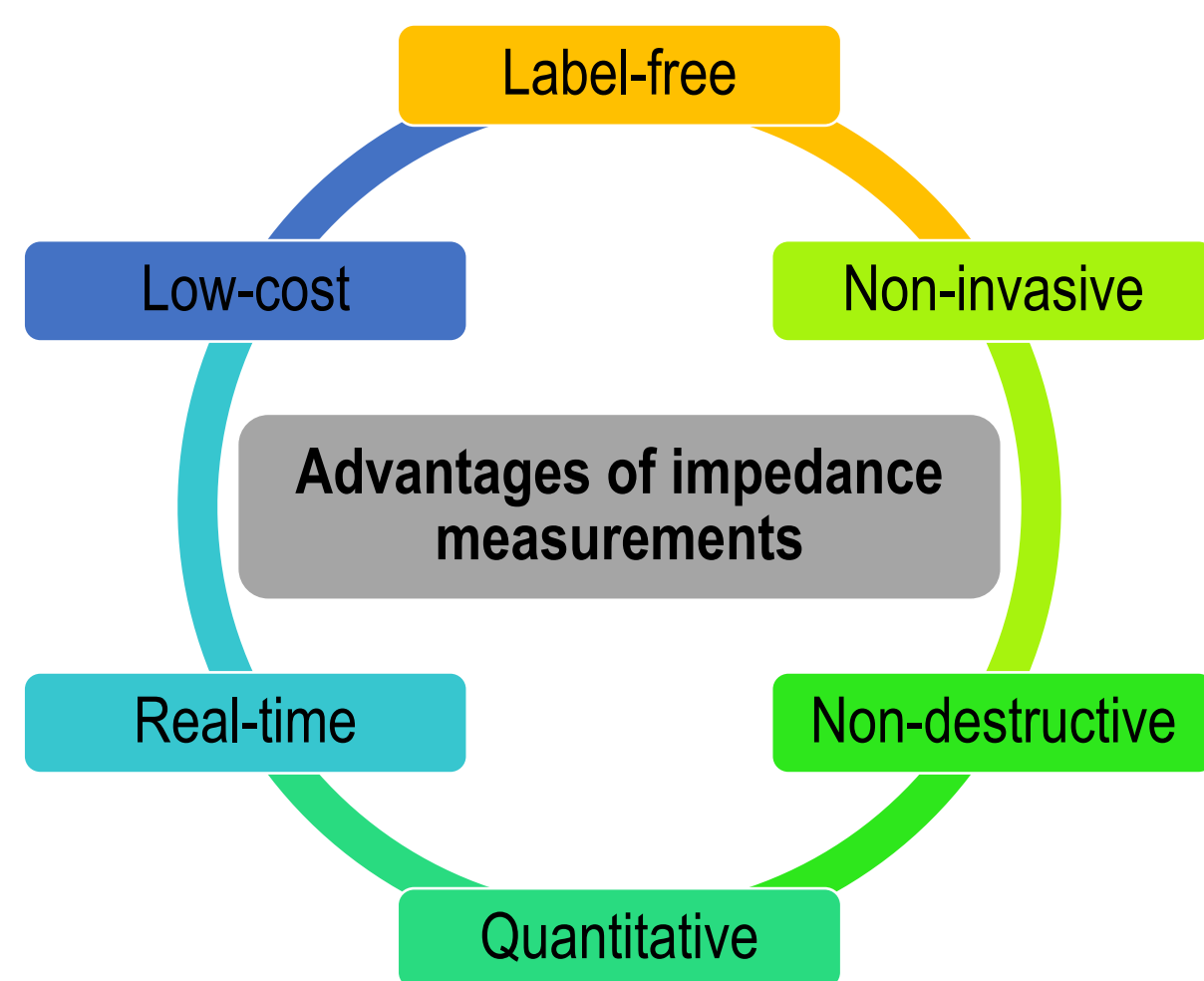
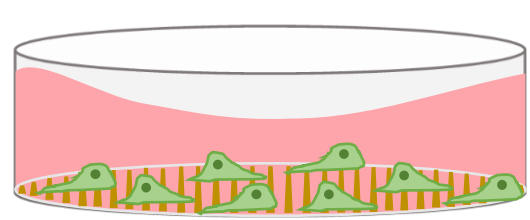


