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STIMULI OPTIMIZATION FOR BIOSCAFFOLDS PLACED AT A BIOREACTOR FOR IN VITRO TISSUE ENGINEERING APPLICATIONS

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Summary: Tissue engineering is today applied to distinct cell types including bone, cartilage, muscle, neural and cardiac tissue. Both in vitro and in vivo implementations typically require a scaffold to nucleate the cell growth which is immersed in the liquid culture medium. One relevant problem within tissue engineering is to identify and implement the optimal conditions for each cell type. To ensure optimal cell replication and survival the mechanical stimulation of the cells must ensure an adequate vascularization of the scaffold. However typically this is not enough as there is experimental evidence that optimal tissue growth requires also the presence of low intensity electric current. The specific direction of the electric current and whether it is continuous or alternate depends on the specific tissue type. To induce these currents several solutions exist both considering conductor and nonconductor scaffolds and directly applying electric fields in the culture medium far from, or close to, the scaffolds as well as externally applying magnetic fields that induce the desired electric current. Also piezoelectric scaffolds have been considered that react to mechanical stimulus such that a direct induction of electrical current is not required. In this work we will focus in the analytical and numerical analysis of a bioreactor for in vitro tissue engineering aiming at giving optimal (1) mechanical vascularization, (2)electric stimulation and (3)measurement access for process control. To achieve these aims we present a topological optimization of the geometry and movement of the bioreactor, the placement of electrodes or electromagnets as well as the electromagnetic properties of scaffolds.