

## DETECTION OF THYROID AND RESPIRATORY DISEASES USING SPLINE TRANSFORM

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**Abstract**—Detection of swallowing events alone was found to be difficult using any type of sensors, which makes no difference with the swallowing and talking events. We present the development on (UWB) radar system and its signal processing algorithms for detecting human breathing and heart rate. Also, it identifies the types of diseases based upon the swallowing movements and respiratory diseases. In this paper, based upon the swallowing sounds, thyroid based diseases can be identified by using Acoustic sensors. Also the respiratory diseases can be detected using IR and UWB radar. Moreover, B-Spline Transform is used to analyse the captured swallowing and breathing signals. A short range measurement of physiological motion pertaining to human cardiac and respiration activity is proposed to determine respiratory disease. A spline transformation algorithm applies to detect region of interest in acquired signal to detect respiratory disease. Furthermore, an acoustic sensor is also placed near the throat region to detect the change in thyroid level of a patient.

**Index Terms**—Chewing, Swallowing, UWB sensor, acoustic sensor, Spline Transform, breathing monitoring, heart beat detection.

### 1.Introduction

The signals from throat and heart are captured using Acoustic sensor and UWB Radar respectively. The sensors satisfying the conditions include a piezoelectric sensor, a throat microphone, a magnetic sensor. Sensor signals are converted to the appropriate feature parameter rather than used directly in a subsequent recognition step. Feature extraction methods included are band-pass filtering and spline transformation. The final step in food intake detection is classification where swallowing events are recognized using the features derived from sensor signals. The underlying assumption is that the features of food intake are statistically well separated from those of non-food intake events (coughing, clearing the throat and speaking).

Methods based on mel-scale Fourier spectrum, wavelet packets, and support vector machines are studied considering the effects of epoch size, level of decomposition and lagging on classification accuracy [3].

Food intake monitoring was detected during the processes of chewing and swallowing. Acoustic Doppler sonar (ADS) detected chewing and swallowing events that were non- contact and free from acoustic interference in [1]. An automated and objective method for extraction of swallowing sounds in a record of the tracheal breath and swallowing sounds. The proposed method takes advantage of the fact that swallowing sounds have more non-stationarity comparing with breath sounds and have large components in many

wavelet scales whereas wavelet transform coefficients of breath sounds in higher wavelet scales are small[4].

## ULTRA WIDEBAND RADAR

UWB sensors take advantage of the properties of the electromagnetic field over a very large bandwidth. They are used for high-resolution remote sensing of their environment and non-destructive volume investigation. Depending on the application and the specific design of the sensors, this information includes geometric values or/and material and related properties. Typical UWB applications cover high resolution radar, precise positioning, object identification and impedance spectroscopy. Specific applications are high resolution short range radar for surveillance, distance and speed measurement in vehicular technology, object recognition and tracking, indoor navigation and positioning, microwave imaging, surface and wall penetrating radar for material layer analysis and detection of hidden objects, persons or landmines (humanitarian demining), detection of biologic activity (heart beat, respiration), impedance spectroscopy to characterize inorganic and organic substances, etc. Hence an integrated UWB-Radar-System was developed.

## ACOUSTIC SENSORS

AW-based sensors can be sensitive to a combination of parameters at the same time. To avoid sensitivity overlaps, different kinds of acoustic device have been used as well as adjustment of material properties, e.g. anisotropy and piezoelectricity.

## FRACTIONAL B- SPLINE

Fractional causal B-splines constructed by considering the analogy of classical B-splines by finite fractional differences of the symmetric and piece wise power functions which is a continuation of polynomial splines for all non-integers,  $\alpha > -$

1. Fractional B-splines is expressed in (1),

$$\beta_x^\alpha(j) = \frac{1}{\Gamma(\alpha+1)} \sum_{p=0}^{\infty} (-1)^p \binom{\alpha+1}{p} (j-p)_+^{\alpha} \quad (1)$$

The generalized fractional binomial coefficients as in (2)

$$\binom{u}{v} = \frac{\Gamma(u+1)}{\Gamma(v+1)\Gamma(u-v+1)} \quad (2)$$

Where  $\Gamma(u)$ , Euler's Gamma function defined as  $\Gamma(u) = \int_0^{\infty} x^{u-1} e^{-x} dx$ . Symmetric fractional B-splines were used to know the inner products of fractional B-spline with degree,  $\alpha > -1$  B  $\alpha =$

$\beta(\alpha-1)/2 * \beta(\alpha-1)/2$ . It means any shape that smoothly passes through a set of points. Thus, it is a smooth interpolating function. The most important feature of a spline is that it is a function that is non-zero over only a small region of space. That region is divided into a set of sub regions, and the B- spline is equal to a polynomial over each sub region.

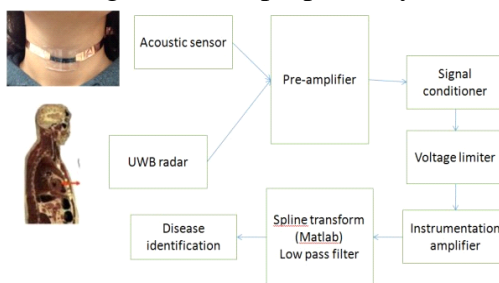
## II.EXISTING METHOD

The single most reliable test to diagnose all common forms of both hypothyroidism and hyperthyroidism is measurement of serum thyroid stimulating hormone (TSH). While there is some variation over what is considered to be a 'normal' range, Ultra-wideband (UWB) radar plays an important role in swallowing events.