## Research context and motivation

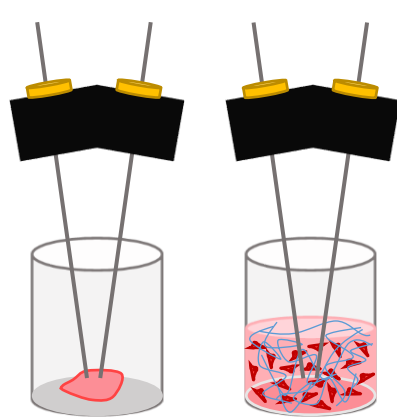
- Exploit the potential of impedance measurements in biotechnology-related applications and Point-of-care (POC) devices.



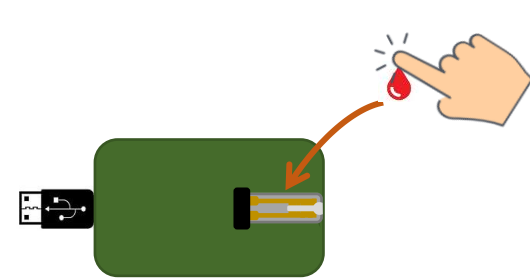
## Addressed research questions/problems



Real-time, low cost and long-term **cell culture monitoring** for the analysis of the temporal evolution of cellular changes and applications in clinical drug-response assays.



Label-free, fast and personalized **analysis of biopsies** with minimum disruption of their microenvironment for tissue characterization and clinical drug-response assays.



**POC device** for in-situ and real-time analysis of biological fluids. Potentially used both by clinicians in hospital contexts and by patients themselves at home, avoiding the burdensome standard procedures.

