**Sampling System Design**

The system is required to distinguish movements in the 3-8 Hz range from other movements during normal daily activities. The sampling system is designed to achieve this requirement while avoiding excessive bluetooth radio traffic between the wearable and the phone, which would reduce battery life on the wearable.

This is achieved by collecting accelerometer readings at regular intervals for a given period, then using a fast fourier transform (FFT) to convert from the Time Domain into Frequency Domain. The two main parameters in designing the sampling system are the sample frequency and period over which samples are collected.

A sampling frequency of 25Hz is available on most wearables. This will allow movements as fast as 12.5Hz to be detected correctly without aliasing (<https://en.wikipedia.org/wiki/Nyquist_frequency>). If the user moves at a higher frequency than 12.5 Hz these movements will appear as alias features in the spectrum. It is judged however that the power of any movement at such a high frequency will be relatively low compared to the normal human movements so these will not be significant. Aliasing has not been identified as an issue during ‘real world’ testing of the system.

The sample collection period determines the frequency resolution of the spectrum derived using fourier transform (The frequency resolution is 1/sample period [<http://www.add.ece.ufl.edu/4511/references/ImprovingFFTResoltuion.pdf>]).

This means that collecting data for 5 seconds will achieve a resolution of 0.2 Hz, by collecting 125 data points at 25 Hz sample frequency as discussed above.

A resolution of 0.2 Hz is judged to be adequate to distinguish movements in the 3-8 Hz region – a shorter sample period of say 1 second would result in a resolution of 1 Hz which would reduce confidence in the frequency discrimination because the region of interest would contain few ‘bins’, and may also be more prone to measurement noise effects. Using a resolution that is slightly higher than is likely to be necessary also allows for potential future algorithm development using an expected frequency response rather than a simple power calculation.

The calculation method is to calculate the vector magnitude of the acceleration for each data point to give a single magnitude value rather than perform the calculation on the 3 different acceleromater axes independently. The reason for this is that although keping the three accelerometer axes searate retains information about the direction of movement as well as its amplitude, it will need three times as much data transfer. Also any algorithm will need to determine the orientation of the wearer if the 3 axes are used, as movement when sitting down is likely to appear in different axes to when lying down.