Introduction

D-Flow is used by MSc Will Bosch-Vuononen to design a biofeedback pipeline for the project “A real-time biofeedback intervention for improving tibiofemoral cartilage quality in older adults” in which Dr Lauri Stenroth is the principal investigator. In brief, the subject walks on the instrumented treadmill and whenever the knee joint loading exceeds a determined threshold, a visual feedback will appear on the screen and will only disappear when the subject lowers the knee joint loading.

The purpose of this technical documentation is for Dr Lauri Stenroth to have clear instructions on how to use and to modify this biofeedback pipeline once MSc Will Bosch-Vuononen is no longer working with him. Note that these instructions are not suitable if the goal is to build a pipeline from scratch. Instead, please look for the tutorials that come together with D-Flow software when installed.

General instructions

The print screen below (Figure 1) represents how the project looks like on 13/01/2025. The project is not ready yet, hence the documentation is also unfinished.

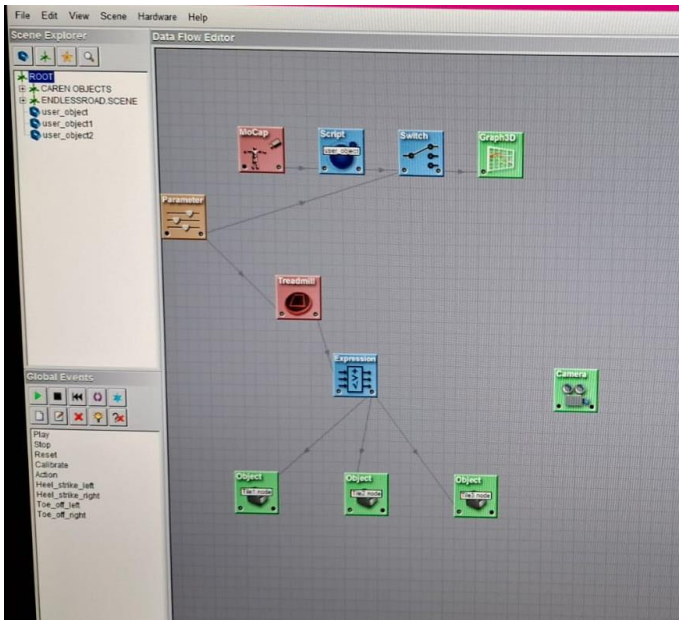

Figure 1: visualization of the entire project on 13/01/2025.

- **It is crucial to use the exact same name for the same variable for all modules to avoid errors.** This is particularly important for the modules Parameter, MoCap, and Switch. Note the Connection Editor in Figure 2. If the variables are not consistently named, making the connections will be more complicated.

- Another important factor is being sure that the variables of a module that will be used in yet other module(s) are being transferred in the Connection Editor (figure 2).