## Novel contributions

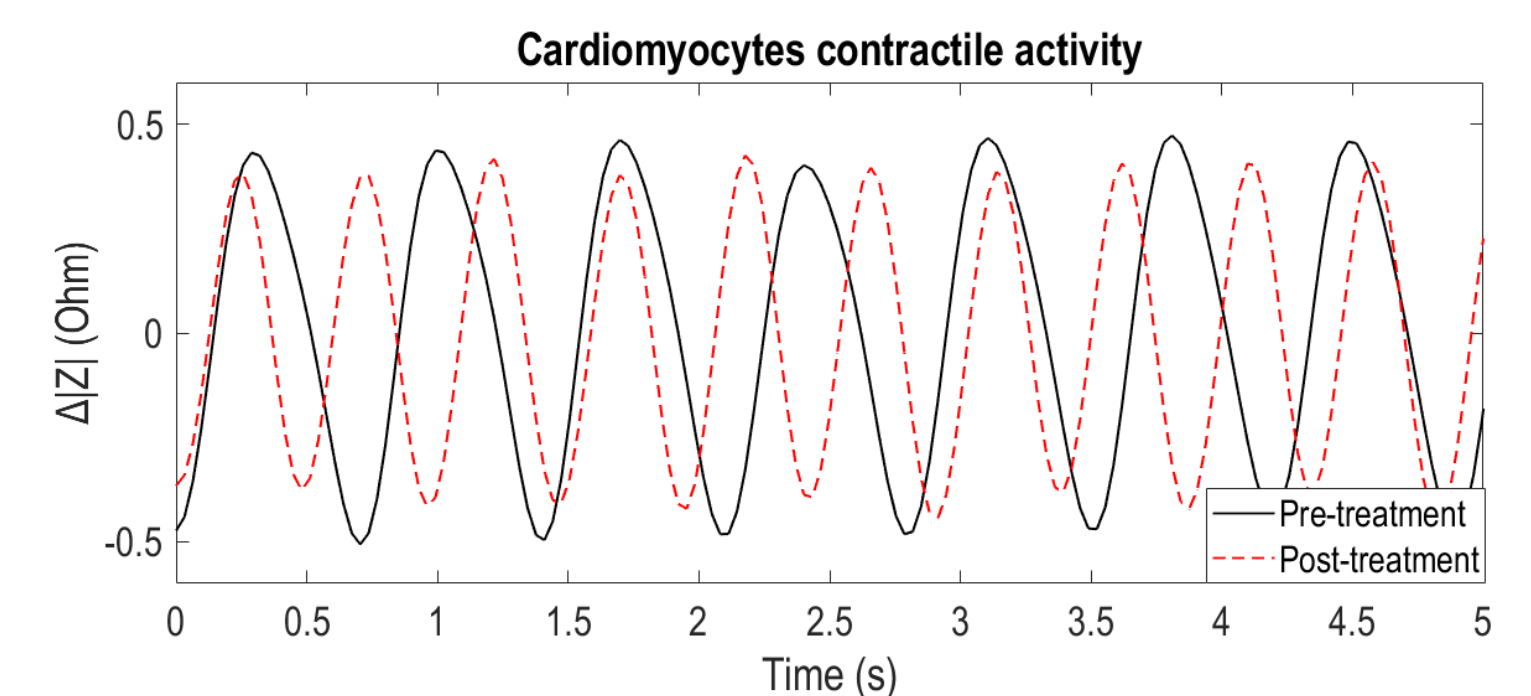
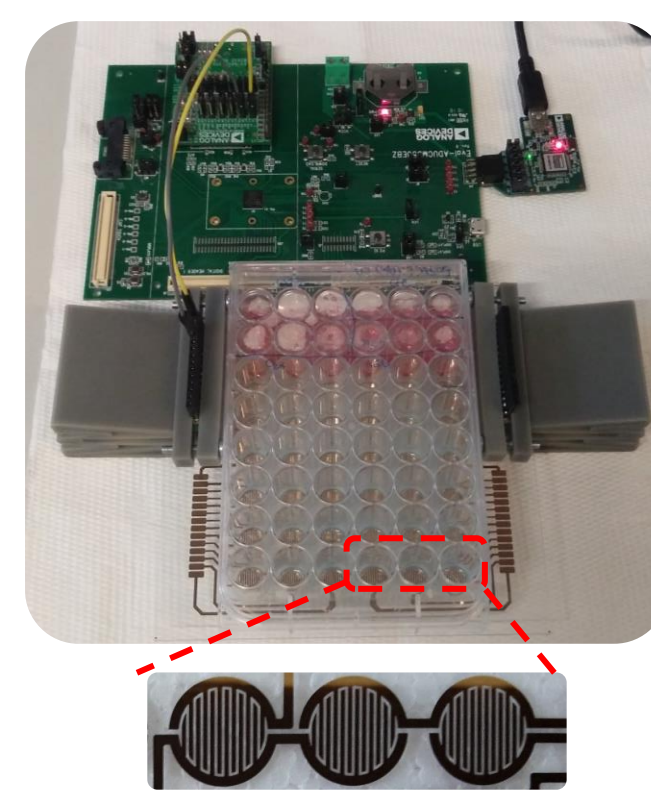
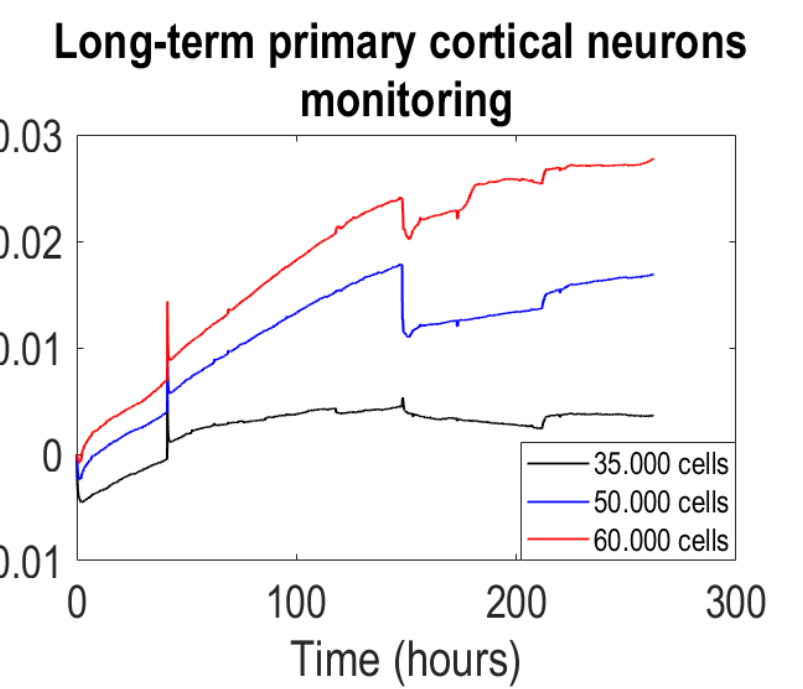
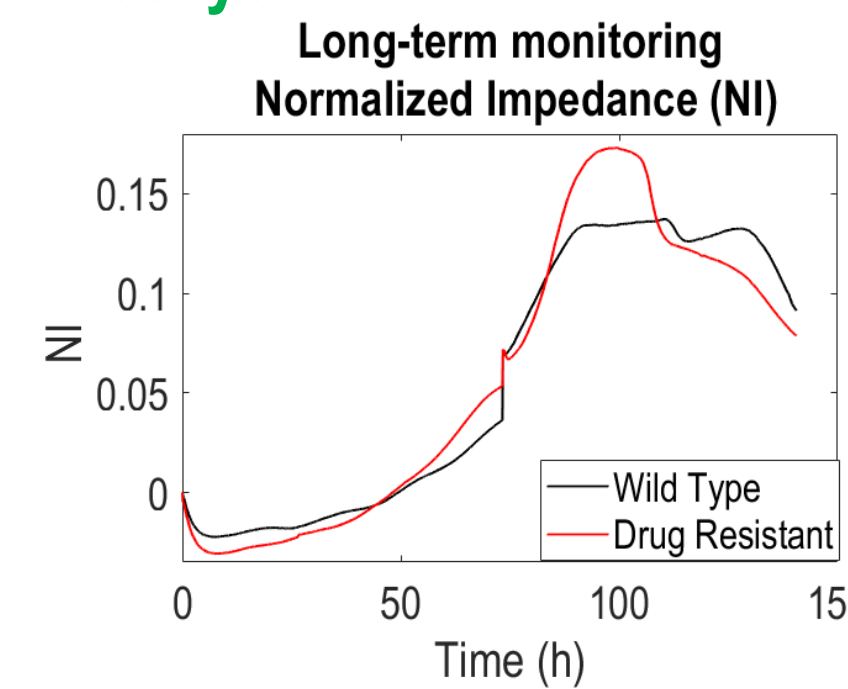
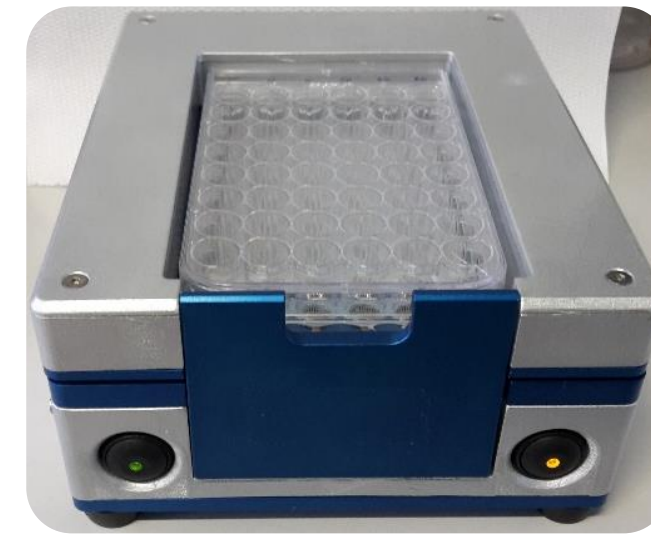
- Validation of the custom-made electric cell-substrate impedance sensing (ECIS) system for **real-time cell culture monitoring** and drug-screening, optimizing culture conditions for high throughput measurement.
  - ✓ **Long-term** cell culture monitoring.
  - ✓ Cell **adhesion** assay.
  - ✓ Drug **cytotoxicity** test.
  - ✓ **Contractile activity** recording of primary cardiomyocytes in-vitro.
  - ✓ Long-term monitoring of primary cortical **neurons** from extraction to **maturation**.
- Impedance-based **drug-resistance characterization** of colon cancer cells through real-time cell culture monitoring.
- Electrical Impedance-based **characterization of hepatic tissue with early-stage fibrosis**.
- Novel impedance-based **device for point-of-care** testing of biological fluids.

