Stretcher user manual

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September 12, 2014

Contents

Chapter 1

Set up

The stretcher set up contains the following components, visible in figure 1.1.

- The stretcher frame with the two stages, number 1 in the picture and a load cell.
- Two USB-to-Serial converter, number 2 and 3, to connect the stages with the laptop.
- A analog/digital converter for the load cell, number 4 in the picture.
- A power supply for the analog/digital converter, number 5 in the picture.
- A USB-to-Serial converter, number 6, to connect the analog/digital converter with the laptop.
- A laptop with the installed stretcher software.

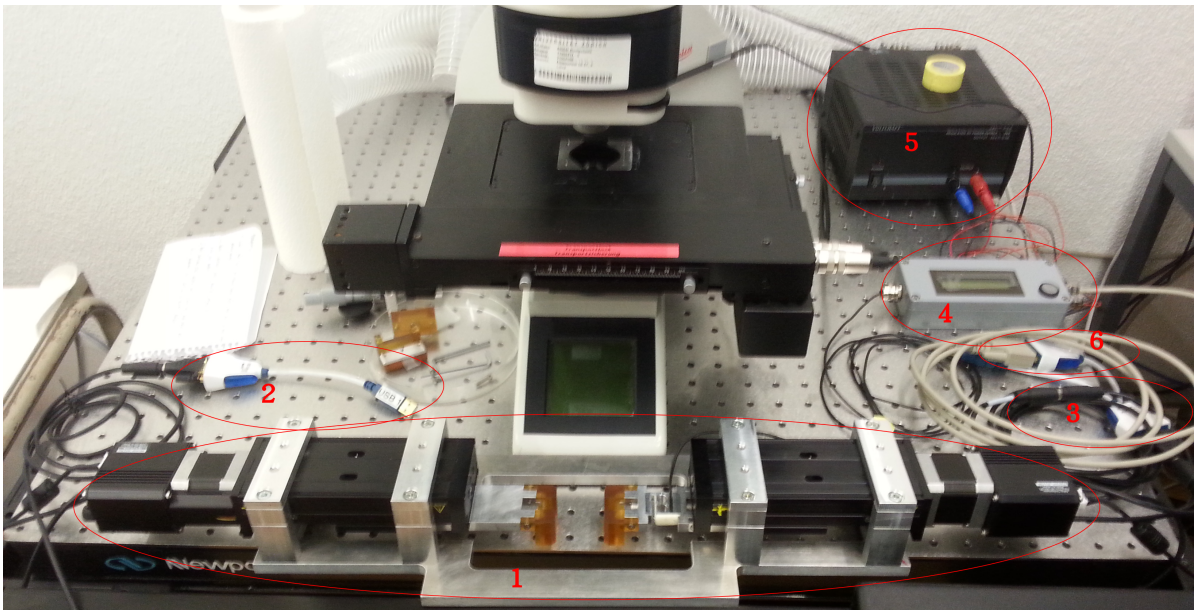

Figure 1.1: Set up

If the whole system is not in use for longer time, it is recommended, to unplug the power supply of the stages, shown in figure 1.2 and the power supply of the load cell.

Figure 1.2: Power supply of a stage

When the whole system is started, it is recommended, to wait until the measurement values on the analog/digital converter are visible as shown in figure 1.3. It is also a good practice to wait around 15 minutes until the analog/digital converter warmed up and shows more or less stable force values before starting with experiments. After that, the values can be zeroed by pushing the button on the analog/digital converter.

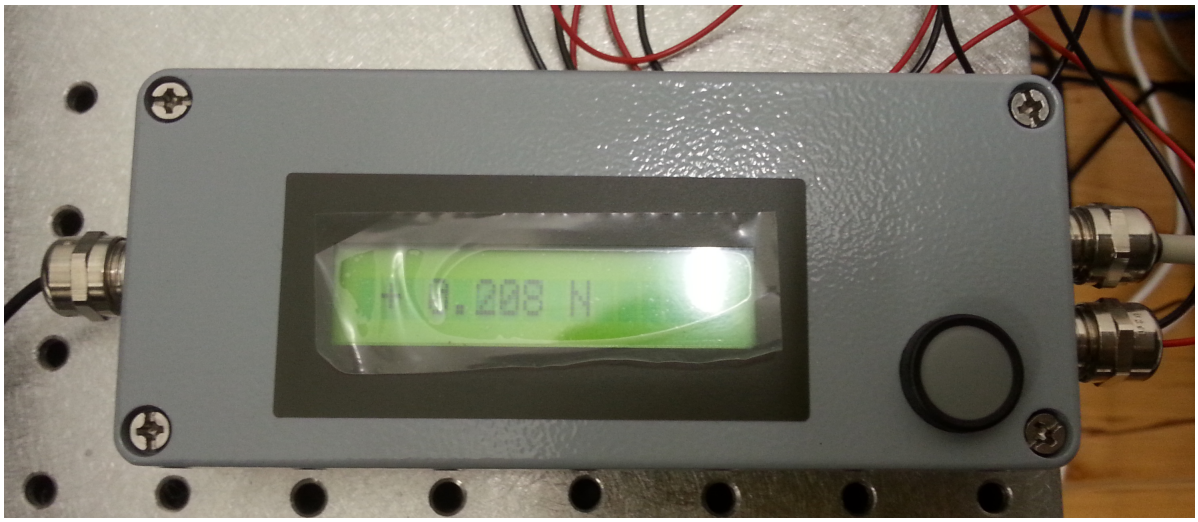

Figure 1.3: The analog/digital converter of the load cell

Chapter 2

Start up

1. Turn on computer and wait until the desktop appears.
2. Connect the 4 USB-to-Serial adapters in the order of their numbers (On which usb-port which adapter is connected doesn't matter).
3. Start the stretcher software.

2.1 Normal start

With the start of the stretcher program, a start-up dialog figure 2.1 will appear and ask if the mechanical set up has changed.

