Resonance Based Measurement Technique for the Detection of Ferromagnetically Tagged Bio-Molecules

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The diagnosis and treatment of many diseases is highly reliant upon the detection of pathogens. The need to develop more efficient bio-analysis techniques is an emerging area. The most effective bio-molecule detection techniques, such as the famous fluorescent technique currently available, require expensive equipment and high-end labs. Therefore, there is a strong need for a more economical and portable way of detection.

In this project we demonstrate the feasibility of building a pathogen detection device by capturing the resonance frequency of a LC circuit. If a ferromagnetically tagged bio-sample can be introduced at the center of the coil, the bio-sample can be detected using the shift in resonant frequency of the LC circuit. With the use of a microcontroller, we calculate the frequency shift and relate it to the number of tagged-molecules present, serving as a quantitative measure of the number of pathogens present in the sample.

Two techniques of detection will be described. The first technique utilizes the measure of the period of a resonant pulse waveform. The second technique utilizes the measuring of the difference in the free-running frequency of a resonant LC oscillator. The theoretical minimum number of molecules that can be detected along with alternative approaches for increasing the sensitivity will be addressed in the presentation.