Investigation of the influence of acoustic parameters on the Neurostimulation Success Rate: *in vivo* study on a simple invertebrate neural model

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Background, Motivation and Objective

An *in vivo* invertebrate neural model has previously been proposed to study the biomechanisms involved in the phenomenon of ultrasound (US) neurostimulation. The purpose of this study is to study the influence of different acoustic parameters on the neurostimulation success rate (NSR) associated with this neural model, and gain mechanistic knowledge from the highlighted trends.

Statement of Contribution/Methods

The general method to evaluate the influence of a given acoustic parameter on the success rate of ultrasound stimulation consisted in administrating US sequences compound of randomly mixed types of bursts, each type of burst varying from one another only by the value of the investigated parameter. The NSR associated with each type of subgroup of stimuli of the sequence was then calculated. Investigated parameters included: pulse duration (PD), pulse intensity (I_{sapa}) and pulse repetition frequency (PRF).

Results/Discussion

Three clear trends were identified: the NSR is increasing for increasing values of PD, I_{sapa} and PRF. The PD threshold to reach 100% NSR is dependant of the fixed value of I_{sapa}. Reciprocally, the I_{sapa} threshold to reach 100% NSR is dependant of the fixed value of PD (see Figure 1). Consequently, for this nervous model, the NSR is increasing for increasing values of the mean radiation force carried by the US stimulus, regardless of the acoustic parameters leading to this value. We suggested that the inertia of the response of the axonal region of the afferent nerves (previously identified as the neural structures directly responding to the US stimulus) to a mechanical push could be responsible for this temporal averaging effect. We suggested that this temporal averaging effect could be explained by the viscoelastic properties of the axonal region of the afferent nerves (previously identified as the neural structures directly responding to the US stimulus), whose response to a mechanical push presents a relative inertia before going back to equilibrium.

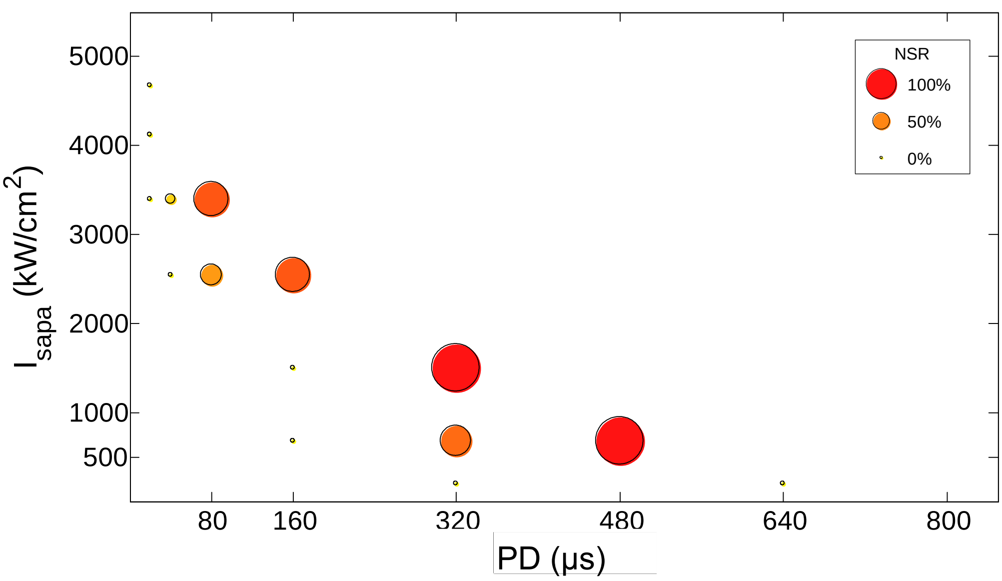

Fig. 1. Combinated influence of pulse duration (PD) and pulse intensity (I_{sapa}) on the Neurostimulation Success Rate (NSR), within a single trial.