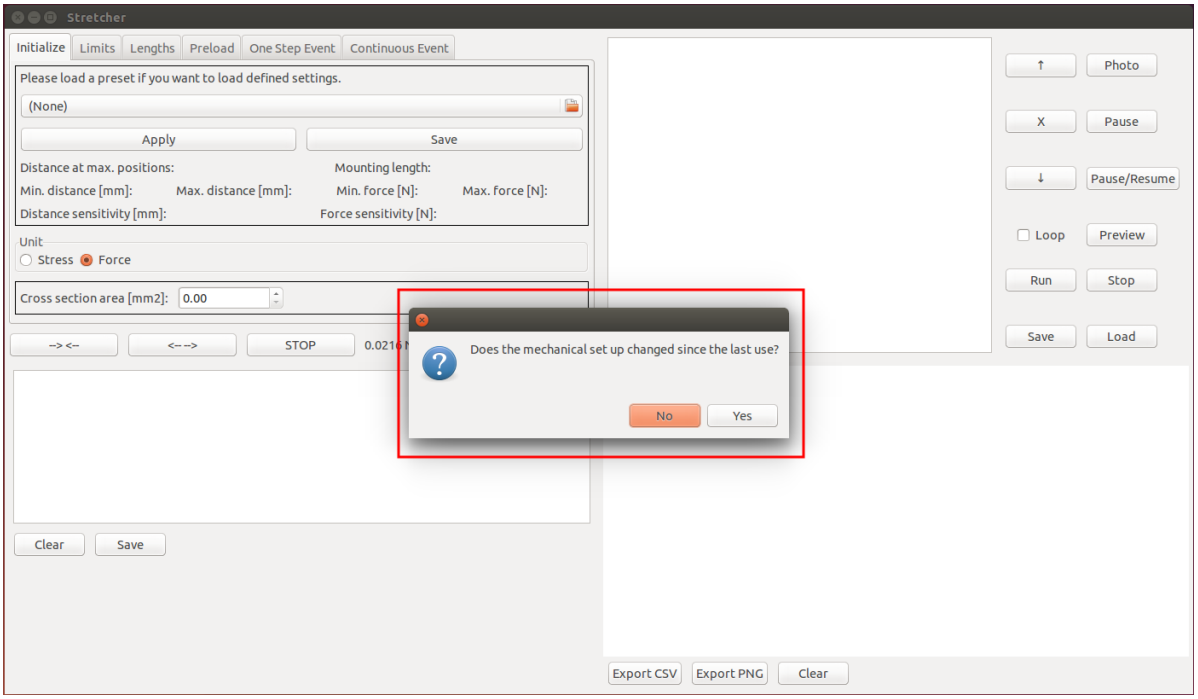

Figure 2.1: Start-up dialog

If the mechanical set up has not change, the program will load the parameters from the last usage. Otherwise, a new dialog will appear, see figure 2.2 and the user should move the stage to a distance, measure it and insert the measured distance it.

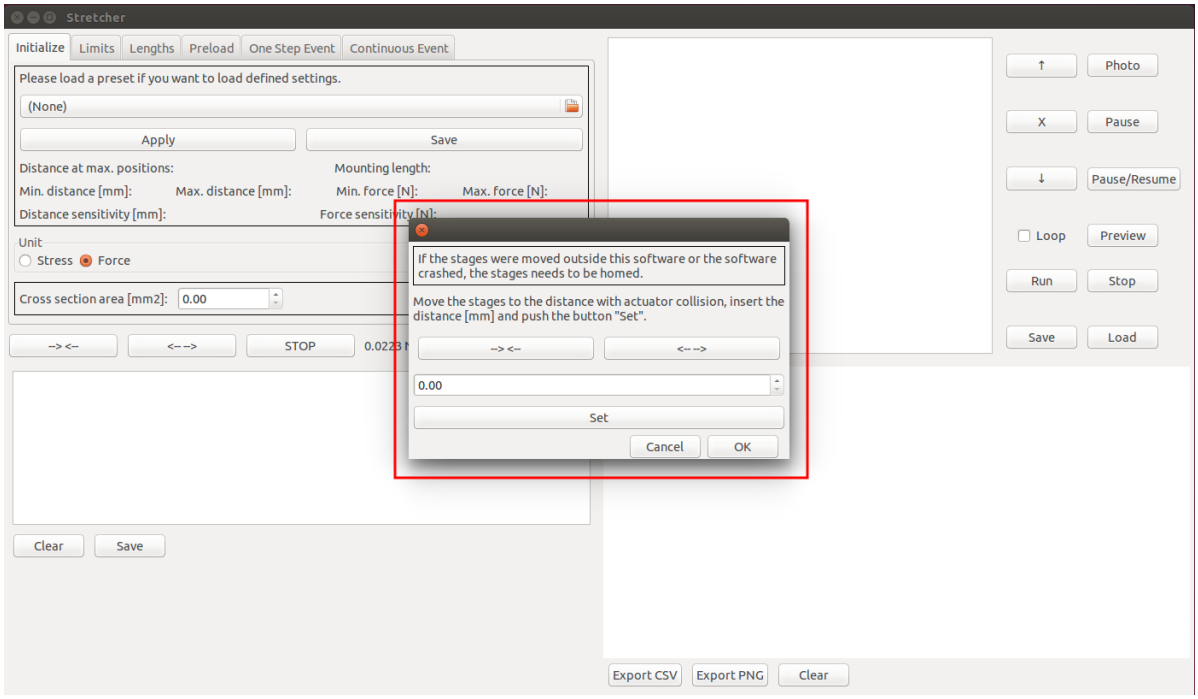

Figure 2.2: Set distance dialog

In both cases, the current parameters are visible in the tab “Initialize”, shown in figure 2.3. In this tab, the user can choose, if the experiments should be force or stress based, by selection the according radio button and in the case of stress, by specifying the cross section area.

In the next step, the user can set/adjust the force/stress and the distance limits. For this the desired values can be chosen in the tab “Limits”, shown in figure 2.4. The user can either input the desired values or load one of the four limit sets and then apply them by pushing the button “Set limits”.

After the limits are correct, lengths settings can be adjusted in the tab “Lengths”, shown in figure 2.5. In the distance field, the user can insert the desired mounting length and then push the button “Go to”, which will move the stages to it. It is also possible to use the increase- and decrease button to adjust the distance. When the mounting length is reached, it can be fixed by pushing the button “Set mounting length”. As next, the the sensitivities for the distance and force or stress values can be defined.

> Note: The sensitivity values are one half of the thresholds used in the experiment to reach a stress, force or distance value. For a better understanding, a value is reached, if the current value $value_{current}$ is between $value_{desired} - sensitivity$ and $value_{desired} + sensitivity$. The sensitivity values have to be chosen according to the used velocity because as higher the velocity as more inaccurate the system becomes.

It it is desired, the stress/force and the distance values can be zeroed by pushing the button “Zero force” respective “Zero distance”.

2.2 Homing of the stages

If the stretcher software crashed, the stages were moved without the stretcher software or the stages aren’t on the same position, the stages should be homed. In this case choose “YES” in the start-

