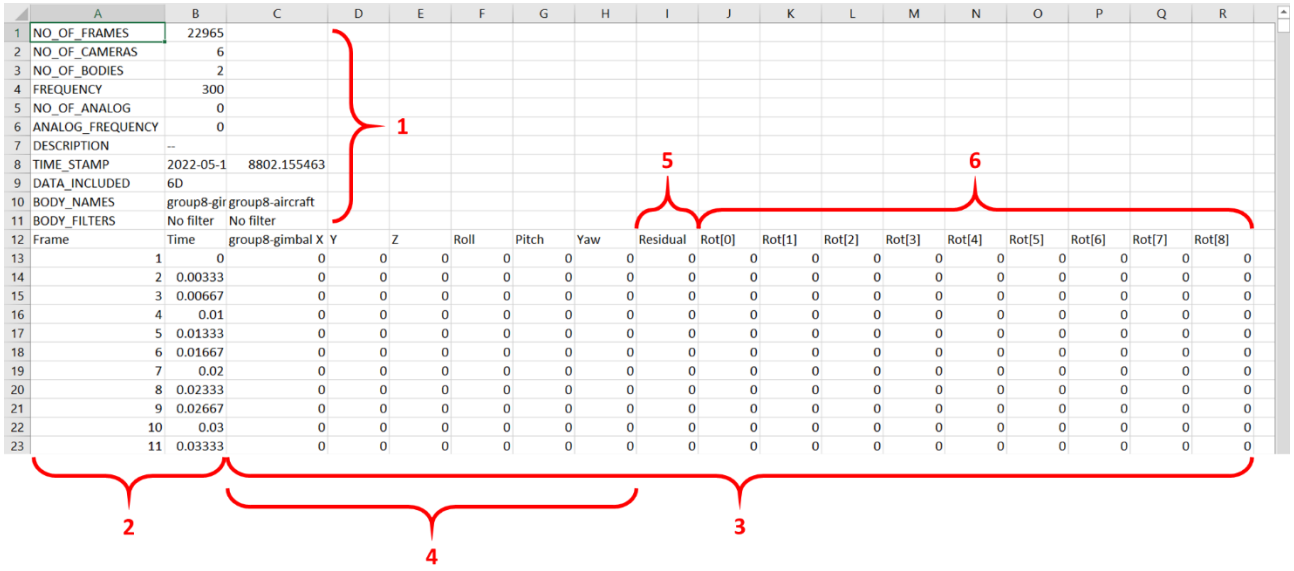
# Overview of Motion Capture Data

The motion capture system captures the positions of a series of IR reflective spheres attached to a body. If the body is rigid the relative positions of these spheres can be used to define rigid body motion. The motion of this body is then translated into a 6 degree of freedom (6DoF) representation which includes x, y and z coordinates (relative to the system's calibrated origin and axis) as well as roll, pitch and yaw angles.

The output of the motion capture system is a .qtm file which requires the proprietary motion capture software to read in and play. However, a tab-separated variable file (.tsv) can also be exported from the system which can be read in a variety of software including Matlab, Python, Excel or any ASCII text file reader e.g. notepad.

To import the data into Excel:

1. In Excel go to file and open
2. Browse to the location of the .tsv file on your computer
3. View all files and select the .tsv file
4. In the text import wizard ensure that delimited is selected and select next
5. For the delimiter select only tab, select next and finally finish
6. If successful you should see something resembling figure 1 below




| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | NO_OF_FRAMES | 22965 | | | | | | | | | | | | | | | | |
| 2 | NO_OF_CAMERAS | 6 | | | | | | | | | | | | | | | | |
| 3 | NO_OF_BODIES | 2 | | | | | | | | | | | | | | | | |
| 4 | FREQUENCY | 300 | | | | | | | | | | | | | | | | |
| 5 | NO_OF_ANALOG | 0 | | | | | | | | | | | | | | | | |
| 6 | ANALOG_FREQUENCY | 0 | | | | | | | | | | | | | | | | |
| 7 | DESCRIPTION | -- | | | | | | | | | | | | | | | | |
| 8 | TIME_STAMP | 2022-05-1 | 8802.155463 | | | | | | | | | | | | | | | |
| 9 | DATA_INCLUDED | 6D | | | | | | | | | | | | | | | | |
| 10 | BODY_NAMES | group8-gir | group8-aircraft | | | | | | | | | | | | | | | |
| 11 | BODY_FILTERS | No filter | No filter | | | | | | | | | | | | | | | |
| 12 | Frame | Time | group8-gimbal X | Y | Z | Roll | Pitch | Yaw | Residual | Rot[0] | Rot[1] | Rot[2] | Rot[3] | Rot[4] | Rot[5] | Rot[6] | Rot[7] | Rot[8] |
| 13 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 2 | 0.00333 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | 3 | 0.00667 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16 | 4 | 0.01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | 5 | 0.01333 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | 6 | 0.01667 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19 | 7 | 0.02 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | 8 | 0.02333 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | 9 | 0.02667 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | 10 | 0.03 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23 | 11 | 0.03333 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Figure 1 – Example .tsv file contents**

To import into other software e.g. Matlab or Python a custom script may have to be written to parse the data correctly. Below is a brief description/explanation of the contents of a typical .tsv file as viewed from within Excel. The numbers in the list below correspond to the numbers in figure 1.

1. The first 11 rows contain information about the capture
    a. The number of frames refers to the number of images that have been captured, this will correspond to the number of rows of data for each 6DoF model
    b. The number of cameras refers to the number of cameras in the system when the data is captured
    c. The number of bodies refers to the number of 6DoF bodies within the file

    d. The frequency refers to the frequency in Hz that the frames are captured at. In this example 300Hz
    e. No. of analog and the analog frequency can be ignored these are for older cameras or motion plate data
    f. Description is a simple text string identifier to describe the captured data – left blank by default
    g. The timestamp is the date and time the data was captured
    h. Data included defines the type of data within the present file
    i. Body names is a list of the names of each body within the file
    j. Body filters can be ignored
2. Columns A and B define the frame number and the time in seconds that the frame was captured.
3. For each body the file will contain 16 columns of information with an empty column of cells separating the data for each body
4. The first three columns define the x, y and z coordinates (in millimetres) of the body with the header for the x coordinates also containing the name of the body. The $4^{th}$-$6^{th}$ columns contain the roll, pitch and yaw angles (in degrees).
5. The residual defines the error in the fit between the markers and 6DoF body
6. The remaining 9 columns define the 3x3 rotation matrix

It should be noted that distances and angles are all defined with respect to the original coordinate system of the capture which is defined during the calibration phase. All aircraft are flown with the front of the aircraft approximately aligned with the x-axis. A positive x movement, therefore, corresponds to the aircraft moving forward, a positive z movement is in the vertical direction and a positive y movement is to the left i.e. a standard righthand definition of the axis. Roll, pitch and yaw are then defined in the usual way around their respective axis.