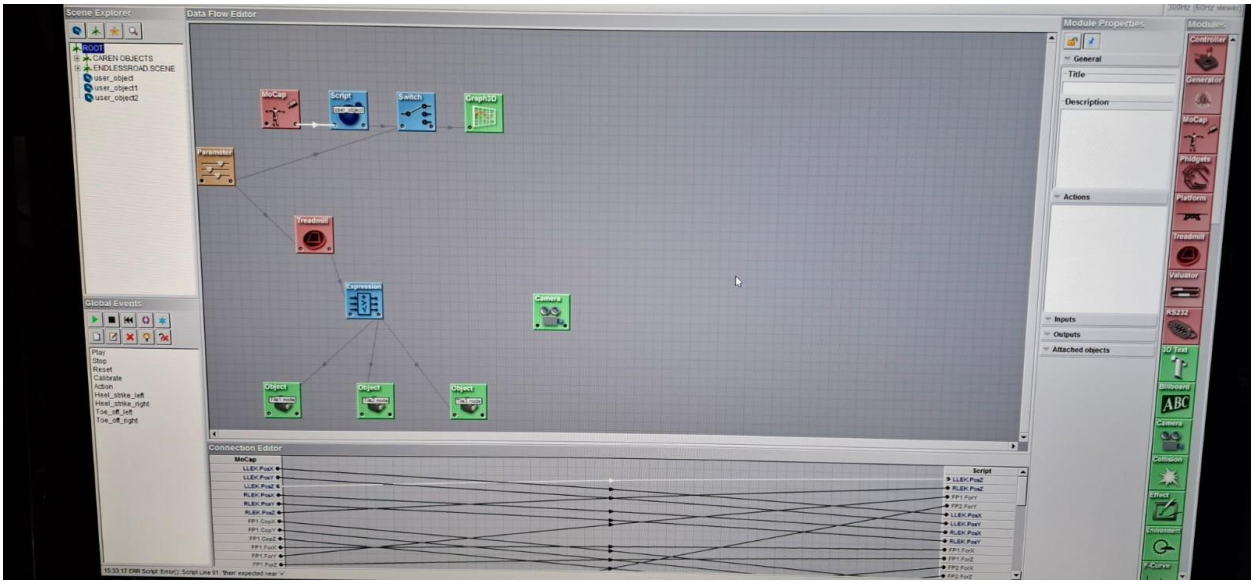

Figure 2: In the connection editor tab, several connections between variables of the modules MoCap and Script are presented.

About specific modules

Parameter module: where you define parameters that will be used in other modules, e.g., in treadmill and switch modules.

- You must define the treadmill speed upper and lower limits as a slider (see figure 3).
- You must define the parameter you want plotted as a list (see figure 3).
- The parameter module should be connected to the treadmill module and to the switch module.

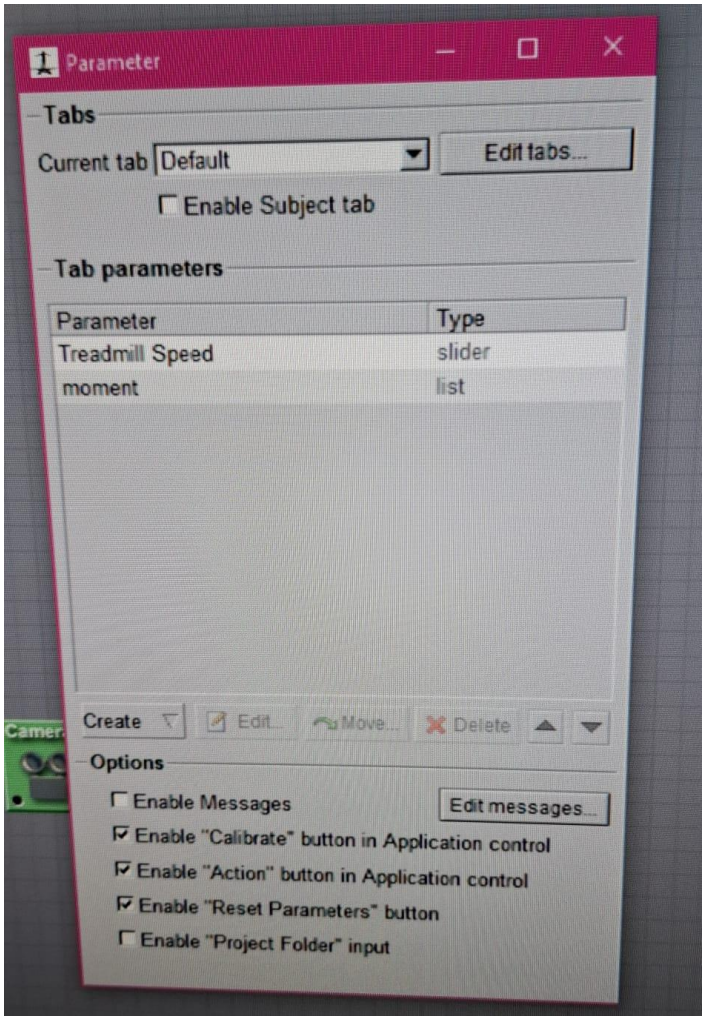

Figure 3: The Parameter module when opened.

MoCap module: where you control how the motion capture data will be used, displayed, filtered and saved.

- **Display Tab:** You can choose to visualize the markers, segments or GRF in the feedback screen.
- **Markers Tab:** You must define which marker set is being used by selecting its source and mode.
- **File Tab:** You can choose to record the trial or to load a previously recorded one.
- **Analog Tab:** You can select the filter and threshold for GRF, and how many output channels you will have.
- **Out Tab:** You select from where the motion capture data is coming, how the output is filtered, and which channels will be used as output (for other modules).

Script module: where you can make codes to execute several functions.

