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COMPUTATIONAL MODELLING AND SCIENTIFIC MACHINE LEARNING FOR PERSONALISED MEDICINE

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ABSTRACT

Personalised medicine increasingly relies on computational modelling, yet industrial applications and clinical translation demand tools efficient and affordable enough for routine use. In particular, forward models capturing multiscale, multiphysics processes are often too costly to support parameter estimation or real-time prediction, and standard data assimilation methods for model personalisation quickly become intractable at the scale required for patient-specific digital twins.

Scientific Machine Learning offers a route around this bottleneck. Surrogate modelling now generalises across varying inputs and geometries, while physics-informed approaches embed governing equations into the learning process to improve data efficiency. More recently, generative and probabilistic methods such as Bayesian neural networks and diffusion models are being explored for uncertainty quantification, while agentic AI systems capable of orchestrating full calibration pipelines mark a further step towards automated personalisation. These developments are reshaping forward and inverse modelling across biomedicine, though their robustness and reliability in clinical settings still require systematic investigation.

This mini-symposium aims to bring together applied mathematicians, biomedical engineers and clinicians working on mathematical modelling and numerical and data-driven methods for personalised computational medicine. We welcome contributions on reduced-order modelling, machine learning for patient-specific parameterisation, data-driven calibration and real-time simulation, integration of multiscale models with clinical data, and industrial applications of digital twins in device design. The session aims to connect academia and industry, encouraging discussion of open challenges and new collaborations within the growing international community working on digital twins in biomedicine.