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MODELING AND COMPUTATIONAL ASPECTS OF MICROCIRCULATION

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MINI-SYMPOSIUM PROPOSAL

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1 MINI-SYMPOSIUM PROPOSAL

1.1 Background

The microcirculation serves vital oxygen and nutrient supply and control functions in living systems. For this reason, microcirculation has been thoroughly studied in vitro and in vivo in the fundamental sciences [1,2]. Recently, analysis by means of mathematical models and numerical simulations have contributed significantly to revealing the physiological function and interaction between blood flow and the surrounding tissues that are difficult to observe otherwise, see [3.4, 4a] just to make a few examples. Modeling and computational approaches of microcirculation has recently become a vivid area of research. Starting from a few seminal contributions [5,6,7,8], yet addressing realistic portions of tissue, to very recent achievements where whole organ simulations are at reach, [9,10].

1.2 Scope of the mini-symposium

Because of the complexity and the multi-faceted nature of the problem, modeling microcirculation requires integration of expertise spanning medical imaging, continuum mechanics for flow and tissue modeling, applied mathematics, high performance computing and big data analysis. The scope of this mini-symposium is to invite experts in these different disciplines to outline the state of the art of the mathematical and computational aspects of microcirculation and stimulate an interdisciplinary debate about next steps to advance the microcirculation research.

Starting from a clear and up-to-date view of the field, we aim to explore the potentially transformative impact that computational models may have in overcoming the challenges of translating theoretical knowledge to the clinic, for example to understand the mechanisms at the basis of complex diseases and to improve treatments. The study of neurodegenerative disease, the design of personalized therapies to fight the effects of aging (dementia, AD), as well as the design of vascular renormalization therapies to improve the treatment of cancer, are among the main drivers for advancing the in-silico models of the micro-vascular environment. Contributions from researchers active in this field who want to present new open questions and stimulate new research directions are also very welcome.

1.3 Target of the mini-symposium

The mini-symposium is open to researchers form different communities involved in the modeling pipeline of microcirculation such as:

- The medical imaging and data analysis researchers interested in complex micro-vascular networks;
- The mathematicians and engineers addressing models of blood flow and soft tissue mechanics applied to the vascular microenvironment, including tissue damage, growth and remodeling;
- Scientists studying mathematical and computational approaches to microcirculation aiming at taming the challenge of using complex vascular networks in computational models;
- Researchers involved in high performance computing and data analysis who focus in reconstructing from computed or real datasets of the micro-vascular environment the emerging information that matters for applications;
- The physiologists and clinicians interested in pathologies where microcirculation plays a relevant role.

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