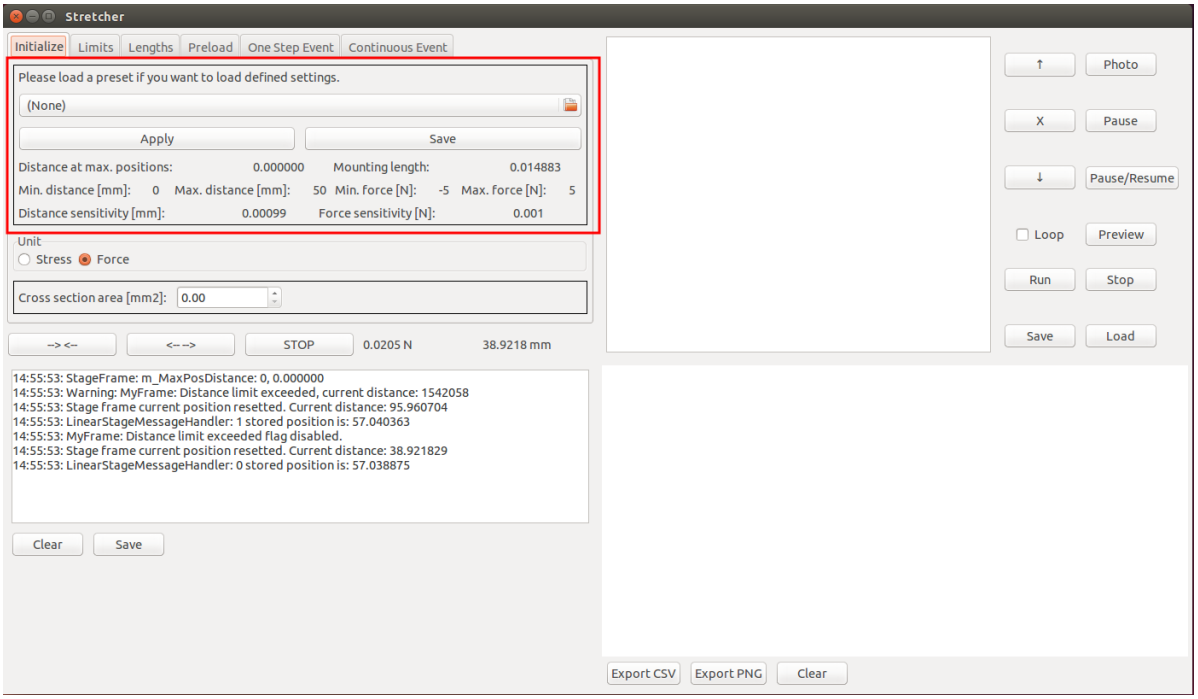

Figure 2.3: Initialize tab

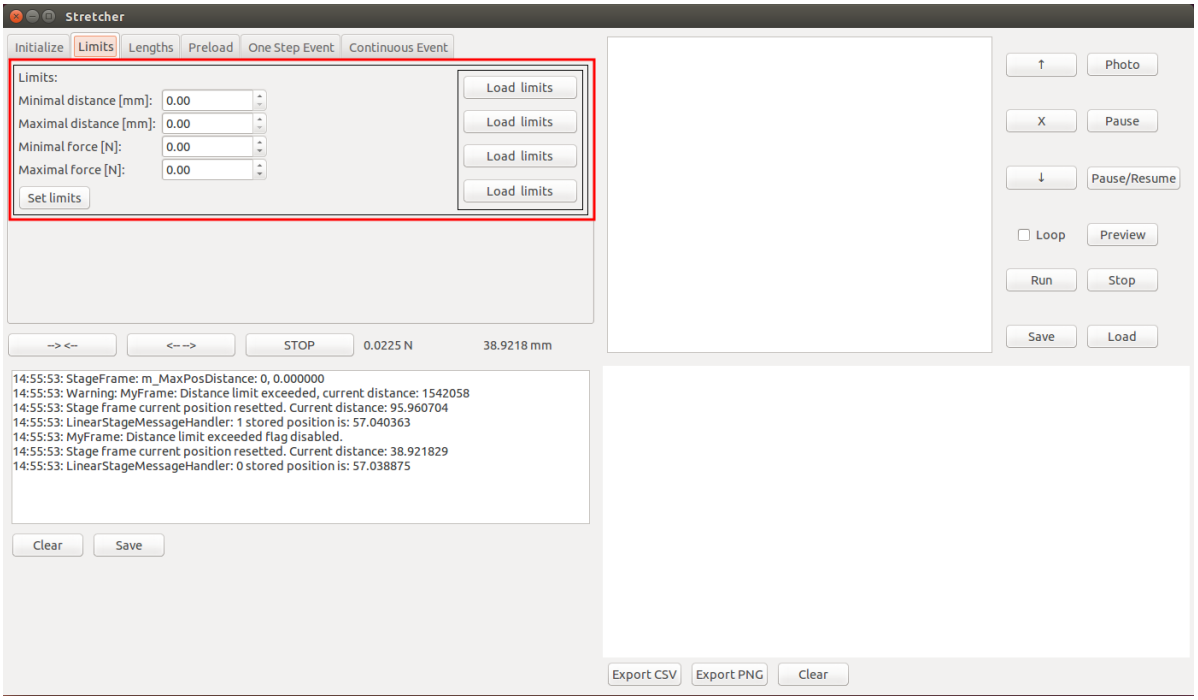

Figure 2.4: Limits tab

up dialog and then “Cancel” in the distance dialog. After that click on “Home stages” in the menu “Advanced”. The homing dialog should appear with a warning message. Make sure, that nothing is

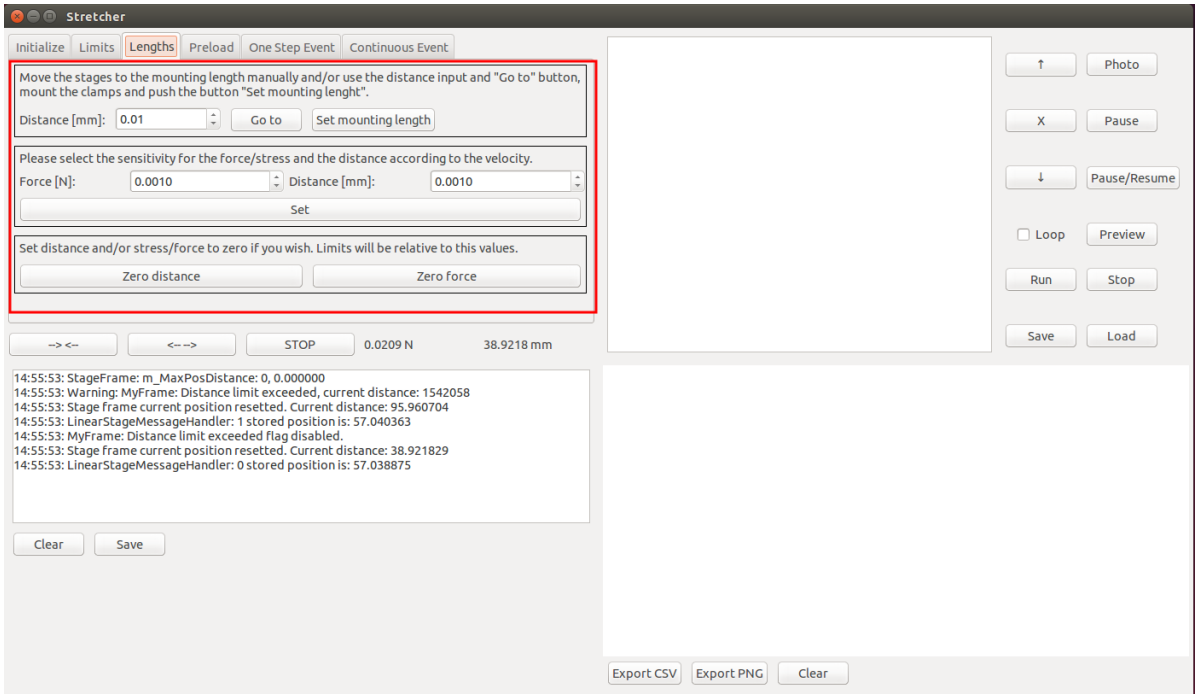

Figure 2.5: Lengths tab

mounted and nothing can break, if the stages go to their home position. If everything is clear, the button “OK” can be pushed which starts the homing of the two stages. In the next step, click on “Start up dialog” in the menu “Advanced”. Now proceed as described in the section “Normal start” 2.1.

