Preface: Particle-based simulations on cell and biomolecular mechanics

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Until recently, the study of cell functionality has been focused on the biochemistry role through the use of molecular and genetic approaches. However, currently, it has become well established the impact that mechanical conditions present on diverse cellular processes and pathologies. Actually, cells are fundamental mechanical components that exert a passive and active role in order to regulate normal cell function and tissue maintenance. Cells are subjected to mechanical forces as a result of physiological function of the body, which deform the cellular cytoskeleton and nucleus updating the cellular response. However, excessive loading or chronic sub-normal loading may cause cell damage or cell death, and thereby, lead to tissue degradation. In addition, cells are active materials, because they are able to exert contractile forces in order to sense the mechanical environment that surround them and regulate their behavior.

To understand this complex and regulatory behavior of the cells in function of the mechanical conditions numerical

methods is a potential and flexible tool that opens many possibilities for improving research in this field, unraveling crucial mechanical-based mechanisms that regulate cell function. In particular, particle-based methods are especially appropriate for this problem in multiple applications at different scale levels: from molecular dynamics simulations to whole cell mechanics or modeling the dynamics of cell populations taking into account cell-cell and cell-matrix interactions. In addition, it is also very relevant for scale-bridging phenomena.

This special issue is a collection of seven technical papers presenting the state-of-the-art in modeling and simulations of cell mechanics problems at different scales involving particle-based methods.

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