Bio-Magnetic Detection of Cardiac Activity Using Wearables

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The aim of this work is to develop a wearable textile capable of discriminating between healthy and non-healthy cardiac activity, identified by monitoring the inherent magnetic fields. Nevertheless, cardiac-generated magnetic fields are much weaker than the earth's magnetic field. This implies that off-the-shelf magnetic field sensors/monitors will mask any recorded bio-magnetic cardiac activity under their noise floor.

Indeed, magnetocardiography (MCG) has shown to require sensitivity within a magnetic window of between 0.1 pT and 300 pT in the frequency range of 1 to 40 Hz. To date, MCG signals are typically captured using Superconducting Quantum Interference Devices (SQUIDs) that are immersed in liquid helium to maintain a superconductive state. Though capable of detecting magnetic fields on the order of fT, SQUIDs require extensive shielding and cryogenic cooling (K. Sternickel and A.I. Braginskli, Supercond. Sci. Technol., 19, 160-171, 2006). As an alternative to SQUIDs, recent work has demonstrated induction coils that leverage advanced Digital Signal Processing (DSP) techniques to monitor MCG activity in non-shielded environments (J. Mooney et al., 3, 1-10, 2017).

In this research, we confirm the feasibility of monitoring MCG activity in conventional (non-shielded) laboratories. Two induction coils are employed upon the chest and used to capture the cardiac activity and surrounding noise, respectively. By averaging the signals upon tens of cycles, subtracting them from each other, and further filtering the resultant waveform, MCG activity is indeed captured. Preliminary results on translating this technology into e-textiles are also reported in this study. The proposed technology may, eventually, be integrated into day-to-day garments to identify and/or monitor numerous cardiac conditions, among others.