# A scalable and user-friendly computational platform for mathematical modeling and simulation about Cardiac Electrophysiology research

Aims: The pivotal role of mathematical modeling in cardiac electrophysiology research necessitates efficient software engineering, which is often overlooked, resulting in decreased productivity and increased communication costs. To mitigate these challenges, we introduce a comprehensive, CUDA-accelerated computational electrophysiology platform that is scalable, user-friendly, and minimizes the need for coding in most tasks. Furthermore, our platform facilitates combined simulations utilizing multiple cell models, ion channel models, and tissue simulations.

Methods: Our platform employs a unified parameter setting system and is compatible with various computational cell models. It also accommodates diverse medicine models, simulation protocols, and tissue structures. The platform incorporates C++ function pointers to expedite the integration of new ion channel models into existing cell models. To address high-performance computing demands in tissue simulations, the platform incorporates GPU acceleration capabilities. A cross-platform graphical user interface is developed using pyQT5.

Results: The platform supports ion channel simulations via current-clamp and voltage-clamp protocols and enables cardiac simulations at both single-cell and tissue levels. Updating cell models within the platform is streamlined, and output data can be visualized and analyzed using the graphical user interface. Furthermore, the platform streamlines the research workflow by providing built-in algorithms for data analysis and graphical representation, eliminating the need for programming expertise in most tasks.

Conclusion: Employing software engineering methodologies, our novel platform enhances various aspects of workflow in cardiac electrophysiology research by providing a user-friendly computational environment.