Infineon-Hackathon

Vital Sensing in Humans using Infineon BGT60TR13C FMCW Radar sensor

# Scope and purpose

We present a method to detect the movement of a person, breathing and heart rate using the given FMCW Radar.

# Intended audience

Hackathon Judging committee

Table of contents

[About this document 1](#_Toc488846629)

[Table of contents 1](#_Toc488846630)

[1 Vital Sensing 2](#_Toc488846631)

[1.1 Detection of Movement 2](#_Toc488846632)

[1.2 Detection of Breathing rate 2](#_Toc488846633)

[1.3 Detection of Heart rate 2](#_Toc488846634)

# Vital Sensing

Non-Invasive Vital sensing is one of the many applications that can be performed using the Infineon BGT60TR13C sensor. The aim of this work is to detect few of them when a single person is sitting in front of the radar facing towards the chest at a distance range of 20 cm to 80 cm. The following parameters are to be detected

* Person Moving/Quasistatic
* Breathing rate
* Heart rate

## Detection of Person Moving/Quasistatic using a Machine learning model

* Configure the device using the following details

// oDevConf = DeviceConfig(1e6, ... % sample\_rate\_Hz

1, ... % rx\_mask

1, ... % tx\_mask

31, ... % tx\_power\_level

33, ... % if\_gain\_dB

59133931281, ... % start\_frequency\_Hz

62366068720, ... % end\_frequency\_Hz

64, ... % num\_samples\_per\_chirp

32, ... % num\_chirps\_per\_frame

0.000411238, ... % chirp\_repetition\_time\_s

0.125, ... % frame\_repetition\_time\_s

0); % mimo\_mode

* For collecting the dataset, set the number of frames we wish to receive and collect the data for static and with movement separately.
* As part of Preprocessing, we perform Range FFT on the input data, we set the values to be taken in the range of 20 cm to 80 cm by dividing the chirp samples by 8 and 2 respectively. The data between this range is then used to detect peaks when the person is moving vs when static.
* The data is now used for training a Non-Linear SVM model to predict between movement and static. The accuracy is shown in corresponding code provided.
* Another method for doing the above task is to perform Doppler FFT on the raw data, take the mean across the antennas and then the columns, taking absolute value of the result and multiply by summing from ( 0 : ((no\_of\_frames/2 )– 250)). If the sum is greater than a certain threshold, the subject is moving else Quasistatic.

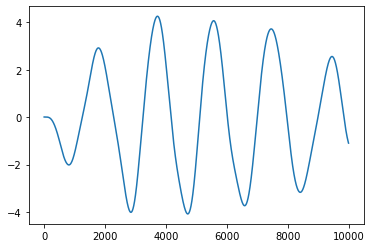


Figure : Plotting of breath signals. Detecting the peaks above a threshold can give breath count

## Calculation of Breathing Rate

* Collection of input data for the provided device configuration.
* Pass this data through a low pass filter to remove the high frequency noise.
* Then, feed the resultant data to the given function: do\_processing().
* do\_processing() function returns the phases of the input data.
* Calculate the mean of the phases across the three antennas.
* Consider the data as an input signal.
* Apply High Pass Butterworth and Low Pass Butterworth Filter of order 4 to the signal.
* Subtract the Mean of Signal from the filtered signal. Plot the graph (Figure 1)
* Set a threshold that will be used in the next step to obtain the number of peaks that cross the threshold in the resultant signal.
* Breathing Rate is obtained with respect to the number of peaks above threshold.

## Calculation of Heart Rate

* Calculation is done similar to the above algorithm with the main difference that signal is passed through a different set of filters with high pass cut off as 0,7 and low pass cut off as 3 Hz respectively.