

# Preface

Mechanical forces act on tissues and organs inducing their movement and/or deformation. This area is a well-known subject of research being called as biomechanics. Sometimes the consequences of mechanical forces are evident, such as when a bone fractures or a ligament is injured by stretching. In the last decades, innovative research has been developed to accurately determine the mechanical behaviour of tissues and organs. Knowledge of how tissues deform and fail is important, but it is even more important to know how mechanical forces act on tissues to maintain health and to regulate biological processes. Therefore, the scientific community is now modelling the actions and their associated responses, ranging from the organ scale, passing through biological tissue, down to individual cells and molecules.

Nowadays, numerical simulation plays a fundamental role in many branches of science, in particular in mechanics. Computational biomechanics is one of the areas in which the numerical simulation of very complex processes takes place. Computational biomechanics is a relatively recent and emergent discipline. Since the appearance of the finite element method in the 1950s it has been undoubtedly the most extended tool to perform such simulation in that field. However, the high complexity of the geometries involved (bones, soft tissues, organs, etc.) and frequently, the large deformations that usually appear make the aspects related to the mesh creation and control an important fact to be considered. Although the finite element method appeared more than five decades ago, other numerical methods such as meshless methods have been successfully used to solve problems in engineering and applied sciences. One can say that the term ‘meshless method’ refers to a broad class of numerical techniques for solving a growing number of science and engineering applications without the dependence on an underlying computational mesh. Currently, the diversity of problems analysed by these methods is very large, and ranges from fracture mechanics, fluid mechanics, laminated composites, multiscale problems and biomechanics, among others.

This book is a significant contribution to the state of the art in the field of computational biomechanics, from the application of meshless methods in biomechanics to the evaluation of stresses in hip prosthesis replacement. The Natural Neighbour Radial Point Interpolation Method (NNRPIM), a recent truly meshless method is presented and developed with special focus on biomechanics. The theoretical fundamentals of NNRPIM is presented and it is extended to several

engineering fields such as solid mechanics static and dynamic linear analysis and structural nonlinear analysis. A special focus is on its application to achieve biomechanical analysis of bone remodelling.

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