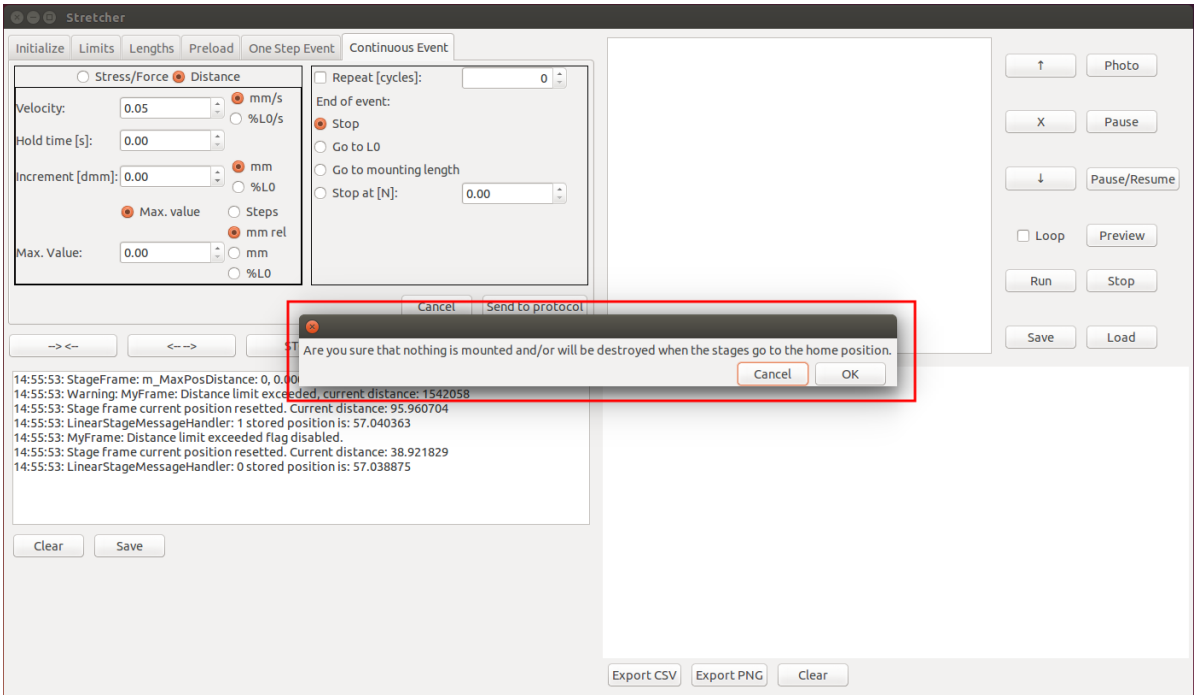

Figure 2.6: Homing dialog

Chapter 3

Experiments

3.1 Preload

The preload experiment is defined by a force or stress value and by the velocity. The velocity can be chosen as either in mm/sec or by $\%length_{mounting}/sec$, as shown in figure 3.1. If one velocity input changes, the other will adapt accordingly.

In a preload experiment, the sample will be stretched with the defined velocity until the defined force/stress is reached and then the stage stops at this position.

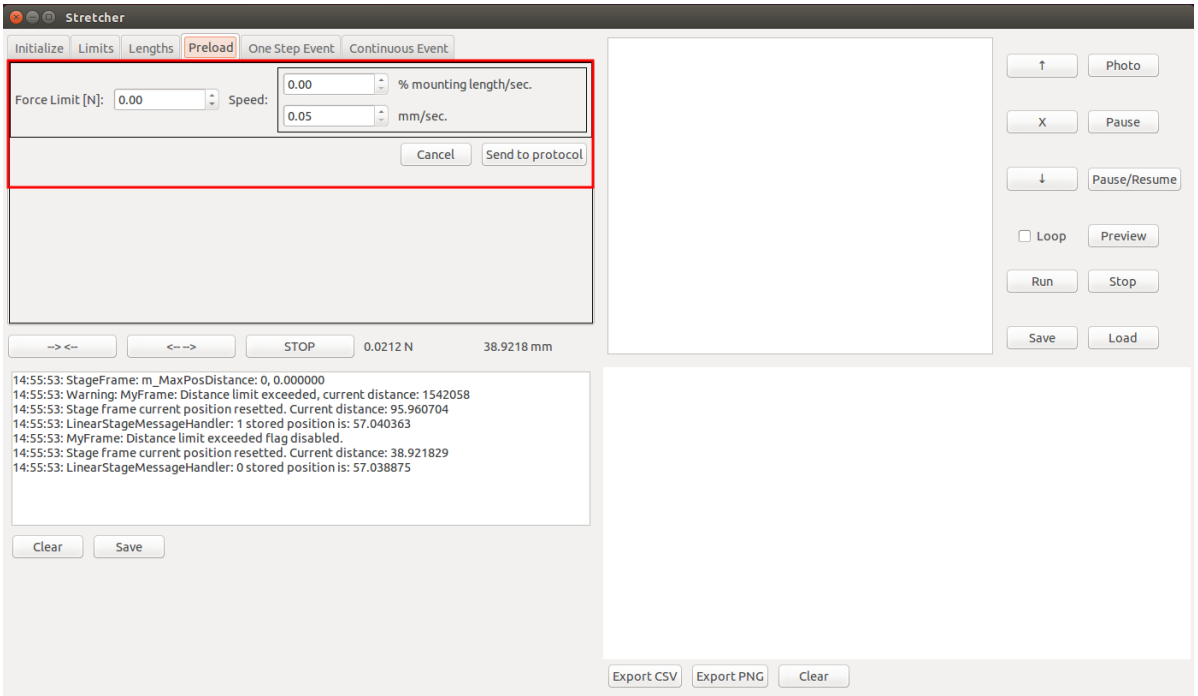

Figure 3.1: Preload experiment

3.2 One step event

The one step event is either distance based, as shown in figure 3.2, or force/stress based, as shown in figure 3.3. In both cases, the experiment is defined by a velocity (mm/s or $\%L_0/sec$), a delay time,

a limit and a dwell time. The experiment can be repeated by checking the check-box "Repeat" and inserting a cycle number. The behavior at the end of the experiment can also be selected. The following options are possible: Stop, Hold a distance, Go to L_0 and Go to $length_{mounting}$. The distance limit and the hold distance can both be defined in three ways, either by mm relative to the start length, mm absolute or by $\%L_0$.

In the one step event experiment, the sample will be stretched with the defined velocity until the limit is reached, after the delay time is over. After the limit is reached, the experiment waits until the dwell time is over and after repeat these steps or act as defined in the end of event behavior, if it was the last cycle.