In the medical field, for many situations, it is essential that a subject's respiration and heartbeat be monitored. The primary tool used for monitoring heartbeat is the voltage- derived electrocardiogram (ECG). Electrical signals cause the heart muscle to contract. These signals pass through the body and can be measured by electrodes (electrical contacts) attached to the skin.

## III.PROPOSED METHOD

Novel method is used such as the acoustics of throat to diagnose thyroid disease and respiratory disease with UWB radar. The acquired signal from the sensor is in time domain hence the signal process takes place with spline transform to determine the much important signal variations. Figure 1 shows the block diagram of the proposed system.



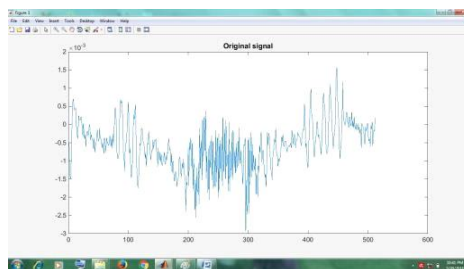
**Figure 1 Block Diagram of Proposed System.**

It consists of Ultra Wide Band (UWB) radar transceivers i.e., both transmit and receive the ultra wide band signal based upon the swallowing. Also the heart beat and respiration signal is also captured. The received signal is processed by the pre-amplifier and the processed signal is sent to signal conditioner. The signal conditioner converts one type of signal into other type of signal. The voltage limiter limits a DC stable voltage. The band limited signal contains essential signals from heart beat and respiration signals. Here, the respiration signal is filtered using motion filter and then filtered with processor. Later, signal transformation is done using B-Spline Wavelet Transform (DWT) to get peak values of heart and respiration signal from the obtained result.

## IV. RESULTS & DISCUSSION

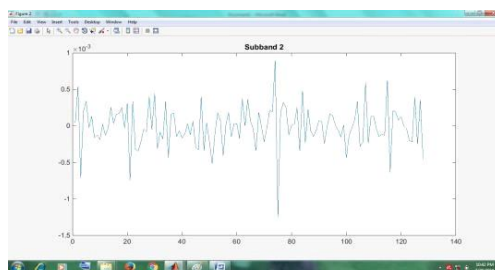
The database for 25 samples of throat and respiratory events has been collected. The recorded signals were analysed using Sigview software. Based upon the time duration, the signals

were recorded and then processed using MATLAB. Figure 2 shows the recorded original throat signal to diagnose the type of diseases.



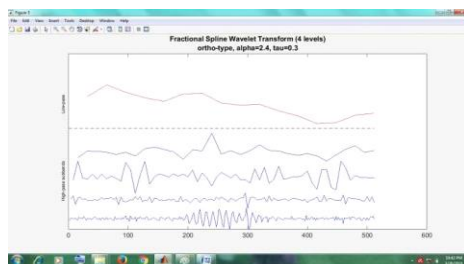
**Figure 2 Original Throat Signal.**

Figure 3 shows the subband signal obtained using Spline Wavelet Transform.



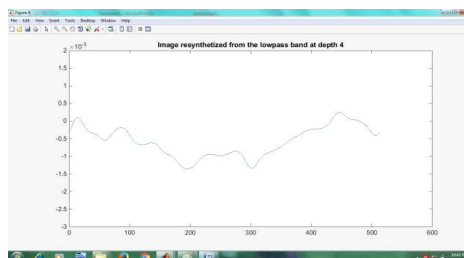
**Figure 3 Subband Signal.**

Figure 4 shows that the recorded throat signals that has undergone fractional Spline Transform with depth of 4 levels. Here, the  $\alpha = 2.4$  and  $\tau = 0.3$  is chosen for synthesis for both LPF and HPF signals.



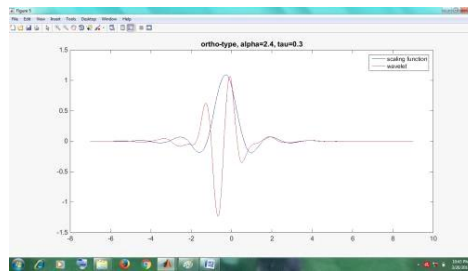
**Figure 4 Fractional Spline Transform with depth of 4 levels.**

Below Figure 5 shows that the filtering on LPF is resynthesized with depth of 4 levels.



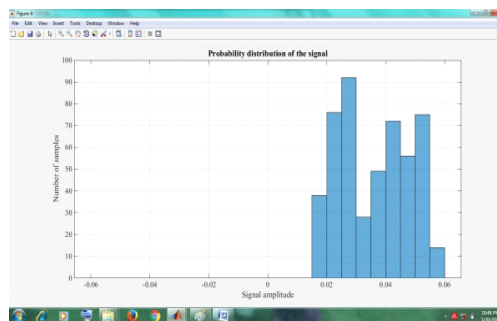
**Figure 5 Filtering on LPF is resynthesized with depth of 4 levels.**

Figure 6 shows the information about Scaling and Wavelet functions of Fractional Spline Transform of recorded throat signal.



**Figure 6 Scaling and Wavelet functions of Fractional Spline Transform..**

Figure 7 is the output waveform obtained by using PSNR value of recorded throat signal.



**Figure 7 PSNR Waveform.**

## V. CONCLUSION

Using UWB radar of advanced signal processing, the swallowing events were recorded and the analysis were also made. The spectral analysis with the DWT methods were made where extraction of breathing and heartbeat. Thus combination of UWB radar and various processing methods has potential for identifying and extractory human body's life signal in complex environment.

## VI. REFERENCES

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