## Submitted and published works

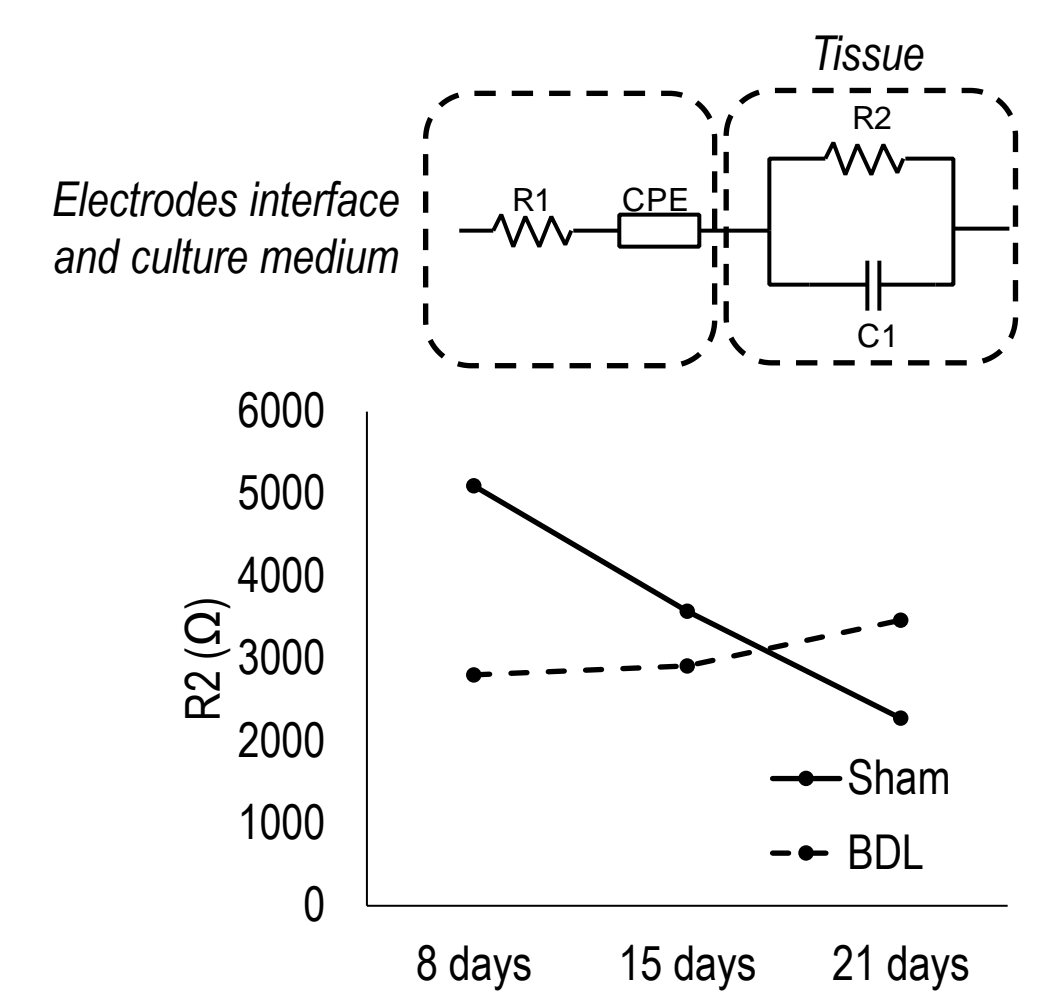
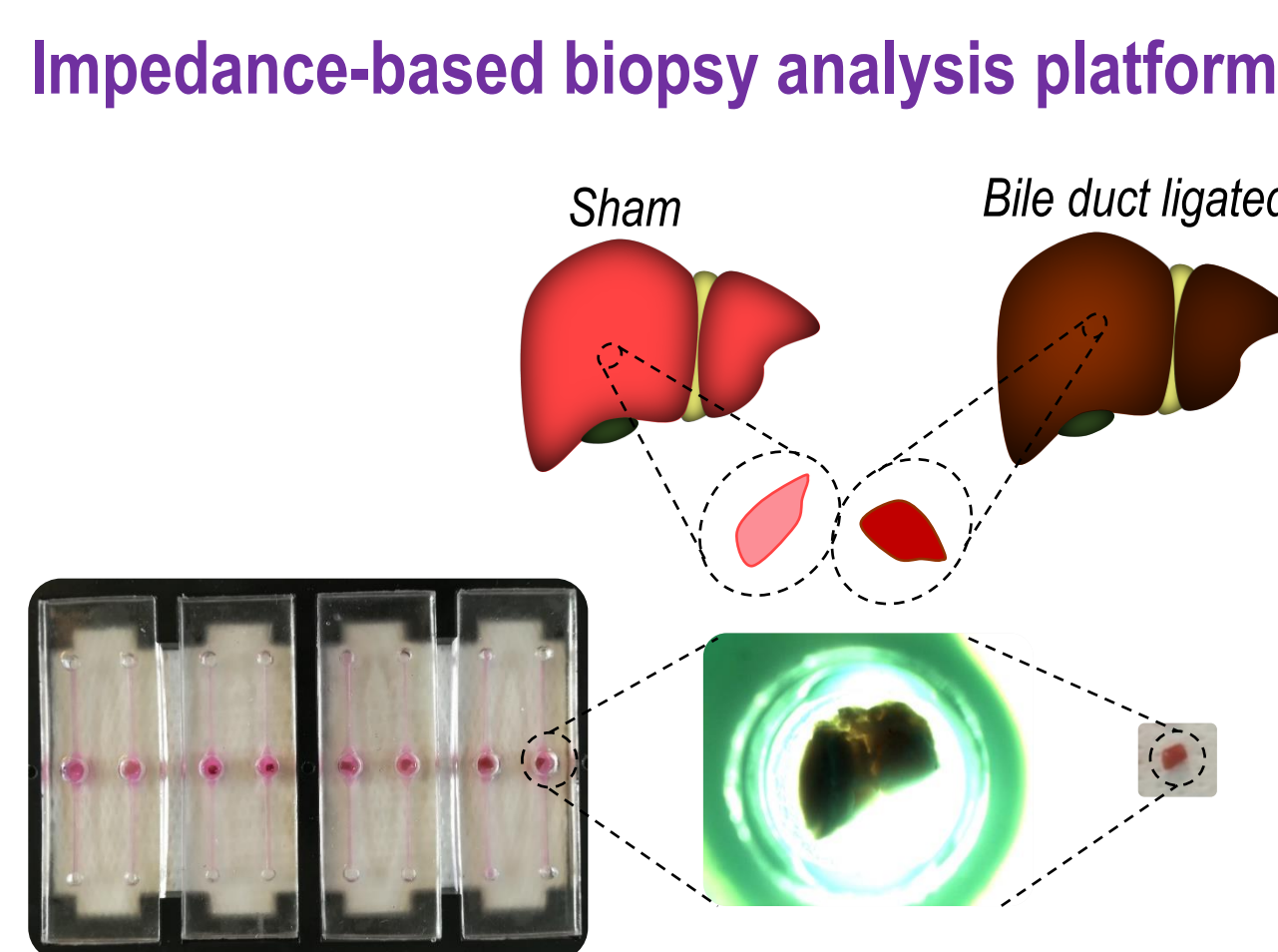
- Fuentes Vélez, S., Fagoonee, S., Sanginario, A., Gallo, V., Riganti, C., Pizzi, M., Altruda, F., & Demarchi, D., "Impedance-based drug-resistance characterization of colon cancer cells through real-time cell culture monitoring", *Talanta*, vol. 222, 2021, pp.1–8.
- Fuentes-Vélez, S., Fagoonee, S., Sanginario, A., Pizzi, M., Altruda, F., & Demarchi, D., "Electrical Impedance-Based Characterization of Hepatic Tissue with Early-Stage Fibrosis", *Biosensors*, vol. 12, no. 2, 2022, pp.1–12.
- Fuentes-Vélez, S., Cicioni, A., Sanginario, A., Gallo, V., Pizzi, M., Demarchi, D., "Overview of the Coagulation System and Clotting Time Measurement Techniques: Towards Hand-held Point-of-care Devices", *Bioengineering*, submitted September 2022.

