Detecting Unique Analyte-Specific Radio Frequency Spectral Responses in Liquid Solutions

Implications for Non-Invasive Physiologic Monitoring

Dominic Klyve, Ph.D.[1], James H. Anderson Jr., M.D.[2], George S. Lorentz, M.A.[3], Virend K. Somers, M.D., Ph.D.[3]

BACKGROUND & AIMS

Know Labs has developed a novel electromagnetic platform technology - the Bio-RFID™ platform - to non-invasively penetrate surfaces, capture data from individual radio frequencies, and convert those data into physiologically meaningful information and insights. Ongoing studies demonstrate Bio-RFID accuracy for non-invasive methods of medical diagnostics, with an ultimate aim of non-invasive blood glucose monitoring.

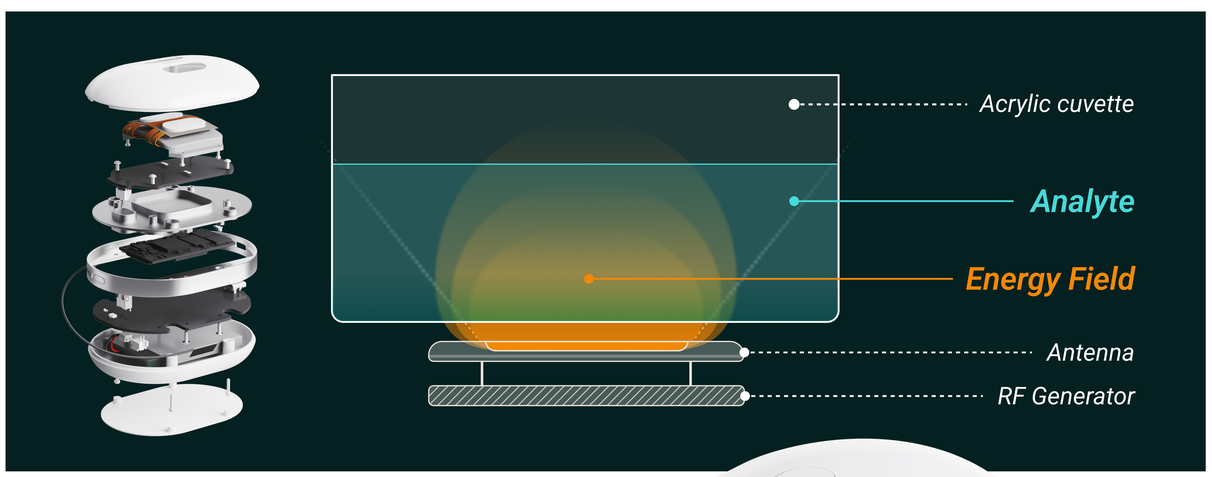
METHODS

DATE:
March 3-5, 2021

LOCATION:
St. Mary's campus of Mayo Clinic, Rochester, MN

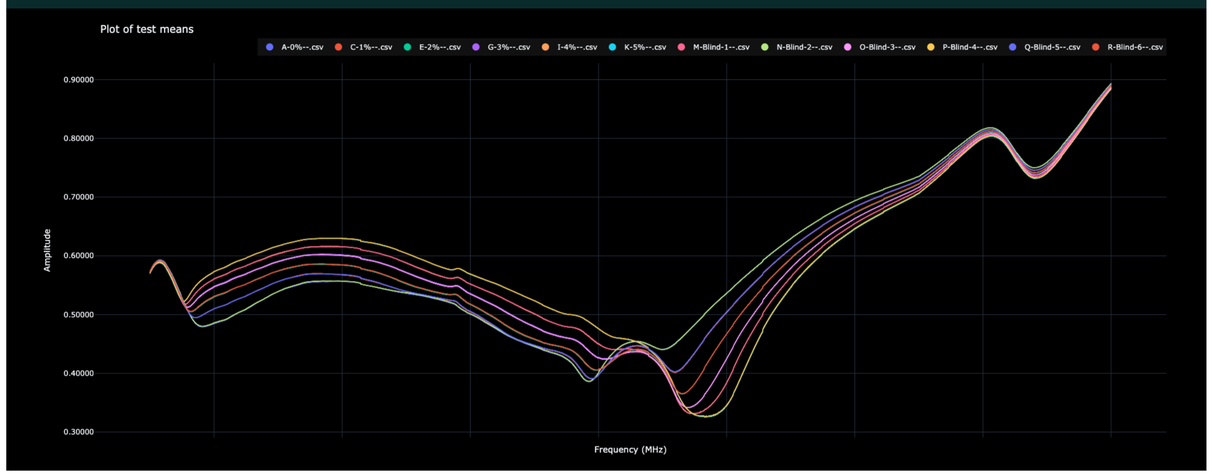
STUDY DESIGN:

- A series of five experiments designed to demonstrate the ability of the RF sensor to non-invasively quantify concentrations of a solute in liquid by scanning solutions once, and then performing blinded scans of the same solutions.
- Solutions of **1)** water in isopropyl alcohol; **2)** sodium chloride in water; and **3)** commercial bleach in water were tested as proxies for biochemical solutions.
- Data were collected using the Bio-RFID sensor that generates RF signals and measures received power through an antenna array.
- For each solution, data were collected continuously, using sweeps across the 1500 MHz – 3000 MHz range at 0.2 MHz intervals, collecting values at 7501 frequencies.
- Proprietary software displayed a spectral scan (Figure 1) known as the Bio-RFID signature of the analyte and computed a similarity metric to compare different signatures.



VKS and Mayo Clinic acknowledge a financial interest in Know Labs.

EXPERIMENT 1, FIGURE 1: Detection of deionized water in isopropyl alcohol at 10,000 ppm



EXPERIMENT 1, TABLE 1: Distance between 0% water and all scanned solutions

TRAINING DATA	DISTANCE	TEST DATA	DISTANCE
		(ordered by nearness)	
		Blind-2	33,157
1% Water	873,013	Blind-5	864,963
2% Water	1,917,048	Blind-6	1,910,652
3% Water	3,116,386	Blind-3	3,086,471
4% Water	4,260,250	Blind-1	4,250,653
5% Water	5,598,519	Blind-4	5,556,104

RESULTS

For each of the five experiments, 100% of solutions in the test data were correctly identified. The Bio-RFID technology was able to detect concentrations as low as 2000 parts per million (ppm), with evidence suggesting the ability to detect considerably smaller concentration differences.

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.

CONCLUSION

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

[1] Central Washington University, Ellensburg, WA, [2] Know Labs Inc., Seattle, WA, [3] Mayo Clinic, Rochester, MN