# XJTLU-XJTU-UoL Joint Doctoral Supervision Project (Full-time)

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| Reference No. | SFXJTU2512 |
| XJTLU School | Design School |
| PhD Programme | Civil Engineering |
| Supervisors | XJTLU supervisor: Professor Konstantinos Papadikis<br>XJTU supervisor: Professor Linlin Fei<br>UoL supervisor: Dr Davide Dapelo |
| Project Title | Direct numerical simulation of droplet impact on deformable porous media at pore scale<br>液滴撞击可变性多孔介质的孔隙尺度直接数值模拟 |
| Application Deadline | Open until the position is filled |

**Requirements:**

A UK first-class or upper second-class honours Bachelor's degree and a UK Master's degree with Merit (or their equivalent) are required for PhD admissions. Exceptional candidates holding only a Bachelor's degree may be considered on an individual basis.

Evidence of good spoken and written English is essential. The candidate should have an IELTS (or equivalent) score of 6.5 or above, if the first language is not English.

For more information about entry requirements and admission procedures of PhD programme at XJTLU, Please visit:

Entry Requirement - Xi'an Jiaotong-Liverpool University

How to Apply - Xi'an Jiaotong-Liverpool University

**Programme Structure:**

Doctoral students in the joint programme are registered with both XJTLU and the UoL. Upon successful completion of the programme, the students will be awarded a PhD degree from University of Liverpool.

During their doctoral studies at XJTLU, students are expected to conduct research at XJTU as visiting students. Additionally, students have the opportunity to apply for a three to six-month research visit to UoL.

**Project Description:**

The impact of droplets on deformable porous media is a complex multiphysics phenomenon with applications ranging from agricultural irrigation and soil erosion to industrial processes like filtration and additive manufacturing. While existing studies often simplify porous media as rigid structures or employ continuum-scale models, this project proposes a novel pore-scale investigation using a coupled Lattice Boltzmann Method (LBM) and Discrete Element Method (DEM) framework to resolve the interplay between fluid dynamics, interfacial interactions, and solid-phase deformation. The primary objective is to advance fundamental understanding of how pore-scale geometric and mechanical properties of deformable porous media influence droplet impact outcomes, including spreading, penetration, rebound, and structural rearrangement of the porous substrate.

The LBM will be employed to simulate the multiphase fluid dynamics of the droplet, capturing interfacial tension, wetting effects, and pore-scale fluid transport. Concurrently, DEM will model the deformable porous medium as an assembly of bonded or frictional particles, enabling explicit tracking of contact forces, particle displacements, and dynamic changes in porosity and permeability during impact. A two-way coupling scheme will integrate fluid-solid interaction (FSI) forces, where fluid stresses from LBM act on DEM particles, and particle motion feeds back into the fluid solver via dynamic boundary conditions. This approach ensures high-fidelity resolution of transient processes such as droplet breakup, capillary invasion, and substrate compaction/fracture.

Key parameters to be investigated include droplet impact velocity, fluid viscosity, wettability, pore-size distribution, and the elastic/plastic properties of the porous medium. The study will quantify metrics such as infiltration depth, energy dissipation, and deformation thresholds that govern transitions between absorption, splashing, and substrate failure.

Anticipated outcomes include predictive correlations between pore-scale morphology, material compliance, and macroscopic impact behavior, offering design guidelines for tunable porous materials in applications requiring controlled fluid absorption or damage resistance. The coupled LBM-DEM framework developed here will also establish a computational benchmark for future studies of dynamic fluid-structure interactions in multi-scale porous systems.

Keywords: Droplet impact, porous media deformation, Lattice Boltzmann Method, Discrete Element Method, fluid-structure interaction, pore-scale modeling.

**Joint Supervisory Team:**

XJTLU supervisor: Professor Konstantinos Papadikis

XJTU supervisor: Professor Linlin Fei

UoL supervisor: Dr Davide Dapelo

**How to Apply:**

Interested applicants are advised to email Professor Konstantinos Papadikis (Konstantinos.Papadikis@xjtlu.edu.cn) the following documents for initial review and assessment (please put the project title in the subject line).

- CV
- Two formal reference letters

- Personal statement outlining your interest in the position
- Certificates of English language qualifications (IELTS or equivalent)
- Full academic transcripts in both Chinese and English (for international students, only the English version is required)
- Verified certificates of education qualifications in both Chinese and English (for international students, only the English version is required)
- PDF copy of Master Degree dissertation (or an equivalent writing sample) and examiners reports available