

COLLABORATIVE IBEC INTERNATIONAL PhD PROGRAMME

Position

1. Project Title:
Computational Methods for the Fast Evaluation of the Quality of Fecal Donations using Untargeted Chemical Analysis
2. Research project/ Research Group description

The study of the microbiome is transforming medicine, offering insights into conditions from psychiatric disorders, such as depression and anxiety, to the efficacy of immunotherapy in advanced cancer treatment. Central to this are the immunomodulatory functions of the gut microbiota, often considered a functional organ. Short-chain fatty acids (SCFAs), key metabolites, maintain intestinal health and modulate immune responses, profoundly influencing therapeutic outcomes.

Fecal microbiota transplantation (FMT) has shown great promise in restoring healthy microbiota, with evidence supporting its role in enhancing responses to immunotherapy for certain cancers. However, the success of FMT hinges on the quality of donor samples, where high SCFA levels serve as a critical indicator. Current SCFA measurement methods are resource-intensive and unsuited for large-scale donor screening, limiting their utility in microbiota biobanks.

This proposal aims to address this gap by integrating ion mobility spectrometry (IMS), Fourier Transform Infrared (FTIR) spectroscopy, and advanced computational methods to enable rapid, untargeted analysis of fecal samples. Signal processing techniques, such as noise reduction and feature extraction, will enhance spectral data quality, while machine learning (ML) models will identify patterns correlating spectral signatures with SCFA levels. Together, these approaches will provide an efficient and scalable solution for ranking and selecting high-quality microbiota samples.

By establishing this spectrometry-based screening platform, the Catalan Microbiota Bank can streamline the identification of suitable samples for advanced clinical applications, such as FMT for immunotherapy. This innovative integration of IMS, FTIR, and computational analysis will accelerate microbiota-based therapies, expanding their clinical relevance and impact.

3. Job position description

PhD Student in Computational Spectroscopy for Microbiota Analysis

We are seeking a highly motivated PhD student to join our interdisciplinary team working on the development of computational methods for rapid untargeted analysis of microbiota samples using ion mobility spectrometry (IMS) and Fourier Transform Infrared (FTIR) spectroscopy. This project focuses on advanced signal processing and machine learning techniques to identify high-quality fecal microbiota samples for clinical applications, such as fecal microbiota transplantation (FMT) and immunotherapy enhancement.

Key Responsibilities:

- Develop and implement signal processing pipelines for spectral data, including noise reduction, baseline correction, and feature extraction.
- Design and train machine learning models to correlate spectral signatures with key microbiota quality indicators, such as short-chain fatty acid (SCFA) concentrations.
- Optimize algorithms for scalability to enable the analysis of large datasets from microbiota biobanks.
- Collaborate with experimental and clinical teams to validate computational findings and integrate methods into practical workflows.
- Publish findings in high-impact journals and present at international conferences.

Requirements:

- A Master's degree in data science, artificial intelligence, biomedical engineering,, physics, or a related field.
- Strong background in signal processing, machine learning, and data analysis.
- Proficiency in programming languages such as R, MATLAB or Python.
- Experience with spectroscopic data or bioinformatics is highly desirable.
- Excellent communication skills and the ability to work in a multidisciplinary team.

This position offers an opportunity to contribute to cutting-edge research with direct clinical relevance, advancing the role of computational methods in microbiota-based therapies.

Group Leader at IBEC

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