## Adopted methodologies

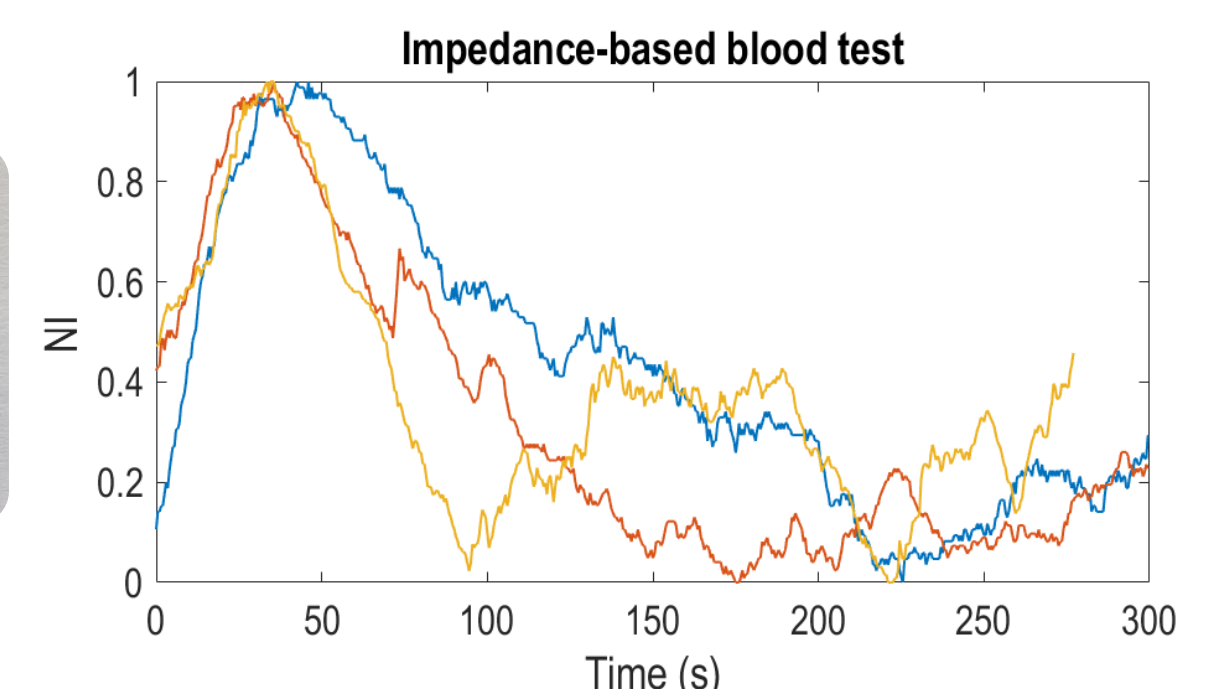
- Impedance-based cellular assays:**



- Impedance-based biopsy analysis platform:**



- Impedance-based biological fluids POC device:**



## Future work

- ECIS device integration for its conversion into a **multipurpose platform** capable of performing different kinds of impedance-based cellular assays.
- Microfluidics integration** for a biopsy/tissue-on-chip for clinical drug-response assays of patient-derived biopsies.
- Design and fabrication of **disposable electrodes** with integrated microfluidics for optimized impedance-based biological fluids testing.

## List of attended classes

- 01UKHKI - Applied spectroscopic methods (15/6/2020, 5 CFU)
- 01SIHRV - Bio-Nano Electronics and BioMolecular Computing (17/7/2020, 4 CFU)
- 02LWHRV - Communication (14/5/2020, 1 CFU)
- 02LCPRV - Experimental modeling: costruzione di modelli da dati sperimentali (9/2/2021, 7CFU)
- 01UNVRV - Navigating the hiring process: CV, tests, interview (8/1/2021, 1 CFU)
- 08IXTRV - Project management (20/3/2020, 1 CFU)
- 01RISRV - Public speaking (2/4/2020, 1 CFU)
- 01SWQRV - Responsible research and innovation, the impact on social challenges (17/4/2020, 1CFU)
- 01RGGRV - Telemedicine and Distributed Healthcare (24/1/2020, 4CFU)
- 01QSXRU - The measurement of electrical impedance (10/3/2021, 2 CFU)
- 01UNXRV - Thinking out of the box (13/11/2020, 1 CFU)
- 01SWPRV - Time management (29/4/2020, 1 CFU)
- 01QORRV - Writing Scientific Papers in English (5/6/2020, 3CFU)
- MICRO-614 - Electrochemical Nano-Bio-Sensing and Bio/CMOS interfaces (15/6/2020, 3CFU)
- MCB80.1x - Fundamentals of Neuroscience, Part 1: The Electrical Properties of the Neuron (10/3/2022, 3CFU)