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Abstract:
European estimatives points to a 23% increase in fragility fractures incidence (osteoporosis related) between the period 2017 to 2030, which represents 2.7 million fractures per year. Tissue Engineering (TE) approaches to the fracture recover problem include the culture of stem cell seeded on a bone scaffold for cell growth and differentiation of bone cells in an environment that mimics the native tissue, for posterior patient implantation promoting local fracture healing. To increase cell rate and time of survival during the in vitro phase, the culture medium must be periodically replaced to supply nutrient and growth factors to cells and removal of toxic cell by-products from the culture to avoid cell necrosis and limit extracellular matrix formation.
Traditionally, in vitro studies are empirical performed being time consuming and highly expensive. Numerical models contribute to overcome these limitations and play a critical role to understand the invitro cellular conditions that are impossible or very hard to measure and control.
We explore multiphysics numerical modelling of bioreactors to optimize the application of different types of stimuli (mechanical or electrical either isolated or combined) and its impact on the biophysics parameters involved.
Different bioreactor designs are presented, and further developments and opportunities for numerical models are discussed.

This is a joint work with Nuno Alves, Abhisked Datta and Paula Pascoal-Faria