Live Demonstration: A Frequency-based System For Wireless Electrical Stimulation of iEAPs

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Abstract—In this demonstration, we present a frequency-based system serving as the stimulator for biocompatible ionic electroactive polymers (iEAPs). We will demonstrate that we can wirelessly tune both the magnitude and the polarity of the voltage provided by the stimulator, by changing the frequency of the input signal, to control the degree and the direction of the movement of iEAPs.

\section{I. INTRODUCTION}

Ionic electroactive polymers (iEAPs), when placed inside an electric field, function very similarly to native muscle tissue, and have a great potential to be used as artificial muscles. The degree and the direction of their movement are dependent on the level and the polarity of the electric field, respectively. As such, the integration of these polymers with implantable integrated circuits serving as their electrical stimulators can provide exciting opportunities for the development of new classes of muscle prosthesis, to help patients who suffer from functional loss and impairment of skeletal muscle. Such a module is envisioned to be able to display controlled contractility upon being implanted.

Towards this goal, here we present a frequency-based system, designed to serve as the electrical stimulator for iEAPs. The proposed system is capable of controlling both the degree and the direction of the movement of iEAPs, using one inductive data link.

\section{II. DEMONSTRATION SETUP}

The demonstration setup is shown in Fig. 1. The equipment required for the demo include two DC power supplies, two function generators, and one multimeter. The setup also includes the designed boards along with samples of iEAPs. The iEAP samples are made of crosslinked mixture of poly (ethylene glycol) diacrylate (PEGDA) and acrylic acid (AA).

Wireless power transfer is used to power the system. The frequency at the primary data coil is set by a function generator, and is used to control the voltage magnitude and the polarity required to actuate the iEAP samples.

The electrical stimulation is applied to the iEAP samples via two Platinum (Pt) electrodes. These two electrodes are suspended, 3 cm apart from one another, in a well of Phosphate-buffered saline (PBS) solution, which has similar ion concentrations as body fluids. When the electric field is applied, the iEAPs’ actuation is caused by ion displacement inside the polymer, similarly to the movement of the human muscle.

\section{III. VISITOR EXPERIENCE}

Visitors will be able to observe how the frequency-based system operates, and how the movement of iEAP samples can be controlled via changing the frequency. They will directly interact with the system and use the function generator to change the frequency of the signal applied to the primary data coil to wirelessly control the voltage magnitude and the voltage polarity provided by the stimulator, and accordingly, the degree and the direction of the movement of iEAP samples.

\section{REFERENCES}