- **Script Tab:** where you write down the script in Lua language.
- **Inputs & Outputs Tab:** You must define the inputs, i.e., data from another module to be used by the Scrip module, in the inputs & outputs tab (Figure 4). You must define the outputs both in the inputs & outputs tab (Figure 4) and in the code itself, i.e., in the Script tab, as "outputs.set(single channel number (= 1, 2, 3), name of the output)" (Figure 5).

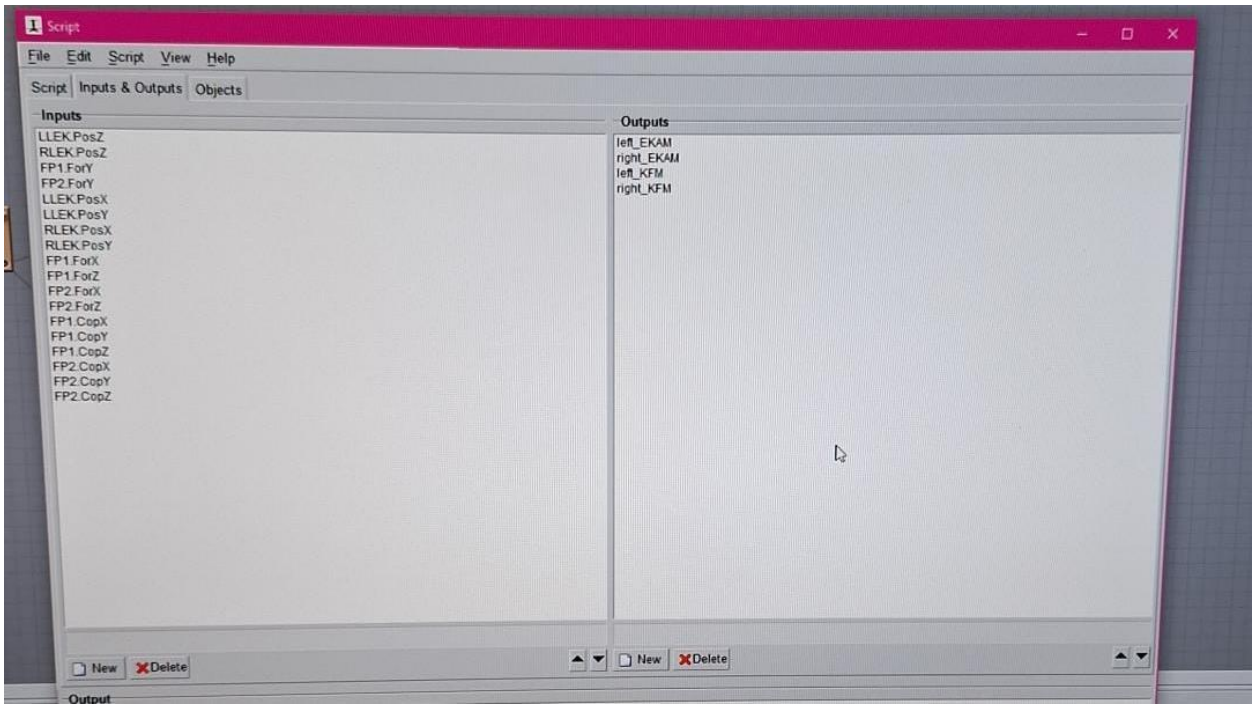

Figure 4: The Script module when opened.

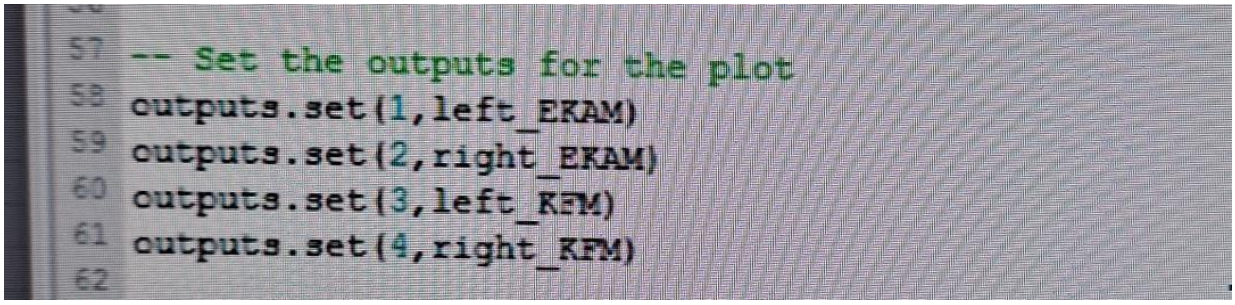

Figure 5: A part of the code showing how to determine the output values.

