1. Information dependency of a sensor between different motions
   1. Dependency of sensors of and using Mutual information

The datasets for motions and are given by matrix , where S is the number of sensors and F is the number of frames. The number of sensors is 8472 sensors, and 554 frames are used. Each frame contains one value which is compressed one dimensional value using PCA.

To compute the mutual information between two individual sensors of and , the following equation is used:

Mutual\_info\_score (, , i = sensor number from 1 to 8472

Mutual information is computed using package in Python called Sklearn which can be used for Mutual information between two discrete random variables. The float values calculated after principal component analysis are converted into integer values before mutual information is computed since the mutual information is based on probability distribution of variables. The decimal place of data set is 13 decimal place which means individual sensors has 554 different values for 554 frames for both motions. Thus, and having same probability distribution will result in same mutual information for 8472 sensors between and . To prevent that problem, values are rounded at -1 decimal place, so that similar values can be considered as one value which can lead different probability distribution between and .

A close up of a map

Description automatically generated

The graph above plotted using MATLAB shows traces of first sensor of the first motion after dimensional reduction using PCA. Blue line indicates traces of original values over 554 frames as well as the red line indicates traces of marginal value after rounding at -1 decimal place.

* 1. Sensor placement with mutual information values

After computing mutual information values of a sensor between and , sensors are plotted as heatmap

A person posing for the camera

Description automatically generated

The figure shows heatmap of mutual information using MATLAB. The right-side figure is front view as well as the left is back view. Every dot on the cloth is sensors which are 8472. A dark blue is used as reference colour for mutual information being 0, which means the darker blue, the closer to 0 the sensor is (i.e. the sensor with darker blue indicates the signal between and are more dependent than other sensors). It seems to be trend that the more the sensor in placed in the centre of body, the less dependent it shows to be between motions. Unexpectedly, the sleeve of top and bottom have relatively higher mutual information than other sensors. However, the value of mutual information is still low since the maximum value of mutual information is 1.402 which is lower than the maximum of mutual information between variables with 2bits. This indicates the motions, and , are quite similar.

* 1. Sensor places with lower mutual information

The Dataset used for computing mutual information between two motions is given by matrix . 8472 mutual information are calculated for 8472 number of sensors between. and .

Mutual\_info\_score (, , i = 1 to 8472

For easy viewing, MATLAB is used to plot the scattering graph for 8472 sensors in sky blue colour as well as optimal sensors are scattered with red points. The red dots on the diagram tells the 50 sensors having lower dependency between motions. The red sensors are bounded using red circles for easy viewing. For the front view, sensors are assembled and straight down the left chest and abdomen from neck to the abdominal region. Most of sensors with low dependency are crowded in the left chest as well as two sensors and six sensors are located on right abdomen and left pelvis respectively.

A picture containing sky, clothing, person

Description automatically generated

1. Correlation of a sensor of and using Pearson’s coefficient

Pearson’s coefficient gives a measure of linear dependence between signals in and . To compute correlation coefficient, same data is used as computing mutual information. In the same period of two signals, correlation can tell the similarity between those in terms of deterministic signals like data used in this project. Unlike mutual information calculation, signal values are not rounded.