UNEXPLORED AVENUES OF COMPUTATIONAL MODELING OF LIVING SYSTEMS, FROM IN SILICO TO THE CLINICS

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ABSTRACT

Patient-specific therapies are one of the key factors of 21st Century medicine. Imaging and measuring devices, mathematical and numerical techniques, new computational architectures, and paradigms altogether provide an unprecedented framework for designing therapies/devices for an individual patient. In such a context, Mathematics and Engineering are struggling to unveil, predict, and control the ground processes of biological systems. Their intrinsic complexity, relying on the tight interplay among several lengths and time scales, requires unexplored computational and applied mathematics avenues. Scientific research looks for accurate models and constitutive laws as well as efficient black-box computational tools able to assimilate either experimental or clinical data to deal with the massive production of quantitative information. The combination of models and data guarantees reliability of the computational tools, as far as the limitations of purely model-driven and data-driven approaches are partially mitigated by the hybridization of the two paradigms. Yet, this is generally highly demanding from the computational point of view, and requires the set up of specific methods to fit the challenge of the clinical timelines.

The present minisymposium aims at gathering prominent scientists active in the vast realm of computational applied mathematics for life sciences, sharing their expertise and perspectives in the context of model-driven/data-driven approaches, their combination (data assimilation) and the pursuit of efficient numerical methods in clinical applications. Novel approaches, theories and techniques dealing with inverse problem solutions, model reduction, machine and deep learning methods will be discussed in view of efficient computational tools for data assimilation and model tuning of biological systems. Discussion on clinical challenges that may benefit from scientific computing, still not investigated enough are welcome. More in general, we aim at discussing how far scientific computing tools are from clinical practice and what actions are needed (also at an educational level) to bring applied mathematics to the bedside in a routinely way, for the sake of healthcare and society.

REFERENCES

[1] A. Gizzi and A. Veneziani, Estimating patient-specific cardiac conductivities: A challenge between models and data. *Siam News - In Press*.