

## **A9: MODELING THE TEMPORAL RESPONSE PROPERTIES OF AUDITORY NERVE FIBERS TO PULSATILE ELECTRICAL STIMULATION**

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Ideally, the cochlear implant should generate the same temporal response pattern of spikes in auditory nerve fibers (ANFs) as evoked by acoustic stimuli. However, contemporary speech processing strategies are unable to achieve this partly because of our limited understanding of ANF responsiveness to electrical stimulation. We present an extension of the refractory version of the Bruce<sup>1,2</sup> model which significantly improves its predictions of temporal responses to high-rate (1-5 kHz) electrical stimuli. ANF responses to electrical stimulation were recorded in acutely deafened guinea-pigs. Electrical pulse trains of 100 ms duration were delivered via an acutely implanted scala tympani electrode using a monopolar electrode configuration. Stimuli were presented at rates of 200, 1000, 2000 and 5000 pulses/s. Stimulus current was varied to evoke a range of spike discharge rates between 0 and 250 spikes/s. The Bruce model was extended to include two components dependent upon subthreshold stimulus pulses: facilitation and accommodation. As stimulation rate increased, facilitation acted to reduce ANF threshold while accommodation increased threshold. The two mechanisms incorporated temporal integration windows of 0.8 and 8 ms, respectively. Recorded ANF responses were compared to those predicted by both the original and the extended Bruce models. The original model predicted much greater variance in inter-spike intervals than was observed in vivo, while results from the extended model better resembled the physiological data. Because the accommodation mechanism “restarts afresh” after each discharge, the extended model predicts a decrease in ANF responsiveness over the entire duration of the pulse train – like that observed in post-stimulus time histograms of ANF recordings. The extended model, with facilitation, was better able to predict changes in ANF threshold with increased stimulation rate. The ability of the extended model to better predict spike timing information may provide insights into how to improve temporal coding with cochlear implants.

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<sup>1</sup>Bruce et al., (1999) IEEE Trans. Biomed. Eng. 46: 617-29

<sup>2</sup>Bruce et al., (1999) IEEE Trans. Biomed. Eng. 46: 630-637