

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

Reference No.	SFXJTU2627
XJTLU School	School of Advanced Technology
PhD Programme	Computer Science and Software Engineering
Supervisors	XJTLU supervisor: Dr. Haiyang Zhang 张海洋 XJTU supervisor: Professor. Feng Xu 徐峰 UoL supervisor: Dr. Kevin Hamill XJTLU Co-supervisor: Professor. Zhijie Xu 许志杰
Project Title	AI 赋能力医学数据库与肿瘤侵袭机制建模
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](#)

Other Requirements (if any):

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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:

1. 项目方向

肿瘤的侵袭和转移不仅由基因突变驱动，也受到肿瘤微环境中力学因素的重要影响，例如细胞外基质刚度升高、应力分布异常、胶原纤维重塑和组织结构异质性等。然而，目前相关证据分散在病理影像、弹性成像、力学测试、分子组学和临床数据等不同模态中，缺乏统一的数据标准、跨尺度对齐方法和可解释建模框架。本项目拟构建面向肿瘤力学生物学的多模态专病数据库，融合数字病理、弹性成像、力学测量、分子特征和临床结局等数据，发展结构—力学一致对齐方法和可解释人工智能模型，揭示肿瘤微结构重塑如何影响力学表型，并进一步驱动侵袭和转移风险。

2. 你将参与的核心研究内容

肿瘤力学生物学专病数据库构建：围绕典型实体肿瘤，整合病理图像、弹性成像、力学测试、分子组学和临床结局等多模态数据，建立可追溯、可复用、可扩展的数据资源。

结构—力学跨模态对齐方法研究：探索如何将二维病理图像、三维力学成像、组织力学参数和分子标志物进行统一表达，实现肿瘤微结构变化与力学表型之间的精细关联。

可解释 AI 与图模型建模：结合多示例学习、图神经网络、超图模型和物理约束神经网络等方法，建立从“微结构重塑—力学表型—侵袭风险”的机制建模框架。

侵袭风险预测与机制解释：面向精准肿瘤诊疗需求，发展可解释的侵袭风险预测模型，形成可审计的力学证据链，为后续临床风险评估和疗效预测提供支持。

Tumor invasion and metastasis are driven not only by genetic mutations, but also by mechanical factors within the tumor microenvironment, such as increased extracellular matrix stiffness, abnormal stress distribution, collagen fiber remodeling, and tissue structural heterogeneity. However, current evidence remains scattered across different modalities, including pathological imaging, elastography, mechanical testing, molecular omics, and clinical data. There is still a lack of unified data standards, cross-scale alignment methods, and explainable modeling frameworks. This project aims to construct a multimodal disease-specific database for tumor mechanobiology by integrating data from digital pathology, elastography, mechanical measurements, molecular features, and clinical outcomes. It will develop structure - mechanics-consistent alignment methods and explainable artificial intelligence models to reveal how tumor microstructural remodeling influences mechanical phenotypes and further drives the risk of invasion and metastasis.

Joint Supervisory Team:

XJTLU supervisor: 张海洋博士，2013 年获吉林大学软件工程学士学位，2018 年获爱尔兰利莫瑞克大学博士学位，2018 至 2021 年在英国谢菲尔德大学从事博士后研究，现为西交利物浦大学助理教授、博士生导师。长期从事信息检索、自然语言处理、弱监督学习与可信智能研究，在偏差分析与因果解耦、PU Learning、可解释智能分析、生物医学信息检索及医疗智能应用等方向形成了较系统的研究积累。累计发表高水平学术论文 40 余篇，其中 SCI 收录 15 篇，Google Scholar 引用 1000 余次。代表性成果发表于 WSDM、ICLR、AAAI、COLING、ACM TIST 等重要会议和期刊。

XJTU supervisor: 徐峰教授，西安交通大学生命学院教授、博士生导师，生物医学信息教育部重点实验室主任，国家医学攻关产教融合平台智慧诊断技术及装备中心主任。获英国剑桥大学工程学博士学位，曾在哈佛医学院及 Harvard-MIT 健康科学与技术研究中心从事博士后与研究员工作，获国家自然科学基金委优秀青年基金和杰出青年基金支持。长期从事生物力学与力学生物学交叉研究，在肿瘤、心血管及组织工程方向取得系统性成果。以第一或通讯作者在 Nature Chemistry、PNAS、Nature Communications 等期刊发表论文 350 余篇，总引用 3.2 万余次，获授权发明专利 60 余项，曾获国家自然科学奖二等奖等。

UoL supervisor: Kevin Hamill 博士，现任英国利物浦大学健康与生命科学学院、生命历程与医学科学研究所 Eye & Vision Sciences 方向 Reader。Hamill 博士早年在英国邓迪大学完成博士研究，曾作为 Wellcome Trust Prize student 开展人类遗传性疾病相关分子机制研究，重点关注创伤愈合障碍 Laryngo-oncho-cutaneous syndrome 的遗传与分子基础。Hamill 博士长期深耕细胞微环境如何调控细胞行为这一核心科学问题，研究方向涵盖层粘连蛋白网络组装、LaNt 蛋白功能、角膜稳态、表皮创伤修复、血管生成、鳞状细胞癌发生发展及侵袭转移等。他的研究方法横跨组织学分析、遗传学、组学、分子与细胞生物学、活细胞成像以及二维、三维和四维荧光成像等多个层面，兼具基础机制研究与疾病转化应用特色。