- **Tab Objects:** where you define the objects used in the module. Note that you have to create the object in Scene Explorer tab (outside script module) by clicking the add object icon (a blue donut) and dragging the object from the Scene Explorer to the Script Module (Figure 6).

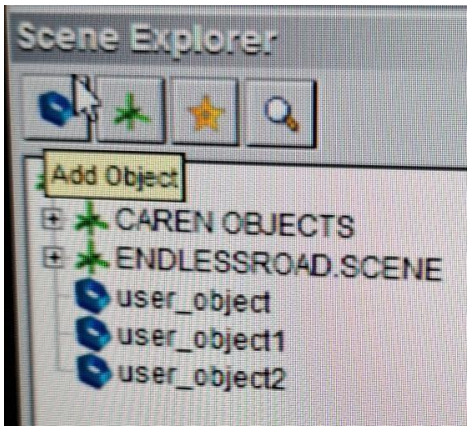

Figure 6: The button to create an object is highlighted.

The Script module should be connected to MoCap module (where the inputs come from), and to Switch module (where the outputs go to). In the connection with MoCap, connect all the input parameters to each other (Figure 2). In the connection with switch, connect all the output parameters with channels Figure 7)

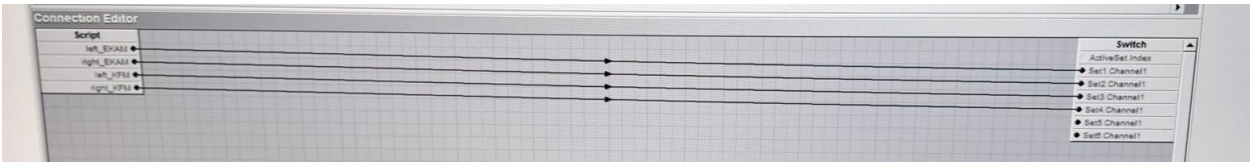

Figure 7: The connections between the variables being transferred from the Script module to the Switch module.

Graph3d module: where you can create graphs to be broadcasted on the feedback screen.

- **Transformation tab:** you determine the location and size of the plot.
- **Grid tab:** you determine the style of the plot, e.g., how many lines and what color.
- **Range tab:** you determine the y axis upper and lower limits.

-> Tip: the Graph module is basically a simplified version of Graph3d, and it doesn't get displayed in the endless road, i.e., to the subject.

Switch module: where you can connect different input data to be passed in a single connection to, e.g., a Graph3d module.

- Keep it connected to the parameter module, and connect the parameter list to the ActiveSet1.Index property of switch module.
- Keep it connected to the graph3d module by connecting Channel1 property from switch module to Channel1 property from Graph3d module.

Expression module: where you define tile properties of the path in the screen that is displayed to the subject. The values were taken from gait tutorial 1 (D-Flow gait tutorial pdf).

- It must be connected to the treadmill module and object modules that define the properties of the road appearance.

Camera module: where you can set how the view of the participant will be regarding the feedback. When you use this module, you cannot use the mouse to zoom in or out in the endless road scene.

- This module is supposed to be not connected to anything.

About the road visualization

Wall: If you wish to remove the wall from the screen, just deleting the files doesn't work (Figure 8). Instead, you must remove the lines representing it in the file EndlessRoad.scene by opening it in Notepad ++ (see Figure 9). The file you must change is located in C:\CAREN Resources\Scenes\EndlessRoad. Note that the original file is copy-pasted in C:\CAREN Resources\Scenes as a safe copy.

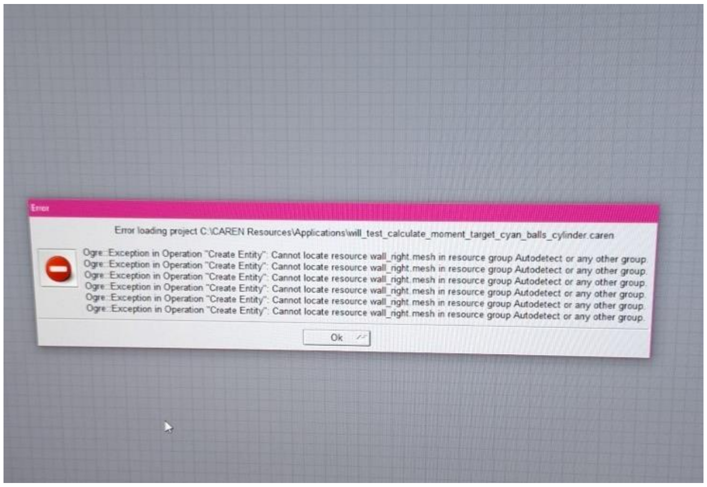

Figure 8: error displayed after deleting the files related to the wall displayed in the screen.

