

between energy propagation, tissue properties, and cellular response mechanisms, and will be designed to generate physically consistent reference datasets.

2. ***Learning-based Approximation Using Neural Cellular Automata:*** Design and train Neural Cellular Automata to approximate the spatiotemporal evolution of tissue damage as simulated by PDE models. This step will explore how local update rules can encode complex physical behavior, drawing inspiration from recent developments in physics-informed learning and neural simulation frameworks.
3. ***Hybrid Simulation and Performance Evaluation:*** Develop a hybrid simulation framework combining PDE-based and NCA-based models. The performance of the learning-based simulations will be quantitatively evaluated against finite-element reference results, with particular attention to computational speed, robustness, and generalization across different simulation scenarios.

Throughout the project, systematic validation will be carried out using numerical experiments and simulation benchmarks.

The doctoral work will be carried out within the host research team, IMAGeS / ICube, building on existing expertise in computational modeling and simulation. Collaborations with academic and clinical partners (IHU, University Hospital Strasbourg) will provide application context and validation scenarios, while the core research will remain focused on methodological and computational aspects.

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Qualifications: Master's degree in computer science. A very good level of programming in C++ or Python is required. Good communication skills and a good level of English are expected. Additional knowledge in computer graphics, numerical methods, medical imaging and artificial intelligence would be a plus.

To apply: Send a CV, cover letter, master internship report, master transcripts with ranking, and the names and contact information of at least 2 people who can recommend you to: essert@unistra.fr and juan.verde@ihu-strasbourg.eu.

NB: Incomplete applications without information about the student's ranking in their master's program will not be considered.