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Molecular Radar: The Future of Rapid Noninvasive Diagnostics

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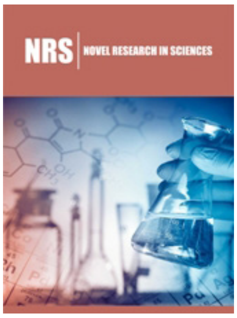

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Abstract

The COVID-19 pandemic has painfully demonstrated the urgent need for next generation sensing and diagnostic technologies. If potential outbreaks are to be avoided going forward, it will be necessary to rapidly identify the emergence of new pathogens and detect individuals carrying such pathogens, regardless of the viral load or whether they were symptomatic. This work will briefly discuss how exploiting the electromagnetic spectrum of biomolecules can be utilized for such detection and identification purposes.

Keywords: Electromagnetic field; Rapid diagnostics; Database; Artificial intelligence; Vibrational resonance

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Introduction

All matter is made up of elementary particles, which have a spin. This implies all matter would have an associated Electromagnetic Field (EMF) signal that may exhibit unique resonance phenomenon that can be measured with highly sensitive instruments in a sufficiently shielded environment. Recent viral outbreaks (e.g., SARS-CoV-2) highlight the need for rapid identification of viruses and other pathogens, which could be realized by exploiting current theoretical work on EMF signal resonance [1-3]. In addition, such EMF sensing devices could be particularly useful for differentiating or resolving viral samples and perhaps even nucleic acid sequence information non-invasively.

Several papers have already been published claiming to experimentally demonstrate that organic molecules (such as DNA/RNA) have an intrinsic electromagnetic signature which carries the structural information and possible function of the molecule. A summary of such work can be found in [4,5]. However, much of this research makes strong claims without careful adherence to the scientific method. Although the current claims are promising, a proper mathematical formalism and setup rigorous experiments need to be conducted. As stated by Romanenko et al. [5]:

One of the most disputed statements [regarding the interaction of EMF and biomolecules] is a resonant-like effect at certain frequencies. Nevertheless, those findings are consistent to some extent with the original Frohlich theoretical conclusions about the role and importance of mmW [millimetre waves] and terahertz electromagnetic oscillations in biology.

If such statements are true, then we hypothesize that there may exist a unique signal for a given biomolecule and its corresponding sequence.

Examining pathogens and sequences via electromagnetic spectrum

Since the human body itself can act as an antenna array [6], we hypothesize this may also hold true for biomolecules/sequences under various experimental/engineered states. Assuming the measured signal can be obtained, from a theoretical perspective, the data represents a resonance phenomenon characterized by waveform scattering. Modulating spatial, temporal, frequency and temperature parameters of the sensor antenna array, we conjecture it is possible to resolve signal information of the resonance structures thereby decoding the sequence data. Furthermore, recent advances in sensor design [7,8] suggest that this is possible to further improve precision by exploiting quantum entanglement of sensor networks. As stated in [8]:

The entanglement shared by different sensors reduces errors and boosts the sensitivity of extracting global information of the object under investigation [where] a typical method to minimize the cost function involves the use of the stochastic gradient descent algorithm...This opens new avenues for ultrasensitive measurements in biological, thermal, and mechanical systems...In optical biosensors, the evanescent wave of the probe light interacts with the sample, and the induced phase shift serves as a means to identify the density and species of the biomolecule.

If the EMF biomolecule data has been collected, we can construct a database and AI system (similar to Google Translate) that will predict the profile of a sequence or pathogen. More specifically, we could develop a Waveform Genetic Translation Engine (WGTE), i.e., a database of molecular waveform signatures, mapping the sequence-to-sequence data to uniquely identify a genetic sample. To construct the training dataset, many independent separate measurements for various different pathogens over a large range of frequencies for each viral stock are required. Systems such as AI-Feynman (neural network based symbolic regression), can be used to aid in the development of analytical models that complement the statistical methods [9]. Once the most important frequency range is determined for different types of biomolecules (e.g., viruses, bacteria, fungi, etc.), a less expensive device can be developed that uses the WGTE as its backend to identify a sample. An example of where a similar technique has been used can be found in [6], which is a paper that outlines how WiFi can be used to track human movement through walls, known as WiVi by training a network on input from a hybrid mode sensor fusion network.

The frequency of vibrational resonances of biological molecules are typically within the 0.5-2THz range [4,10]. However, there remain significant challenges when using THz sensing systems. Firstly, resonance-based sensors are material and case specific as each biomolecule has its own resonance. This means that a general THz sensing system for biomolecule identification would be very expensive due to the number of case specific fabrications that would be required. Moreover, current technology does not yet have optimal capabilities to deal with the noise floor of such systems, which typically are on the order of -50dBm. If lower frequency measurement systems could instead be used for distinguishing various biomolecules, this would be ideal since they are less expensive, and have more adequate accuracy and precision because the noise floor is on the order of -150dBm [SSN]. However, it is possible that microwave sensing techniques could be effectively used for sample identification [11-13]. The authors are currently investigating such sensing methods to create a "molecular radar" device for medical diagnostics [14].

Conclusion

In summary, if sufficiently precise and accurate measurements of EMF signatures of biomolecules can be performed, we conjecture that a waveform-based sensor could be rapidly deployed to enable real-time pandemic diagnostics. If our proposed method is feasible, it has the potential to revolutionize the medical industry, specifically for non-invasive rapid identification of pathogens. Such technologies would allow healthcare professionals and epidemiologists to track the emergence of viral variants in real time. In turn, this could help prevent future outbreaks which could possibly be more destructive than the current pandemic.

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