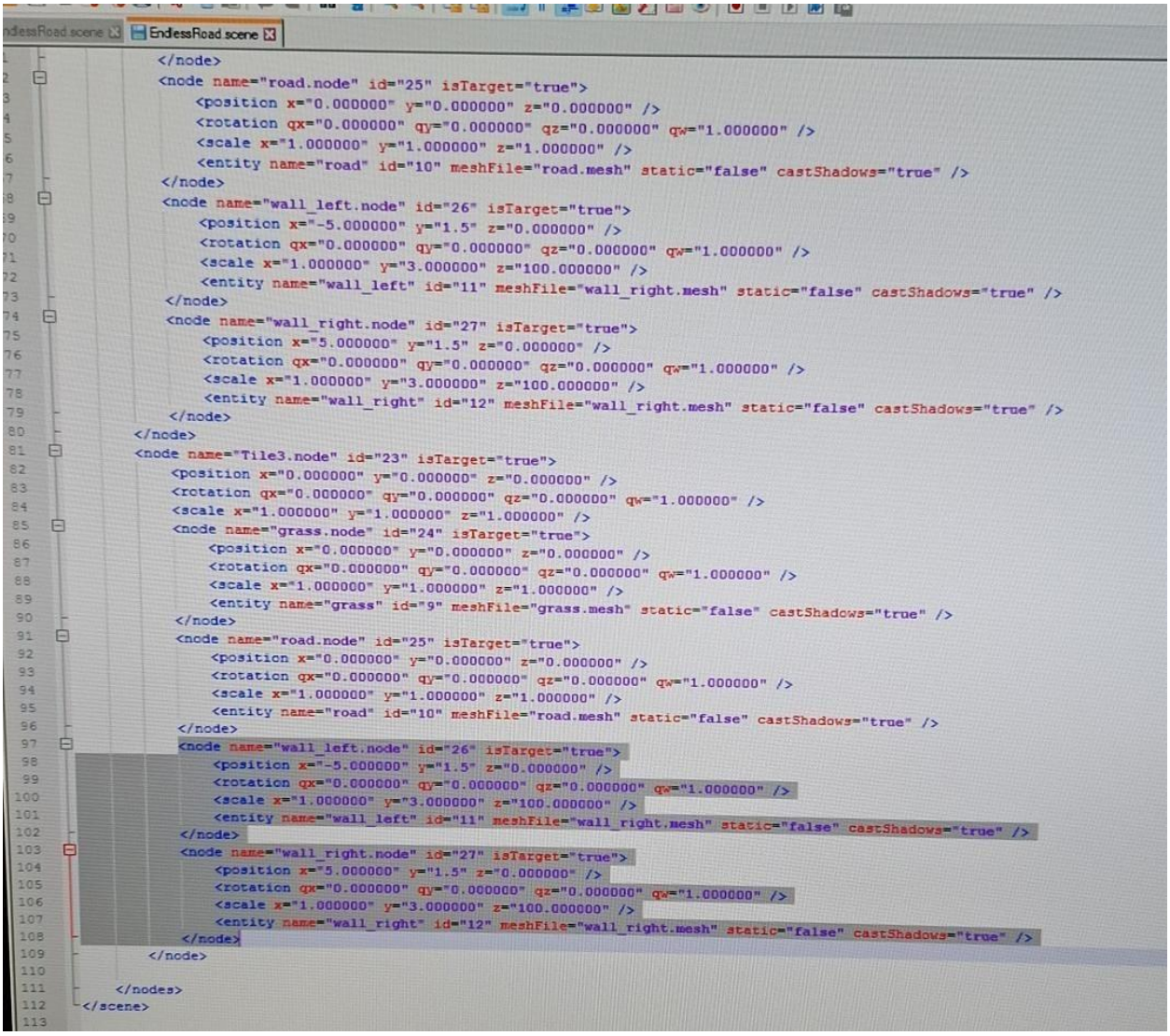

Figure 9: The lines defining the road properties are highlighted.