Proper Generalize Decomposition Method for an Efficient Estimation of Cardiac Conductivities

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ABSTRACT

While the potential groundbreaking role of mathematical modeling in electrophysiology has been demonstrated for therapies like cardiac resynchronization or catheter ablation, its extensive use in clinics is prevented by the need of an accurate customized conductivity identification [1]. Data assimilation (DA) techniques are, in general, used to identify parameters that cannot be measured directly, especially in patient-specific settings. Yet, DA procedures may be computationally demanding. This conflicts with the clinical timelines and volumes of patients to analyze. In our work, we adopt a model reduction technique, i.e., the Proper Generalized Decomposition (PGD) [2], to accelerate the estimation of the cardiac conductivities required in the modeling of the cardiac electrical dynamics [3]. In more details, we resort to the Monodomain Inverse Conductivity Problem (MICP) deeply investigated in the literature in the last five years to look for cardiac conductivities. We provide a significant proof of concept that PGD is a breakthrough in solving the MICP within reasonable timelines. PGD relies on the offline/online paradigm and does not need any preliminary knowledge of the high-fidelity solution. This allows to show that the PGD online phase estimates the conductivities in real-time for both two-dimensional and three-dimensional cases, including a patient-specific ventricle.

REFERENCES

