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BIOMECHANICAL APPLICATIONS USING ADVANCED DISCRETIZATION TECHNIQUES

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Summary: ABSTRACT: Presently, it is possible to find in the literature several advanced discretization numerical techniques capable to simulate in-silico the structural behaviour of biological structures. Within the computational mechanics research community, the finite element method (FEM) is recognize as the most popular numerical technique. FEM is a robust technique, easy to program and allows to obtain fair approximations. In order to discretize the problem domain, FEM uses a grid of nodes organized with a structured element mesh.

Nevertheless, in the last two decades, new mature advanced discretization techniques started to appear – the meshless methods. The most attracting feature of meshless methods is their unique capability to discretize the problem domain with an unstructured nodal distribution. With meshless methods it is possible to obtain a discrete geometrical model directly from medical images. Thus, this meshing advantage is a true asset in computational biomechanics.

There are numerous discrete meshless techniques capable to perform a biomechanical structural analysis [1]. However, since the several numerical approaches described in the literature are fundamentally very dissimilar, their computational performances are different. Consequently, the computational mechanics research community is continuously seeking the best numerical approach to reproduce and simulate in-silico biological phenomena.

In this work, radial point interpolation meshless methods are used to analyse nonlinear biomechanical problems, assuming for instances: the transient behaviour of bone tissue; the elastoplastic behaviour of biological tissues, the blood fluid flow and the structural response of implants and bio-structures. The meshless results are compared with FEM solution, allowing to understand the efficiency and accuracy of meshless methods.

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