

Toward an Optogenetic Autonomous Nerve Control (OANC) System

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Optogenetics is a developing field in neuroscience, where nerves are stimulated through optical instead of electrical signals, allowing for a more selective action of nerve populations [1]. In the context of electrical stimulation, the autonomous nerve control (ANC) system has been used successfully, first to map the response of different nerve fibers to create a Nerve Activation Profile, and then to use this profile in recruiting specific nerve fibers in a controlled way [2]. The objective of the present project is to apply the ANC system to optical stimulation thus creating what we could call an optically-driven ANC system (OANC).

With this in mind, we have designed an optical cuff that delivers an optical signal through LEDs whose light intensity is controlled by the ANC system. Using this cuff electrode, we have performed preliminary experiments (at The Jackson Laboratory, Bar Harbor, Maine) on genetically modified mice which include a light sensitive protein on the cell membranes that allows them to convert the optical stimulation in to electrical signals on the sensory nerve fibers in the sciatic nerve. These preliminary experiments showed very encouraging sensory nerve response, suggesting that further work is warranted in order to develop a closed loop OANC that measures the degree of nerve stimulation and controls the input signals accordingly.

[1] A. Aravanis et al. J. Neural Eng. 2007

[2] MP Ward et al., "The Autonomous Nerve Control System: A Flexible Platform for Personalized Nerve Stimulation Therapy," unpublished manuscript in preparation.