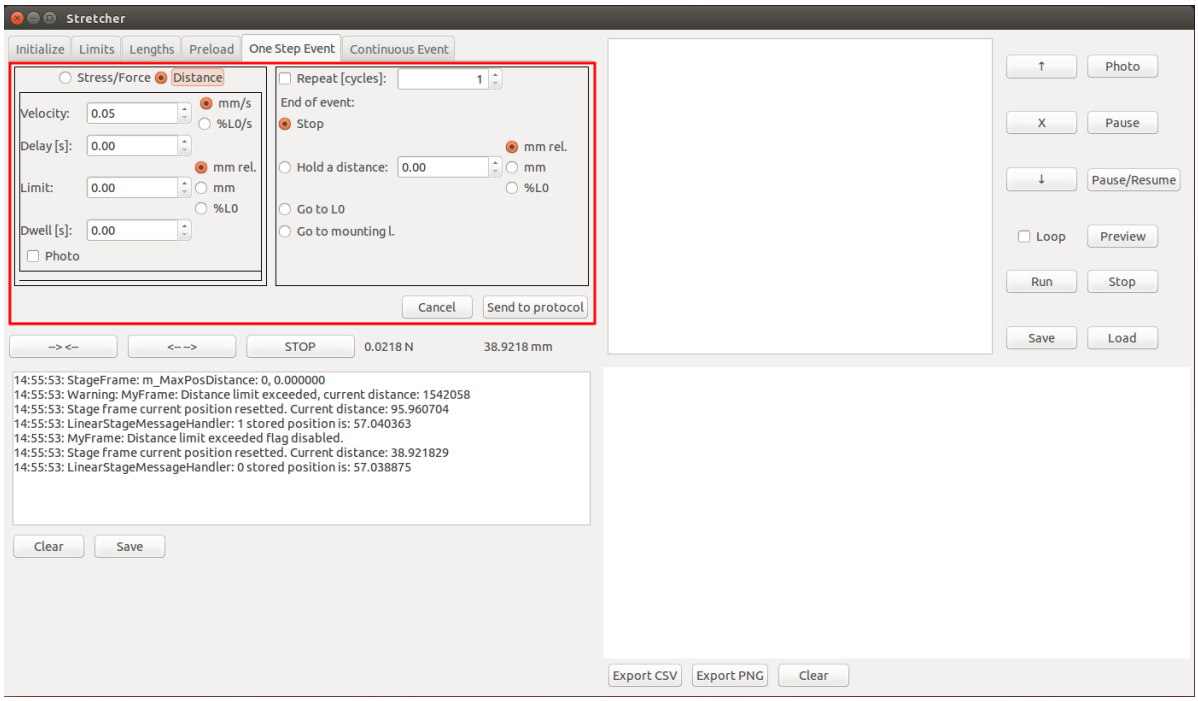

Figure 3.2: One step event experiment distance based

3.3 Continuous event

The continuous event is also either distance based, as shown in figure 3.4, or force/stress based, as shown in figure 3.5. In both cases, the experiment is defined by a velocity (mm/s or $\%L_0$), a hold time, an increment and a maximal value or a number of steps. The experiment can also be repeated by checking the check-box "Repeat" and inserting a cycle number. The behavior at the end of the experiment can also be selected. The following options are possible: Stop, Go to L_0, Go to $length_{mounting}$ and Stop at force/stress. The distance increment can be defined in two ways, either by mm absolute or by $\%L_0$. The distance maximal value can be defined in three ways as the increment or by mm relative to the start length. If the experiment is defined by a maximal value, the steps will be calculated at the start of the experiment otherwise the inserted steps will be taken into account. If the maximal value is defined in $\%F_{max}$ a ramp to failure experiment will be performed and the increment values will be ignored.

In the continuous event experiment, the sample will be stretched until the increment is reached, then the experiment waits for the hold time. This procedure will be repeated according to the number of steps. After the last step, the experiment will be repeated, or it acts as defined in the end of event

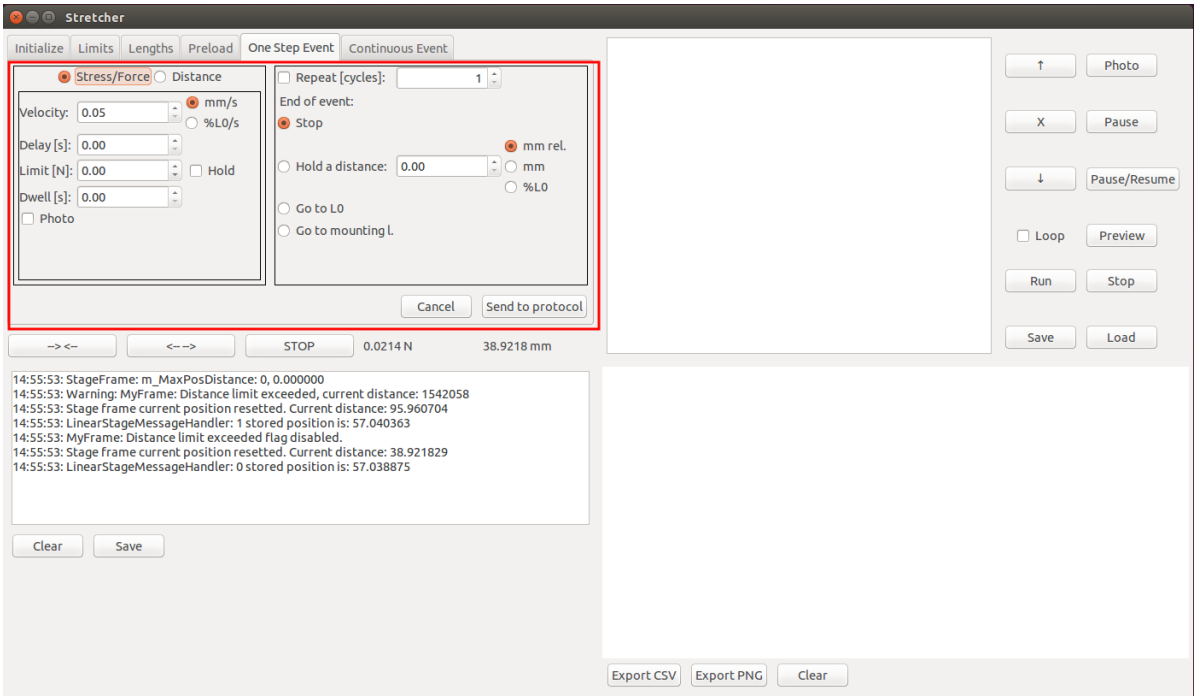

Figure 3.3: One step event experiment force/stress based

behavior, if it was the last cycle.
If a ramp to failure experiment will be performed, the sample will be stretched until the current force/stress drops under the specified percentage of the maximal measured force.

3.4 Pause

The pause experiment is defined by only one parameter, the pause time. To add a pause experiment, the “Pause button”, shown in figure 3.6 has to be pushed, which opens the pause dialog, shown in figure 3.7. Here the pause time in seconds can be inserted and applied by pushing the button “OK”.

In the pause experiment, nothing happens until the pause time is over and the next experiment can start.

3.5 Pause/Resume

The pause/resume experiment doesn’t have any parameters. To add a pause/resume experiment, the “Pause/Resume” button, shown in figure 3.8, has to be pushed.

In the pause/resume experiment, a dialog will pop up and the experiment waits until the user continuous by pushing the button “OK”.

3.6 Trigger

The trigger experiment will send a message over RS-232 to the connected microscope control software. This can trigger a protocol in the microscope control software. Please refer to the microscope control software manual.

