**User Guide for IMU-Based Kinematics with a MatLab Application**

*This MatLab application was developed by Dr. Ben Hindle and shared with his permission. The original research paper that cites the methodology behind this application can be found* [*https://www.mdpi.com/1424-8220/20/16/4586*](https://www.mdpi.com/1424-8220/20/16/4586)

When running the application, a pop up will appear on your screen. In the bottom left-hand corner of the pop up, you will see two buttons: **Settings** and **User Guide**.

When you click on the **Settings** button, it will open the window and you can choose either:

* Run all selections at once (“Auto”)
* Manually check through all diagnostic plots as you go (“Manual”)
* *Note:* it is recommended to use the Manual Selection the first few times you complete this process to help give you a better understanding of the outputs and what you are looking for exactly.

The **User Guide** button will bring up an informational window that will tell you how you can best structure your data for file naming.

* While this is not necessary, you are able to edit this application code to best suit your needs.

The left-hand side of the pop up has a set of four buttons that you will step through before being able to run data analysis on the sensors.

1. The **Set Up** button will enable you to chose the method in which you collected your data.
2. The **Sensors** button enable you to select the sensors you wish to include in your analysis.

* The **Base** can be either the pelvis (unilateral or bilateral analyses) or the foot (unilateral analyses only).
* The sensors of interest should auto-populate within the drop-down menus.
  + Sensors collected with Vicon will auto-populate with the name associated with them in the Vicon Nexus software.
  + Sensors collected with CaptureU will auto-populate with the numerical identification of the sensor.
* Rotation Sequence should have the most important plane of motion in the middle (e.g., YXZ indicates that the rotation of most interest are sagittal plane rotations).
  + Planes of motion follow conventional biomechanics rules: Sagittal (X), Frontal (Y) and Axial (Z).

1. The **Trial** button is intended for setting up data information on the motion trials.

* Input the sample rate of the exported document used to analyze the sensor data. If you wish to up or down sample the data, you can change the output sample rate.
* Chose if you would like to analyze the entire trial or a selection.
  + Can select frame (based off of sampling frequency) or time start/end (in seconds).
* *Note:* iMeasureU data collected with Vicon does collect raw data at a sampling frequency up 1125 Hz. However, exporting data that has been collected alongside other analogue and digital data results in a likely up sampling of the data (e.g., force platform data collected at 1250 Hz results in synchronous IMU data being output at 1250 Hz).

1. The **Calibration** button is intended for setting up calibration-trial specific information.

* As with the trial button, you can select a portion of a motion trial for the calibration (useful when there is movement during the static trial), sampling frequency, etc.
* *Note:* The code necessitates at least 1s of data for the static calibration trial.

1. The **Filter** table enables the user to chose the filtering properties of the kinematic data.

* Options: Bandpass, Bandstop, High Pass, Low Pass.
* Order, cut-off frequencies, etc. are chosen by the user and left up to their discretion.

1. The **Export** table enables the user to chose properties of the output files.

* *Analysis plane:*
  + Frontal (Y), Transverse (Z), Sagittal (X), or All.
* Data table output parameters:
  + Joints (Ankle, hip, knee, All)
  + Side (Left, Right, Both)
  + Timestamp
* Plot output Parameters:
  + Joints (Ankle, Hip, Knee, All)
  + Unilateral, bilateral.
* Data output directory: Where the .csv files will be output from the analyses.
* Plot output directory: Where the MatLab plot files will be output from the analyses.