

PhD Topic title

AI-Driven Multimodal Biomedical Data Fusion

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No

Expiration date: day, month, year

Long-term

PhD Topic description/details

Technological advances in biomedicine now enable the collection of high-dimensional, heterogeneous data across multiple platforms, including imaging, genomics, transcriptomics, metabolomics and clinical information, providing a comprehensive view of disease biology. Despite this, integrating such multimodal data remains challenging due to the complex interactions across data types. Artificial intelligence (AI), particularly transformer-based models behind the modern interactive and generative AI, provides new opportunities to contextualise within-modality features and uncover latent relationships across modalities through self-attention and cross-attention mechanisms. This project aims to develop advanced AI models to fuse multi-modal imaging, multi-omics, and preclinical/clinical datasets to predict immunotherapy outcomes and uncover mechanisms of response and resistance. You will have opportunities to gain experience in research into representative AI architectures including the transformer, other state space models (e.g. Mamba) and hybrid models (e.g. Jamba and Griffin).

You may focus on one or more of the following key research directions, with potential outcomes, including:

- (1) developing and validating models for accurate patient stratification, including early identification of non-responders to immunotherapy.
- (2) revealing key spatial and molecular determinants of therapy resistance, integrating imaging and omics signatures.
- (3) developing composite non-invasive biomarkers that fuse imaging and multi-omics data for precise prediction of treatment response,
- (4) informing new clinical decision protocols, enabling better patient selection and targeted combination therapy,
- (5) establishing mechanistic links between tumour microenvironmental factors like hypoxia and metabolic reprogramming and immunotherapy resistance.
- (6) guiding drug development by identifying critical molecular targets associated with immunotherapy response, with the long-term goal of overcoming resistance and improving patient outcomes in immunotherapy.

The successful candidate will be jointly based in the Department of Computer Science and Department of Biosciences at Brunel University of London. The project will be co-supervised by Prof Yongmin Li (specialised in Artificial Intelligence and Data Science) and Dr Doreen Lau (specialised in Cancer Immunology,

Immunotherapy and Biomedical Imaging). This interdisciplinary environment will provide comprehensive training in AI model development, computational biology, cancer immunology and translational biomedical research.

For informal enquiries about the research, please email yongmin.li@brunel.ac.uk.

Supervisor(s)

Prof Yongmin Li and Dr Doreen Lau

<https://www.brunel.ac.uk/people/yongmin-li>

<https://www.brunel.ac.uk/people/aihuidoreen-lau>

Subject(s) – here you can find the list of subject areas:

Computer Science

Biosciences

Research Centre(s)

N/A

Challenge area(s)

- Health
- Biosciences
- Artificial intelligence
- Data science

Research Group(s)

Intelligent Data Analysis

Biosciences

Doctoral Training Programmes or indicate ‘not applicable’

N/A

Funding

Self-funded.

Brunel offers a number of funding options to research students that help cover the cost of their tuition fees, contribute to living expenses or both. See more information [here](#) The UK Government is also offering Doctoral Student Loans for eligible students, and there is some funding available through the Research Councils. Many of our international students benefit from funding provided by their governments or employers. Brunel alumni enjoy tuition fee discounts of 15%.

How to apply

If you are interested in applying for the above PhD topic please follow the steps below:

- Contact the supervisor by email or phone to discuss your interest and find out if you would be suitable. Supervisor details can be found on this topic page. The supervisor will guide you in developing the topic-specific research proposal, which will form part of your application.

- Click on the 'Apply here' button on this page and you will be taken to the relevant PhD course page, where you can apply using an online application.
- Complete the online application indicating your selected supervisor and include the research proposal for the topic you have selected.