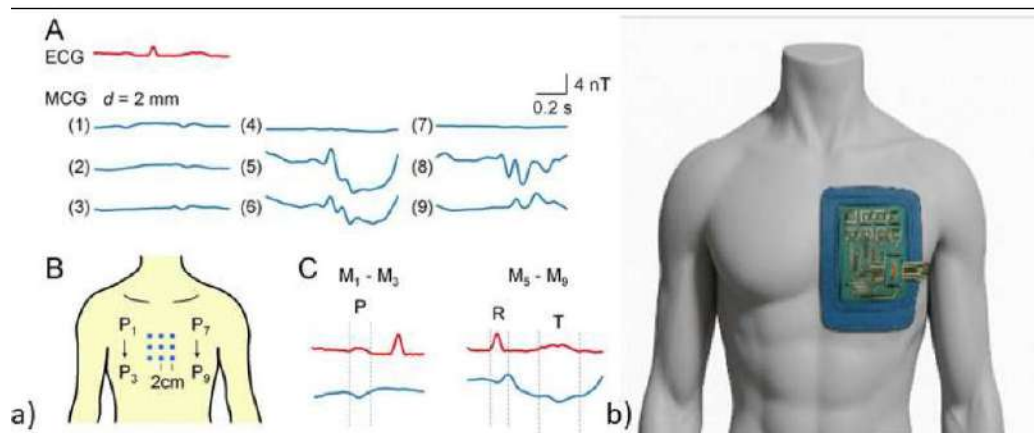


Colectores Aerossois



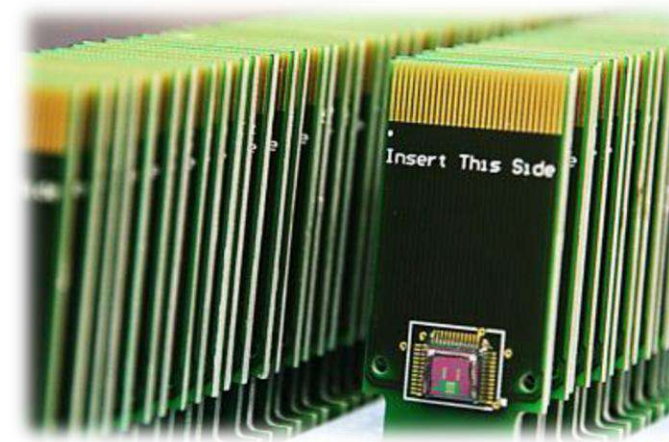
PCR portátil

Biometric signal detection



Stress Biomarkers detection

- i) **Free cortisol** (in sweat and saliva) – The most specific biomarker for stress;
- ii) **alpha amylase** (in saliva only);
- iii) **epinephrine** (in saliva, but more relevant in urine);
- iv) **IL-6** (in sweat).



Textile - Wearable electronics



Safefire (PCIF/SSO/0163/2019)

Graphene electrodes