Guide on How to use the scripts of the ‘Final\_project\_3DVBM\_kinect\_IMU’ folder.

1. ***ACQUISITION OF KINECT DATA***

For acquisition of Kinect data you can use the script **GetDataFromKinect**. This is a version modified of the program available here: [Skeleton Viewer for Kinect V2 Skeletal Data - MATLAB & Simulink Example - MathWorks Italia](https://it.mathworks.com/help/supportpkg/kinectforwindowsruntime/ug/plot-skeletons-with-the-kinect-v2.html). In the version provided by us you need only to run the code and acquire the data. Frames are stored in ***colorImg*** data while the joints position are stored in ***metadata*** which is the main struct that you have to consider. **Run this code and store the data before the usage of any of the following provided script.**

* 1. Change the time acquisition changing the number of frames in **line 22.** Set the number by considering that the frame rate of Kinect is more or less 30 frame/s so if you want to perform an acquisition of 10 seconds you need to consider framePerTrig = 300.
  2. If some errors appear you need to check that:
     1. **At least Matlab R2021b is installed;**
     2. Increase the pause at line 31 in order to permit to the Kinect to provide frames in a correct way to the PC.

From line 94 there is a script through which you can obtain a gif with the frames provided by Kinect in order to reconstruct the exercise.

1. ***ACQUISITION OF IMU DATA (FOR MATLAB MOBILE APP)*** 
   1. Open the App, click on menu (top left) -> Sensors
   2. Stream to ‘Log’ to store locally the data
   3. Set the Sample Rate (Note: in many trials we noticed it was not constant as set in the options)
   4. Turn on the sensors you want
   5. START the acquisition, and STOP at the end of the test.
   6. Enter log name -> the Session will be saved locally
   7. Use MATLAB Drive to see and download the session file.
2. ***USE OF FINAL\_PROJECT\_3DVBM\_KINECT\_IMU.M FILE*** 
   1. Note: in order to use this script the:
      1. buildSkeletonConnectionMap.m
      2. KinectTrackingTimeXYZ.m
      3. metadata.mat (from the Kinect log)
      4. IMUdata.mat (from MATLAB)

MUST be present in the current folder. All the HYPERPARAMETER to be set from the user are inserted into a paragraph starting and ending with \*\*\*\*\*\*\*\*\*\*\*\*\* symbol. Example:

% \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

% Interpolate data with the max between the two sampling frequency,

% in order to avoid loss of information

FREQ\_INTERP = FREQ\_IMU\_MAX;

% \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

* 1. As the file contains guide on how to use the script, in the following paragraph the main steps will be reported:
     1. Importing the data
     2. Extract the first and last timestamp of the Kinect Data;
     3. Cut the IMU data with a SAMPLE\_MARGIN wrt to the Kinect data indexes
     4. Preprocess the Kinect data (see the KinectTrackingTimeXYZ.m function)
     5. First Inspection of data
     6. Interpolation of both IMU and Kinect data
     7. Integral of Acceleration Data -> Velocity
     8. Cross-correlation computation between
        1. Velocity IMU and Kinect
        2. Acceleration IMU and Kinect
     9. Synchronization (Note: set the SHIFT parameter)
     10. Peak detection algorithm of Kinect and IMU data
     11. Plotting the final results
     12. Find the amplitude and frequency displacement from the acceleration and Kinect

1. ***USE OF PlottingScriptFromZeroTimeAndHeight***

This script aims to plot the x,y,z position of a joint with respect to the time. In this script the time starts from zero considering, as reference time, the instance in which the one skeleton is recognized by Kinect. This script needs to be used after the data acquisition one. At ***line 59*** you need to put the number of joint in which you are interested in.

* 1. Firstly, data acquisition is needed;
  2. At line 20 you need to insert the height of the Kinect in order to have only positive values of y that start from zero;
  3. Run the script changing the number of joint at line 59;
  4. Is provided also the how the acquisition frequency is changing in time in figure 4;

In the second part of the script you obtain the reconstruction of the skeleton by the Kinect during the exercise that you have performed.

In the third part you obtain the same results of the first part but, in this case, you have a drawing of the x, y, z positions of the interested joint which is synchronized with the skeleton of the point before.