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# Non-Confidential Description - PSU No. 3461
# "Real-Time Adaptive Signal Averaging for Enhancing the Sensitivity of Continuous Wave Magnetic Resonance"

**Keywords:**

Adaptive filtering, signal processing, magnetic resonance, electron spin resonance, analytical chemistry, quantum computing

**Links:**

Inventor Website

**Inventors:**

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## Background

Magnetic resonance analytical techniques have become very useful tools in a variety of fields ranging from medicine to solid state electronics and even to archaeology. A number of forms of magnetic resonance techniques are currently in use such as nuclear magnetic resonance (NMR), electron spin resonance (ESR), electron nuclear double resonance (ENDOR). These techniques are highly sensitive, but can require long data acquisition times in order to enhance the signal to noise ratio (SNR) of the signal being measured. Because of the length of time required to run these measurements, the complexity of the equipment conducting the analysis, usage costs can be challenging. There is a demand for more efficient imaging, signaling, and quantum computing technologies that perform more rapidly and have lower time-to-cost ratios than current techniques. Furthermore, because not all analytical measurements require state-of-the-art sensitivity, market demand for more efficient devices with shorter operating times is high.

## Invention Description

The disclosed invention is a real-time, adaptive signal averaging technique that greatly decreases the amount of time needed for signal averaging of continuous wave magnetic resonance measurements. The technique provides an efficient means to achieve a significant improvement in signal to noise ratio (SNR) and to reduce data acquisition times. The technique has been demonstrated for electrically detected magnetic resonance (EDMR) via spin dependent recombination (SDR) in individual transistors. The approach should be widely applicable to continuous wave magnetic resonance measurements for a variety of applications. In addition, the technique may enable the use of less expensive hardware in situations where less than state-of-the-art sensitivity is required.

## Advantages / Applications

- Shorter data acquisition times
- Capable of reducing the noise variance in a single trace by a factor of ten
- Technology can be applied to any virtually field where signal averaging is utilized
- Less complex equipment can be used to implement the technology

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