PHD job description

Starting period: September 2021   **Salary:** 2852.72€ /month

Location : Marseille IRPHE   **Duration :** 36 months

PHD subject title: A new geo-inspired mixer to optimize bioreactors

Objectives: Characterize mixing in a soft mixer in order to maximize transport while minimizing shear.

Expected Results: Large output growing of biological cells is difficult because cells need a large supply of oxygen (hence large mixing rates) but they are killed by large shear strains. Thus, bioreactors require efficient mixing yet very smooth stirring. Such a "soft mixer", inspired by the precession of the Earth, has recently been proposed in a patent, which is currently tested for algae growth by a local start-up company.

The bioreactor consists of a cylindrical container rotating slowly around its axis. The flow is forced by the motion of the free surface with respect to the cylinder due to the small angle between the axis and the vertical. This generates a strong resonance of the flow leading to a large increase of scalar transport, while decreasing the small-scale shear. The goal of the project is to improve the fundamental knowledge on mixing in this simple configuration which can be tuned to generate a 3D laminar or a turbulent flow. The mixing characteristics (stirring law, mixing times, concentration distributions) of the "soft mixer" will be investigated using Laser Induced Fluorescence measurements. In parallel, the flow will be characterized through PIV measurements (mean velocities and shear, PDF of velocity and shear) and described analytically using the eigen modes of rotating fluids. The mixing properties will then be recovered using a new numerical technique based on diffusive Lagrangian tracers.

Context/Benefits:
This PhD work is part of the Innovative Training Network CoPerMix (grant number 956457) on Control, Prediction and Learning in Mixing Processes funded by the European Union Marie Skłodowska-Curie Program. The objective of the network is to develop a unified vision, numerical tools, and experimental techniques allowing the fundamental description and the quantification of mixing processes in complex flows spanning a broad range of applications[1].

Website: www.copermix-itn.eu

Eligibility:

At the time of recruitment, the applicant must not have resided or carried out his/her main activity (work, studies, etc.) in the country of the host organization for more than 12 months in the 3 years immediately prior to his/her recruitment. Compulsory national service and short stays such are not taken into account.

For applications, please send cover letter and CV to:
Emmanuel Villermaux - emmanuel.villermaux@univ-amu.fr
Patrice Meunier - patrice.meunier@univ-amu.fr

---

[1] *If this position is not quite right for you but you are interested in the science of mixing, we have 14 other PhD offers within the Network available on EURAXESS. For more information on the project: www.copermix-itn.eu*