XJTLU co-supervisor: 许志杰教授，现任西交利物浦大学计算机系主任，国家部委国家级杰出人才。2024 年加入西交利物浦大学之前，他曾任英国哈德斯菲尔德大学全职教授，专攻视觉计算领域。任职期间，他承担了计算机科学与工程多个学科的本科及研究生课程开发与教学工作，涵盖计算机图形学、计算几何、游戏与扩展现实（VR/AR/MR/XR）、数字图像处理、计算机视觉等方向，同时负责各类团队式及工作室项目的指导工作。徐志杰教授拥有 30 余年研究经验，研究领域广泛，深耕实时图形学、交互式可视化、机器视觉、机器人技术、智能系统、计算语言学、机器学习及计算机体系结构等多个方向。他已指导 20 余名博士生顺利毕业，发表同行评审论文 200 余篇，主编著作 5 部；持有十余项视觉与可视化相关专利，覆盖新算法、新模型、设备装置等多个维度。他曾牵头、联合牵头多项重大科研项目，并担任英国研究理事会（RCUK）、“欧洲地平线”计划等资助机构重大项目的同行评审专家，个人牵头项目累计获得经费超 150 万英镑。

****XJTLU Supervisor:****

Dr Haiyang Zhang received his BSc degree in Software Engineering from Jilin University in 2013 and his PhD degree from the University of Limerick, Ireland, in 2018. From 2018 to 2021, he conducted postdoctoral research at the University of Sheffield, UK. He is currently an Assistant Professor and PhD Supervisor at Xi'an Jiaotong-Liverpool University. Dr Zhang has

long been engaged in research on information retrieval, natural language processing, weakly supervised learning, and trustworthy intelligence. He has developed systematic research expertise in bias analysis and causal disentanglement, PU learning, explainable intelligent analytics, biomedical information retrieval, and AI-enabled healthcare applications. He has published more than 40 high-quality academic papers, including 15 SCI-indexed papers, with over 1,000 citations on Google Scholar. His representative work has appeared in leading conferences and journals such as WSDM, ICLR, AAAI, COLING, and ACM TIST.

****XJTU Supervisor:****

Professor Feng Xu is a Professor and PhD Supervisor at the School of Life Science and Technology, Xi'an Jiaotong University. He serves as Director of the Key Laboratory of Biomedical Information Engineering of the Ministry of Education and Director of the Intelligent Diagnostic Technologies and Equipment Center under the National Medical Research–Industry Integration Platform. He received his PhD in Engineering from the University of Cambridge and subsequently conducted postdoctoral research and served as a research scientist at Harvard Medical School and the Harvard–MIT Health Sciences and Technology Institute. He has been supported by the Excellent Young Scientists Fund and the Distinguished Young Scholars Fund of the National Natural Science Foundation of China. Professor Xu has long been engaged in interdisciplinary research in biomechanics and mechanobiology, with systematic contributions in tumor biology, cardiovascular diseases, and tissue engineering. As first or corresponding author, he has published more than 350 papers in journals including **Nature Chemistry**, **PNAS**, and **Nature Communications**, with more than 32,000 citations in total. He holds over 60 authorized invention patents and has received major awards including the Second Prize of the National Natural Science Award.

****UoL Supervisor:****

Dr Kevin Hamill is currently a Reader in Eye & Vision Sciences at the Institute of Life Course and Medical Sciences, Faculty of Health and Life Sciences, University of Liverpool. Dr Hamill completed his doctoral research at the University of Dundee, where, as a Wellcome Trust Prize student, he investigated the molecular mechanisms underlying human inherited diseases, with a particular focus on the genetic and molecular basis of the wound-healing disorder laryngo-onycho-cutaneous syndrome. Dr Hamill has long focused on the fundamental question of how the cellular microenvironment regulates cell behaviour. His research interests include laminin network assembly, LaNt protein function, corneal homeostasis, epidermal wound repair, angiogenesis, and the development, invasion, and metastasis of squamous cell carcinoma. His research approaches span histological analysis, genetics, omics, molecular and cellular biology, live-cell imaging, and two-, three-, and four-dimensional fluorescence imaging, combining fundamental mechanistic studies with translational disease research.

****XJTLU Co-supervisor:****

Professor Zhijie Xu is currently Head of the Department of Computing at Xi'an Jiaotong-Liverpool University and a nationally recognised distinguished talent under a national ministry-level talent programme. Before joining Xi'an Jiaotong-Liverpool University in 2024, he was a

full Professor at the University of Huddersfield, UK, specialising in visual computing. During his tenure there, he was responsible for the development and delivery of undergraduate and postgraduate courses across multiple areas of computer science and engineering, including computer graphics, computational geometry, games and extended reality technologies (VR/AR/MR/XR), digital image processing, and computer vision. He also supervised a wide range of team-based and studio-style projects. Professor Xu has more than 30 years of research experience across a broad range of areas, including real-time graphics, interactive visualisation, machine vision, robotics, intelligent systems, computational linguistics, machine learning, and computer architecture. He has supervised more than 20 PhD students to successful completion, published over 200 peer-reviewed papers, and edited five books. He holds more than ten patents related to vision and visualisation, covering new algorithms, models, and devices. He has led and co-led several major research projects and has served as a peer-review expert for major funding bodies, including the UK Research Councils (RCUK) and the European Horizon programme. The projects he has led as principal investigator have secured more than £1.5 million in research funding.

How to Apply:

Interested applicants are advised to email haiyang.zhang@xjtlu.edu.cn the following documents for initial review and assessment (Please include 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