

ACUTE STIMULATION INDUCED IMPEDANCE CHANGES OF DBS SYSTEM IN CHRONICALLY IMPLANTED LIVE PORCINE MODEL

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Background

Historically, Deep Brain Stimulation (DBS) has been delivered using voltage-controlled pulse generators with a single voltage source. The therapeutic fields generated by these systems are subject to the variance of the impedance measured at each lead contact. More recently, stimulators with single or multiple current sources have been proposed. In the case of single-source current-controlled stimulators, the therapeutic fields are subject to variance in the relative balance of impedance between multiple active contacts of the same polarity. Multiple, independent current sources allow for constant stimulation across variance of impedances per contact, or between contacts.

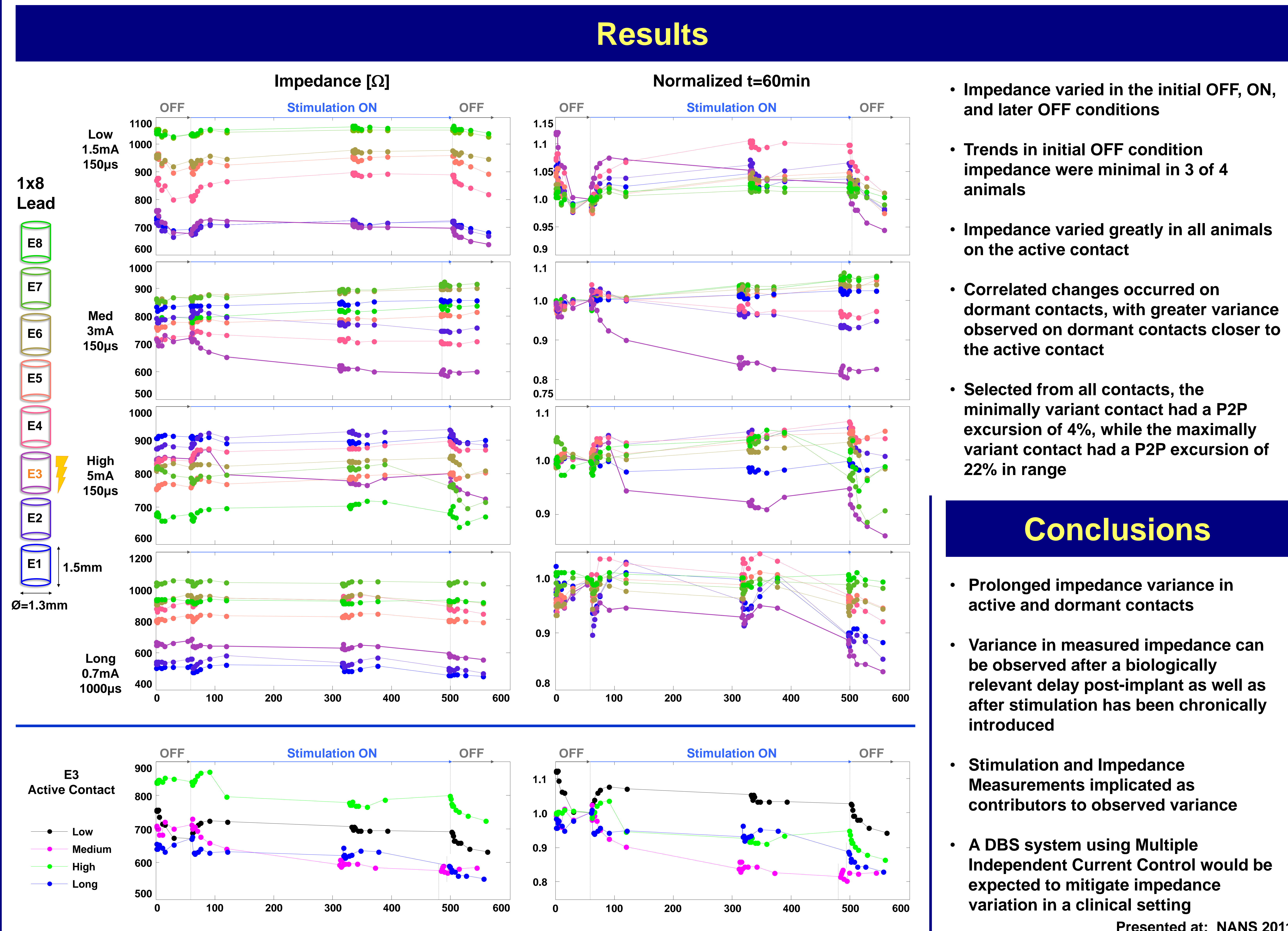
It has been observed that the impedances of implanted electrodes vary both after implantation and with stimulation [Benabid 1996, Lempka 2009, Miocinovic 2009, Lempka 2010]. We were interested to investigate the short-term variance due to stimulation in a live model, in which long-term implant and stimulation related impedance changes had stabilized.

Methods

Four (4) pigs were implanted with DBS leads 24/25 days prior to data collection. A 1x8 lead with contact dimensions of 1.5mm in length and 1.3mm in diameter was placed in the frontal lobe of each animal. Each animal had a distinct stimulation program, labeled Low(1.5 mA), Medium(3 mA), High(4.5 mA), and Long(0.7 mA). All programs used a pulsewidth of 150µs except the Long program, which had a pw of 1000µs. All animals were stimulated at 139Hz with stimulation delivered by contact 3.

Stimulation was first turned ON 1 day after implant, i.e. 23/24 days before data collection, and was ON for approximately 8 hours per day, Monday-Friday, and OFF otherwise. Stimulation had been OFF for >60 hours prior to this study. In this way, we anticipated that impedance variation due to both implantation trauma and long-term stimulation-related effects had stabilized prior to data collection.

The data collection protocol involved four (4) recording series, where each series logged data at t=[0,1,2,4,5,10,15,30,60] minutes. Series 1 began in the OFF state, immediately followed by turning stim ON and recording series 2. Stimulation was left ON, and after 5 hours of stimulation, series 3 was recorded with stim ON. After 8 hours of stimulation, stim was turned OFF and series 4 was recorded.



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