Ecole graduée

Sciences de l'Ingénierie et des Systèmes

EGENGSYS

Titre Thèse (subject)	Rayleigh–Bénard convection through two immiscible fluid layers	
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Equipe (research team)	Mécanique des fluides complexes (MFC)	Web : https://uml.univ-lille.fr/recherche/mecanique-des-fluides-complexes-mfc
Financement prévu ☒	Contrat Doctoral Etablissement ☒ Région – Autre Contrat de recherche Préciser :	ULille ☒ UPHF Centrale Lille UGE IMT Autre
Financement acquis ?	Contrat Doctoral Etablissement Région – Autre Contrat de recherche Préciser :	ULille UPHF Centrale Lille UGE IMT Autre

Résumé du sujet (abstract):

Context. Convective flows in multiple fluid layers is ubiquitous in nature and technology (ex. the coupled flows between the ocean and the atmosphere, Earth mantle convection, liquid encapsulated cristal growth,…). Compared with flows with only a single layer, multilayer flows have more complicated dynamics and thus more complicated global transport properties. The underlying mechanisms governing the dynamics of such systems can generally be attributed to the coupled action of buoyancy and capillary forces. The influence of these forces, in conjunction with the thermal and viscous interactions at the fluid-fluid interfaces result in a plethora of unique thermoconvective modes. In order to investigate the dynamics of two-layer thermal convection, we choose the classical Rayleigh–Bénard (RB) system, where two immiscible fluid layers are heated from below and cooled from above.

Work plan and goal. In this thesis, the dynamics of the two-layer RB system will be investigated theoretically and numerically. Owing to the interfacial interactions and the possibility of convection onset in the individual layers, the two-layer system typically exhibit diverse excitation modes, which range from non-oscillatory mechanical/thermal couplings to oscillatory standing/travelling waves. We intend to investigate the regimes of occurrence of such convective modes via linear and weakly nonlinear stability analyses. System dynamics and global transport properties in the fully nonlinear regime will then be investigated by means of direct numerical simulations. The PhD student will work in close collaboration with Professor Diwakar from JNCASR (India). His team will carry on the experimental part of the investigation and a research stay in India can be envisaged for the future PhD student.

Research team. The PhD thesis (starting in October 2023) will be conducted at UML laboratory, Lille. It will benefit from an ongoing collaboration with F. Zoueshtiagh (IEMN), A. Duchesne (IEMN), and S. V. Diwakar (JNCASR, India) for the experimental part.

Candidate. Good knowledge of fluid mechanics or dynamical systems will be appreciated and also an interest for numerical methods; Master in Fluid Mechanics, Physics, Geophysical Fluid Dynamics, or Applied Mathematics. Good knowledge of oral and written English is required.

Application. Interested candidates should send their CV, a letter of motivation, and contact information of two references.