Selective block via kilohertz high-frequency alternating current (KHFAC) in the rat sciatic nerve

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***Abstract*—Kilohertz high frequency alternating current (KHFAC) waveforms in the range of 3-50 kHz have been shown to induce repeatable and reversible nerve conduction block in various amphibian and mammalian animal models with minimum side effects. Furthermore, the use of KHFAC block has also been shown to be selective in blocking motor versus sensory fibers. An *in vivo* rat sciatic nerve preparation was used to determine the parameters for fiber specific nerve conduction block. Preliminary results indicate that complete independent block of the early and late responses can be achieved in a mammalian nerve preparation using a sinusoidal waveform at frequencies from 5 kHz to 50 kHz. Here we demonstrate that KHFAC can create quick and reversible block of different fiber-types.**

Selective stimulation of neural activity is a major challenge in neural interfacing, with numerous applications in basic neuroscience (fiber-specific interactions among neural circuits), neuroengineering (brain machine interfaces), and clinical practice (diet control, diabetic neuropathies, hyperspasticity, neurally controlled prostheses, local anesthesia). One approach to selectively controlling neural activity is to inhibit activity in specific peripheral nerve fiber-types that are not of interest.

For many years, kilohertz high frequency alternating current stimuli (KHFAC, 3-50 kHz) have been shown to be effective at blocking action potential propagation in whole nerves [1], [2], which consists of both myelinated (A) and unmyelinated (C) fibers. Previous studies by our lab and others have demonstrated this phenomenon in both *in vitro* and *in vivo* setups. Further work in our lab has also demonstrated that the threshold for C-fiber KHFAC block is lower than the threshold for A-fiber KHFAC block at sufficiently high frequencies in an *in vitro* peripheral nerve model [3], [4]. We also demonstrated selective block of both early and late responses of the compound action potential in the same model.

Here we demonstrate the ability to selectively block either motor (myelinated, A-fiber) or sensory (unmyelinated, C-fiber) information in the rat sciatic nerve to achieve selective stimulation of neural activity. Figure 1 shows single trial data of KHFAC block of A-fiber and C-fiber activity in the rat sciatic nerve preparation. This data demonstrates that selective block of fiber-specific activity is feasible in mammalian peripheral nerves and may provide for selective modulation of afferent and efferent neural activity.

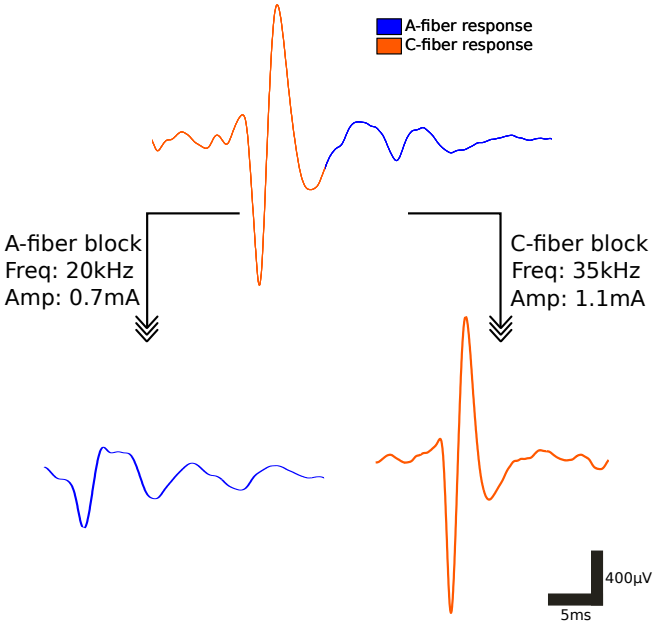

Fig. 1. **Single trial preliminary data demonstrating fiber-specific KHFAC-induced block of neural activity in the rat sciatic nerve.** The block threshold for the A-fiber response was found to be 20kHz at 0.7mA for this nerve. The block threshold for the C-fiber response was found to be 35kHz at 1.1mA.

References

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