University of Basel
Department of Biomedical Engineering

BIROMED-Lab
Medical Robotics and Mechatronics

Master Thesis: Gas analysis for non-invasive detection of bacterial contamination in cell cultures

Context: Organs-on-a-Chips (OoaC) are essential to ensure pharmaceutical pre-clinical safety. OoaCs are in vitro miniaturized simplified model systems of organs. Most OoaC engineering in academic research is carried out manually and is labour-intensive. We currently perform research to build an automated OoaC bioreactor that includes necessary functions to care for OoaC 24/7 (see Figure 1).
Usually, bacterial contamination is detected by humans in microscopy imaging, which is not automated, or by pH monitoring, which is not accurate and is invasive, as sensors should be added directly in contact with the OoaC perfusion medium. We aim to automatically detect bacterial contamination inside the automated OoaC bioreactor with compact and non-invasive sensors. It has been demonstrated that bacterial contamination can be detected in a non-invasive fashion using chromatography-mass spectrometry (GC-MS); however, GC-MS is expensive, bulky, and therefore, cannot be integrated inside bioreactors.
The question of whether compact, non-invasive, and automatic detection of bacterial contamination is feasible and effective to detect bacterial contamination in an OoaC automation context is your opportunity to work on an exciting project that impacts research and the pharmaceutical industry.

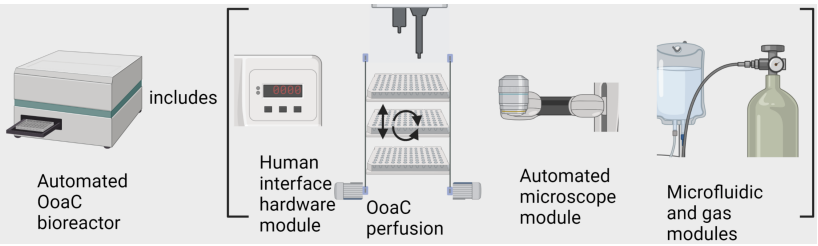

Figure 1: The main functions integrated with the automated OoaC bioreactor.

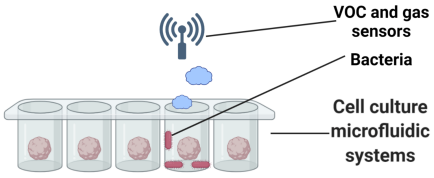

Figure 2: Bacterial contamination on an OoaC inside the automated bioreactor.

Task description: You will be responsible for selecting non-invasive, automation-friendly bacterial detection strategies and sensors. Your education in microbiology will be an asset to define and test a range of potential sensors (fig. 2) that deliver the bacterial contamination probability information to the control system.

Workpackages:

- review of the relevant literature on bacterial exometabolomics, bacterial detection using gas sensors, and volatile organic compounds (VOC) sensors
- design an array of solutions and assess their integration feasibility with the existing device
- test and compare 2 to 3 solutions on detection of non-pathogenic bacteria
- setup the bacterial contamination probability information into the existing control system

Start: FS 2024 or upon agreement
Duration: 6 months
Location: Allschwil, Basel-Landschaft
Unpaid

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