LOW-INTENSITY ULTRASOUND FOR STIMULATION OF TISSUE CULTURE

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1. Introduction

The propagation of mechanical waves and interaction generated with tissular microstructure has not been addressed enough to characterize both physical principle of diagnosis and treatment. Recent results evidence these aspect: Ultrasound (US) technology has been used in biotechnology for improving of cell viability via its ability to increase mass transport, and also in the context of cartilage and bone regeneration or tissue engineering, where it increased cellular activity.

In accordance with them, a stimulation ultrasound wave device is proposed. The ultrasonic wave energy, frequency and shape is estimated to be compatible to those used in previous references by analyzing the signal from a receiver.

2. Experimental methodology

Layout of design and methodology has been developed based on simulation-optimization of a high energy and low energy transductor, using Finite Elements Methodology (FEM). A robust algorithm to reconstruct mechanical parameters from measured signals was applied.

Equipment allows to generate a variable frequency-energy-shape excitation ultrasonic signal. The transmitted signal was generated as a 10-cycle burst composed by a 50 − 500 [kHz] sine of variable amplitude with a repetition rate of 10 [ms]. This signal interacts with the culture and the interaction is captured by the ultrasonic receiver. The received signal is amplified, digitized with a high resolution A/D converter, and digitally processed off-line in a computer, using MATLAB.

3. Results

If a transmitted signal of frequency f = 50 [kHz] at amplitude Dt = 10 [V] yields a registered signal of amplitude Dr = 0.5 [mV], the stress at the tissue to be stimulated is estimated to be of the order of 368 [Pa].
Similar magnitudes were observed in the range between f = 20 − 500 [kHz], with a monotonically increasing trend.

4.Conclusions

Scientific and strategic strength lie on ultrasounds interaction with tissue, and applied engineering in physical devices, to face up a deep understanding at a micromechanical scale of tissue and physical organ level. Establishing a link between regenerative medicine and a possible contribution during clinical surgery.

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