Performance Analysis of Tissue Impedance Measurement for Wi-Fi Transmission using QAM & QPSK

Varalika*, Mukesh Kumar†, A.K. Jaiswal† and Rohini Saxena†
†Dept. of Electronics & Communication Engineering, SHIATS, Allahabad, UP, India

Abstract
A quick and accurate estimation of the tissue impedance system over a wide range of excitation frequencies with a low cost wireless transmission technique has been presented. Windowing function is used to reduce the lobe effect. Signal is processed through cross-correlator and FFT to provide quick and accurate result for tissue impedance measurement. Impedance measurement helps to find out the tissue health. This method gives economy in computing power. Its simple design, low power consumption and quickness of result calculation make it different and useful technique for tissue impedance measurement. Here a method of fast and accurate impedance measurement and its wireless transmission through Wi-Fi has been proposed. QPSK and QAM modulation technique has been applied and it has been found that QAM based transceiver is more efficient. It has low noise power and higher modulation error ratio.

Keywords: Tissue impedance, Wi-Fi, QPSK, QAM.

1. Introduction
Various advantages of Wi-Fi make it popular in the field of wireless transmission applications. Now it has also its importance in medical field. In these days health related problems have become very common to all. So to fight with health related issues it is necessary to have a system which may provide quick, accurate and continuous medical supervision. There is also a requirement of such type of medical devices which are working as Ass.

Here a method has been discussed for impedance measurement which gives accurate, fast measurement of impedance and has simple design than previous methods.

The whole work has been arranged as: II section deals with the methodology which has been further divided in two subsections, first deals with method for tissue impedance measurement and second with the proposed Wi-Fi modulation technique(QPSK and QAM) for wireless transmission of measurement. III section deals with the application of tissue impedance measurement and Wi-Fi technology. IV section deals with conclusion and future scope.

2. Methodology
2.1 Tissue Impedance measurement
An excitation signal (or input signal) is given and V(t) is generated that can be expressed as

\[ V_{ch}(t) = \sin\left(2\pi(f_1 t + (f_2 - f_1)t^2/2T_{ch})\right) \]  \hspace{1cm} (1)

Here \( f_1 \) is initial and \( f_2 \) is final frequency. \( T_{ch} \) is the duration of signal pulse.

Window functions \( W(t) \) are use to reduce the Gibbs or side lobe effect and to provide the smooth measurement effect. The actual excitation or input signal passes through the window function and amplitude tapered response signal \( V_{exc}(t) \) obtained as

\[ V_{exc}(t) = W(t) \cdot V_{ch}(t) \]  \hspace{1cm} (2)

A voltage to current converter is used to convert this response from voltage signal to current signal \( I_{exc}(t) \). The excitation current \( I_{exc}(t) \) passes through a bio-impedance \( Z \) which is under the observation. The tissue electrical circuit is composed of resistor and capacitor. It provides a response voltage \( V_r(t) \). This response voltage is cross-
correlated with the actual excitation signal $V_{exc}(t)$. Finally, the signal obtained from the cross-correlator applied to the FFT. The result is obtained in form of amplitude and phase.

Figure 1 shows the block diagram for impedance measurement system.

![Block diagram of impedance measurement system](image)

**2.2 Wireless Transmission Using Wi-Fi**

Wi-Fi is a wireless transmission technology it uses radio waves to provide wireless high speed data transmission. No physical wired connection is needed between sender and receiver to transfer the data. It provides simple, low cost and secure wireless transmission.

**2.3 Proposed Methodology**

Following figure 2 shows the steps to be conducted for remote monitoring.

1. Measure impedance using excitation signal
2. Transmission through Wi-Fi
3. Reception of data

**2.4 Modulation used for Wi-Fi**

Here QPSK and QAM modulation technique is used for modulating the Wi-Fi signal.

**2.4.1 Quadrature Phase Shift Keying**

Quadrature phase shift keying is known as QPSK, it is a modulating technique which is widely used for modulating the data signal. Here quadrature means the signal shifts in its phase states that are separated by 90 degrees and data into the modulator is separated into two channels such as I and Q. In quadrature phase shift keying two bits are transmitted simultaneously that is one bit per channel. The theoretical bandwidth efficiency of QPSK is two bits/second/Hz.

**2.4.2 Quadrature Amplitude Modulation**

Quadrature amplitude modulation is known as QAM, it is a modulation technique which is widely used for modulating data signal for radio communication. It has various advantages over other form of data modulation technique so it is widely used. In QAM two carriers shifted in phase by 90 degrees are modulated and there is a variation in amplitude and phase both comes as result. In QAM, both amplitude and phase variation are present, so it is also known as, mixture of amplitude and phase modulation. Data is split into two channels known as I and Q and two bits are routed to each channel simultaneously. Theoretical bandwidth efficiency of QAM is 4 bits/second/Hz. So QAM has higher data rate and better bandwidth efficiency than the QPSK.

**3. Result and Discussion**

Since a tissue can be modeled in its electrical equivalent, its overall impedance can be measured to monitor many health problems. For distant monitoring, wireless transmission using best modulation scheme can be fruitful in medical applications.
the low modulation error ratio while large cloud is due to high noise power hence gives the high modulation error. So QAM gives a large cloud of symbols which give a high modulation error ratio and decrease the noise power while QPSK gives a low modulation error ratio and increases the noise power.

Wi-Fi is a useful real time access to the patient information immediate bedside for doctors and hospital staff. It is also easiest way for on-site consultation with doctors.

4. Application

State of tissues can be easily detected with the help of tissue impedance measurement and it can help to diagnose many health problems such as skin hydration, cerebral monitoring, dental decay diagnosis and many more.

References

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