Transmission Line Axon Model for Acupuncture Therapy

Kondagunta Sivaprasad, Kent Chamberlin and John LaCourse
University of New Hampshire

Acupuncture relies on the use of fine needles being inserted into specific points on the body with varying amounts of manual or external stimulation. Though studies of the curative benefits of acupuncture have been well-documented, there is no indisputable universal theory on the mechanism of pain relief.

The Gate Control Theory (GTC) states that acupuncture 'closes the Gate' to pain and blocks pain perception in the brain via stimulation of large nerve fibers. However, the GTC is a qualitative approach to pain relief, whereby the research presented here concentrates on a quantitative model for this pain relief mechanism. This research proposes that the stimulation of large nerve fibers does relieve pain, but via a different mechanism, which can be described by a transmission line axon model. In this model, the no-pain state is defined to be when there is a match in impedance between the brain (the load) and the equivalent impedance along the axon. Pain is felt when there is a significant mismatch in impedance between the axon and the constant electrical impedance of the brain. Using this model, the insertion of acupuncture needles induces a capacitive effect along the axon, which results in the mitigation of pain as it creates a better match in impedance between the brain and the axon. A sensitivity analysis is presented to demonstrate the effect of needle placement on predominant model parameters, which would most likely cause impedance mismatches.