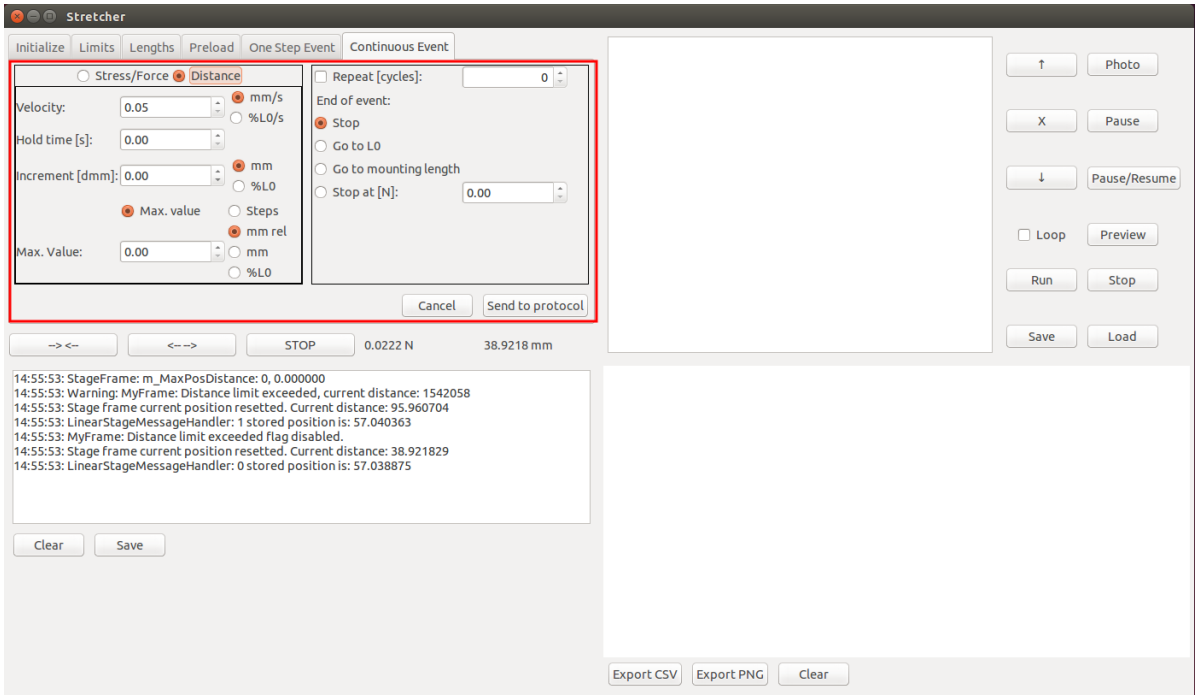

Figure 3.4: Continuous event experiment distance based

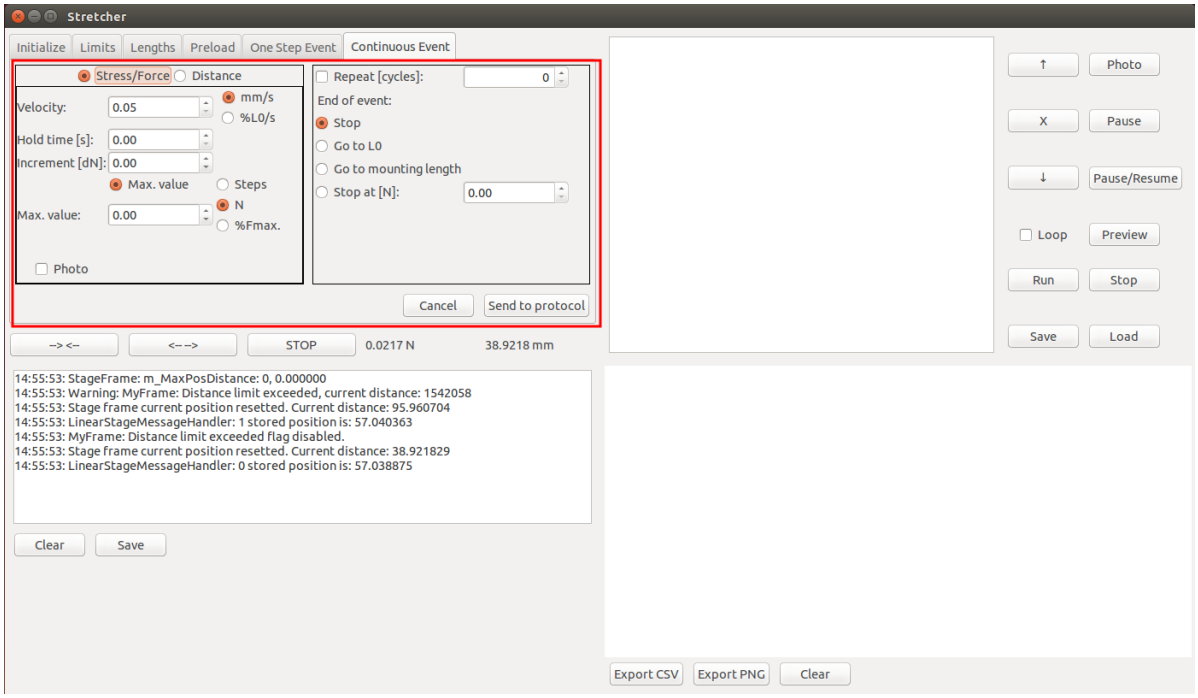

Figure 3.5: Continuous event experiment force/stress based

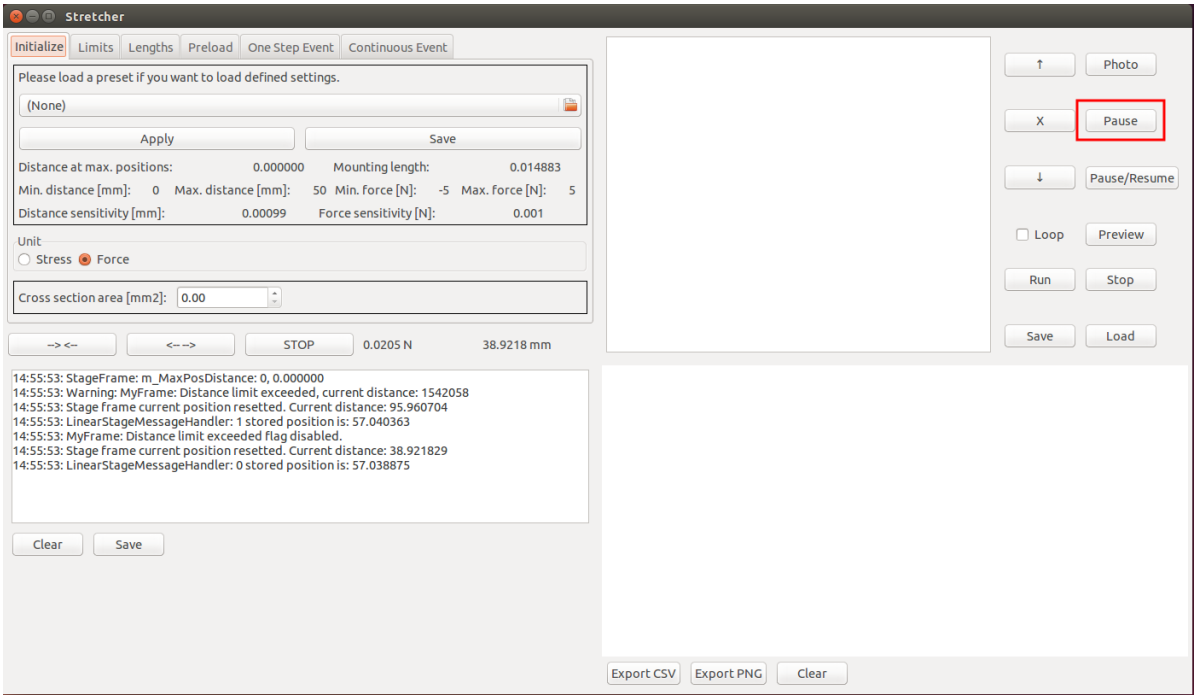

Figure 3.6: Pause experiment button

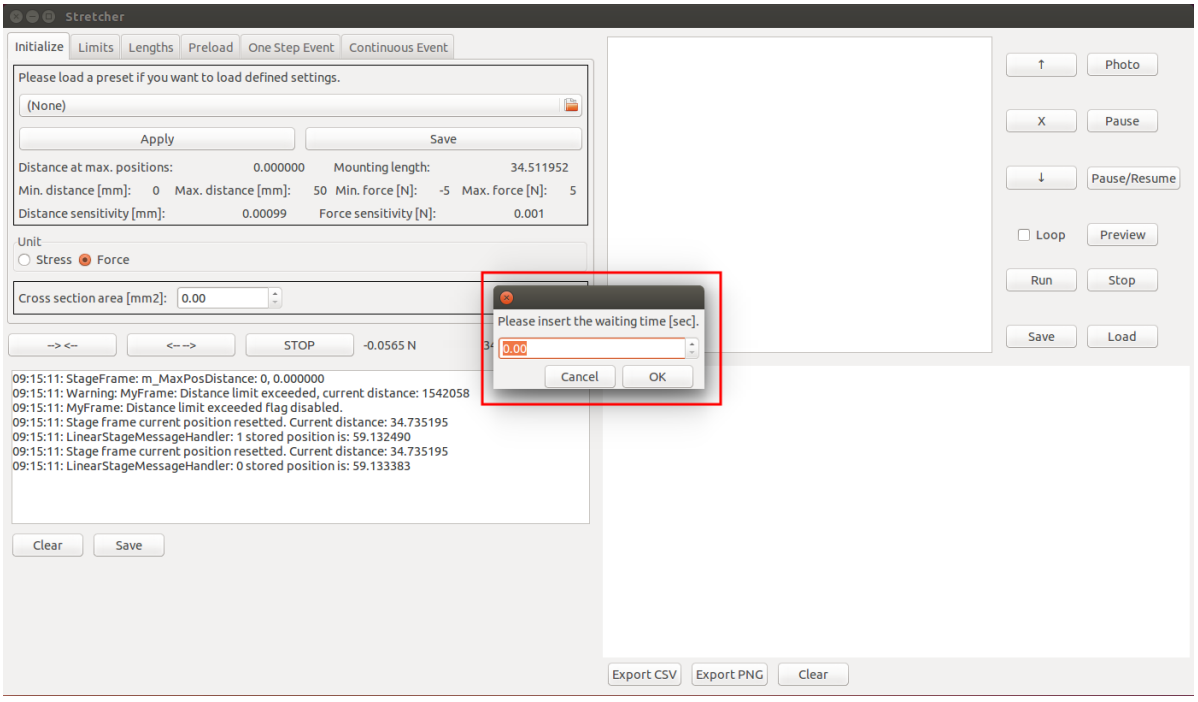

Figure 3.7: Pause experiment dialog

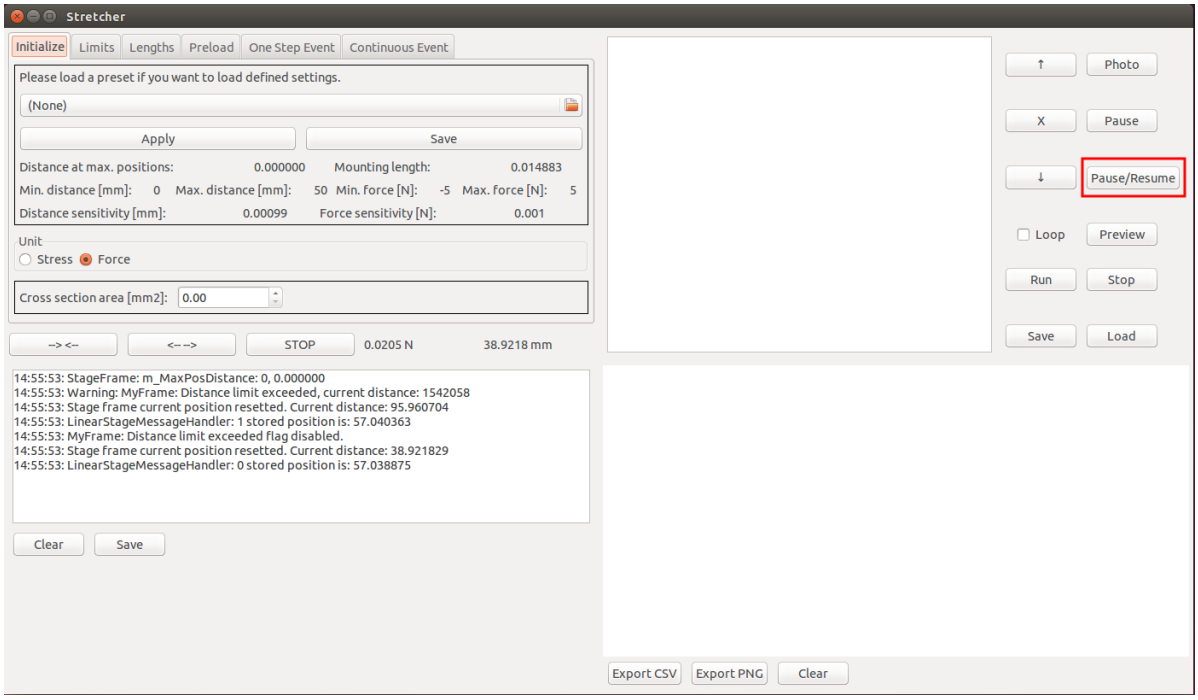

Figure 3.8: Pause/resume experiment

Chapter 4

Protocol

4.1 Experiment navigation

Once some experiments are in the protocol, by pushing their "Send to protocol" button, they can be moved up, moved down, deleted and edited. Figure 4.1 shows the protocol section in the graphical user interface with the containing buttons.

4.2 Delete experiment

To delete an experiment, the experiment has to be selected with a left-mouse click and then it can be deleted by pushing the button "X", number 1 in the figure 4.1.

4.3 Move experiment up/down

To move an experiment up or down, the experiment also has to be selected and than it can be moved by pushing the button "↑", number 2, respective, the button "↓", number 3 in figure 4.1.

4.4 Edit experiment

To edit an experiment, the experiment has to be selected and then with a right-mouse click a context menu will appear, where the option "Edit" has to be selected. To button "Send to protocol" now changed its name to "Save changes" and the current tab is locked. Now the parameters can be changed and afterwards applied by pushing the button "Save changes" or the process can be canceled by pushing the button "Cancel".

4.5 Repeat protocol

If it is desired to repeat the whole protocol, the check-box "Loop", number 4 in figure 4.1 can be checked.

4.6 Preview

To get a preview of the protocol, the button "Preview", number 5 in figure 4.1 can be pushed. The preview will plot the minimal and maximal force/stress and distance limits and a preview of the force/stress and distance values in the graph.

4.7 Start and stop

The protocol can be started by pushing the button “Run”, number 6, and stopped by pushing the button “Stop”, number 7 in figure 4.1. When the protocol stops, either manually or after the last experiment, the experiments in the protocol will be reseted.

4.8 Save and load

It is possible to save a project to a file to load it later. For this, the button “Save”, number 8 in figure 4.1 can be pushed, to display a file choosing dialog. Loading an experiment works in the same way, except, that a file has to be chosen in the file dialog, which then will be loaded.

