Detecting Unique Analyte-Specific Radio Frequency Spectral Responses in Liquid Solutions – Implications for Non-Invasive Physiologic Monitoring

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With rising healthcare costs and the rapid increase in remote physiologic monitoring and care delivery, there is increasing need for economical, accurate and non-invasive continuous measures of blood analytes. Based on radio-frequency identification (RFID), we have developed a novel electromagnetic platform technology (the Bio-RFID platform) to non-invasively penetrate inanimate surfaces, capture data from individual radio frequencies, and convert those data into physiologically meaningful information and insights. Here we describe ground-breaking proof-of- principle studies using Bio-RFID to accurately measure various concentrations of analytes in deionized water.

The *in vitro* Bio-RFID platform consists of an acrylic cuvette in the shape of a 4 inch x 4 inch x 8 inch rectangular prism mounted on the Bio-RFID sensor. This apparatus is in turn mounted on a balance that allows the determination of the mass of the analyte being scanned to within 0.1g. The hardware scans through several thousand radio frequencies and sends the data to proprietary software running on a laptop computer. The software displays a spectral scan known as the Bio-RFID signature of the analyte and computes a similarity metric to compare different signatures.

We tested the hypothesis that the Bio-RFID platform is able to precisely and non-invasively measure and identify a variety of analytes *in vitro*. For this assessment, varying solutions of 1) water in isopropyl alcohol; 2) salt in water; and 3) commercial bleach in water were tested, using a randomized double-blind trial design, as proxies for biochemical solutions in general. The Bio- RFID technology was able to detect concentrations of 2000 parts per million (ppm), with evidence suggesting the ability to detect considerably smaller concentration differences. Figure 1 shows detection of deionized water in isopropyl alcohol at 10,000 ppm.

The novel application of a Bio-RFID electromagnetic platform technology accurately detects, measures, and quantifies specific molecules in liquid. While these findings have *in vitro* commercial applications, these proof-of-principle studies provide strong support for the

application of Bio-RFID technology for non-invasive bio-monitoring of physiologically and medically relevant analytes, such as alcohol and glucose, in the human body.

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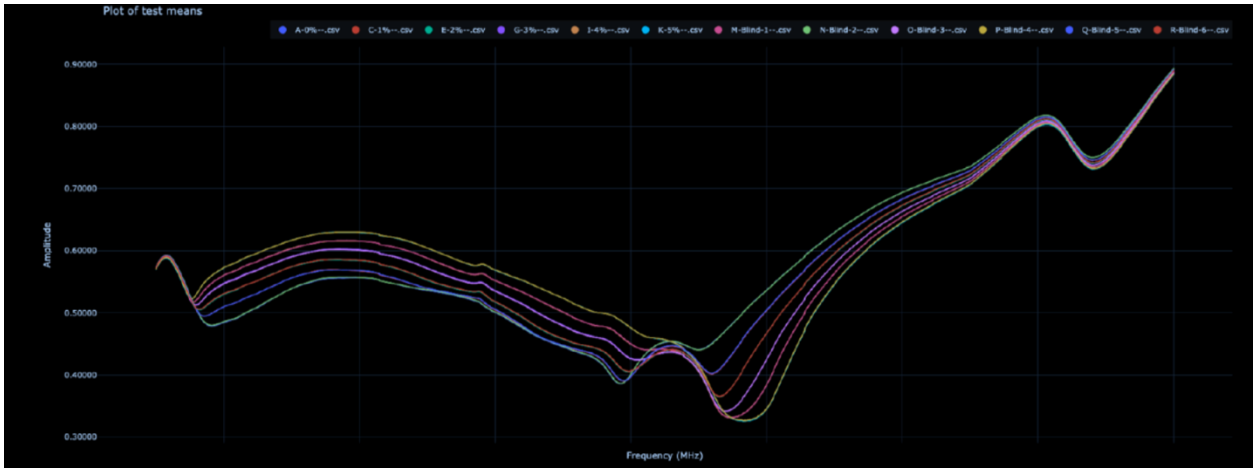

Figure 1: Bio-RFID signatures of analytes from Test 1

Figure 1 displays the Bio-RFID signatures of isopropyl alcohol, together with the 1%, 2%, 3%, 4%, and 5% water solutions. It is noteworthy that the image contains the graphs of 12 lines, yet only six are distinguishable. This is due to the fact that the two scans of each of the six solutions led to visually indistinguishable signatures. After every blinded scan, the team was able to visually identify which of the analytes had been scanned from the Bio-RFID signature alone.