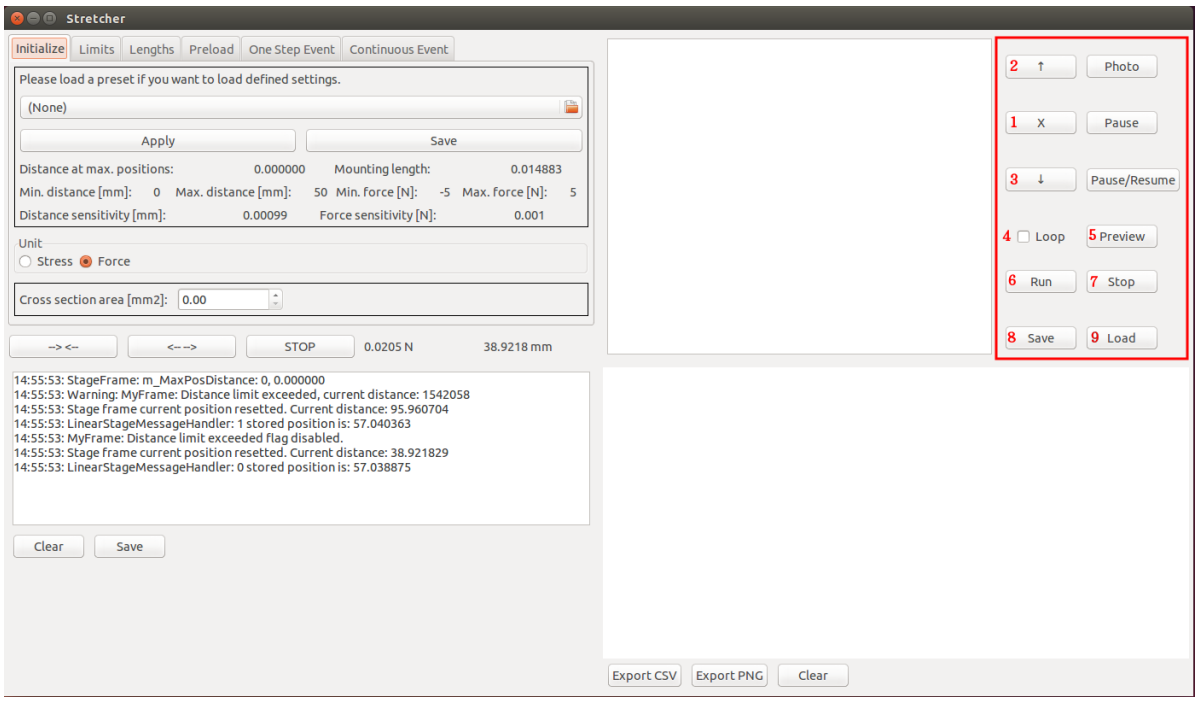

Figure 4.1: Protocol

Chapter 5

Graph

5.1 Export CSV

To export the measured data to a csv-file, the button “Export CSV” in the graph part of the graphical user interface, shown in figure 5.1 has to be pushed. This opens the export dialog, shown in figure 5.2, where the path and the file name can be chosen and experiments can be muted, if this is desired. To confirm the export of the measured data, the button “OK” has to be pushed.

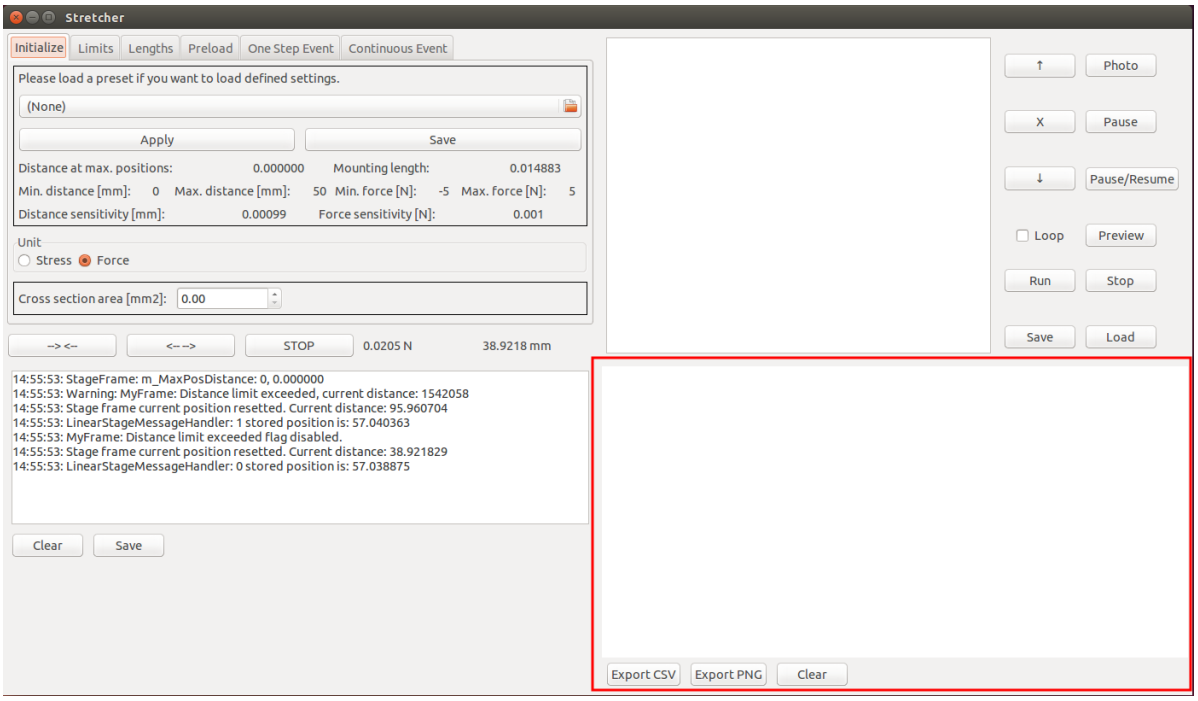

Figure 5.1: Graph

5.2 Export PNG

It is also possible to export the graph as a png image. For this the button “Export PNG” has to be pushed, and the path and a file name has to be chosen and then the export has to be confirmed by pushing the button “OK”.

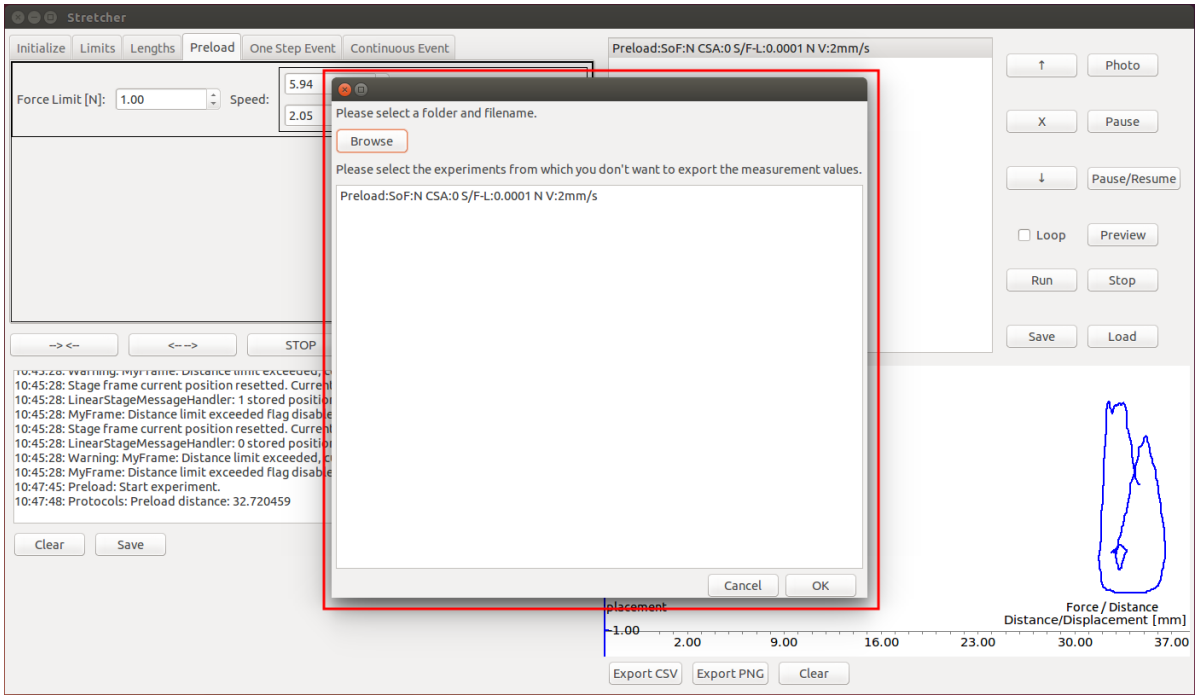

Figure 5.2: Export CSV