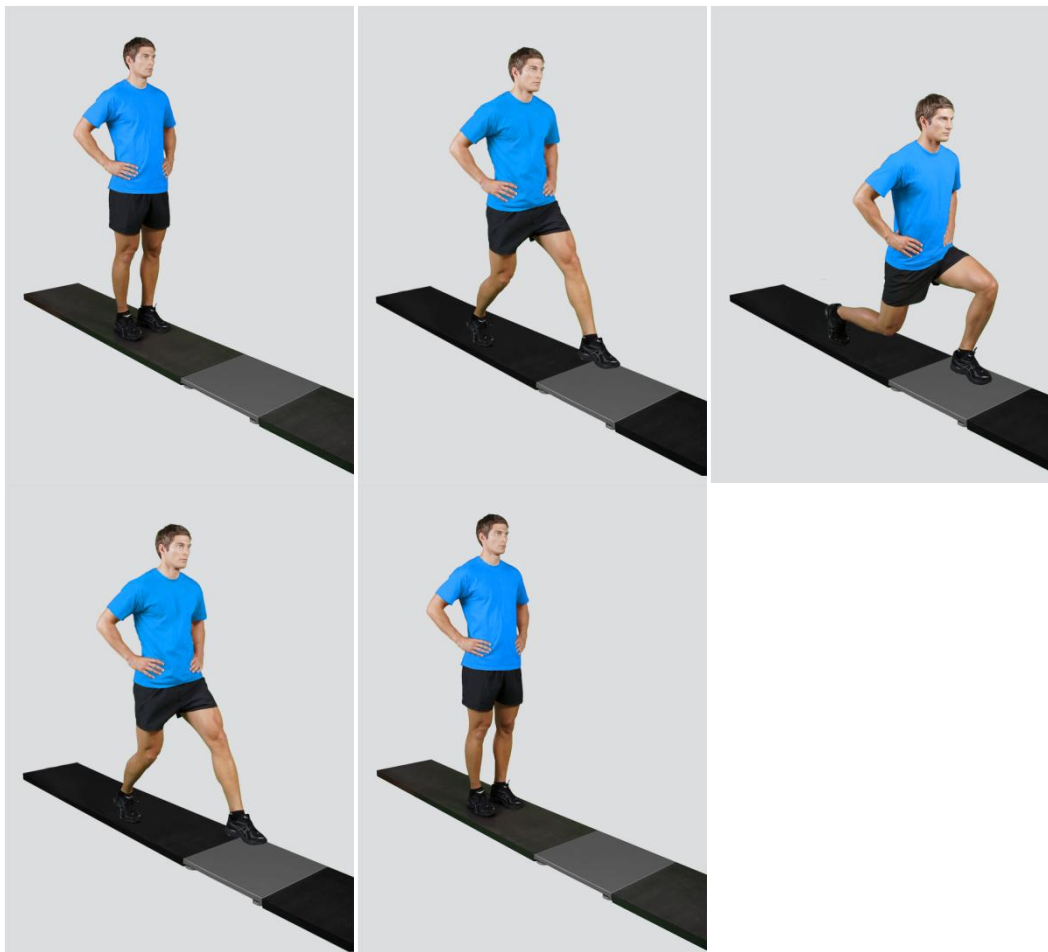# MODULE: FORWARD LUNGE

BRIEF DESCRIPTION:

Forward Lunge is a movement task, where the subject lunges/steps forward onto one leg, and then pushes back with that leg to return to a start stance position. The goal is to step as far as possible, however sustaining control over the posture, and to push back as fast as possible. For the optimal performance of the forward lunge it is required to have enough strength, good range of motion, balance and coordination. Based on the ground reaction force the software quantifies distance of the lunge, contact time, impact force, and force impulse.

The initial position of the subject is usually an upright stance position. From this position a person steps forward into a lunge (front knee ~90° and trunk vertical). From the lowest position the subject than pushes back into the initial position.

When the Forward Lunge module opens, the existing measurements of the selected subject inside the current Visit are displayed and the user can review it (see section Analysis for details). If no measurements have yet been done for this subject, than only the option to start a new measurement is enabled. In order to begin a new measurement, click New Measurement button and select the Input Parameters to exactly define the measurement task.

When the New Measurement button is selected for the first time after entering the Forward Lunge module, the force plate is initialized. After the automatic initialization process is finished, the zero offset must be done (follow the instructions on the pop-up message). The plate must be unloaded during the entire initialization and zero offset procedure. This procedure is performed every time you enter the Forward Lunge measurement module. Zero offset can be repeated any time manually by pressing the Offset button, otherwise the automatic zero offset is done every 30 minutes.

BASIC FUNCTIONS:
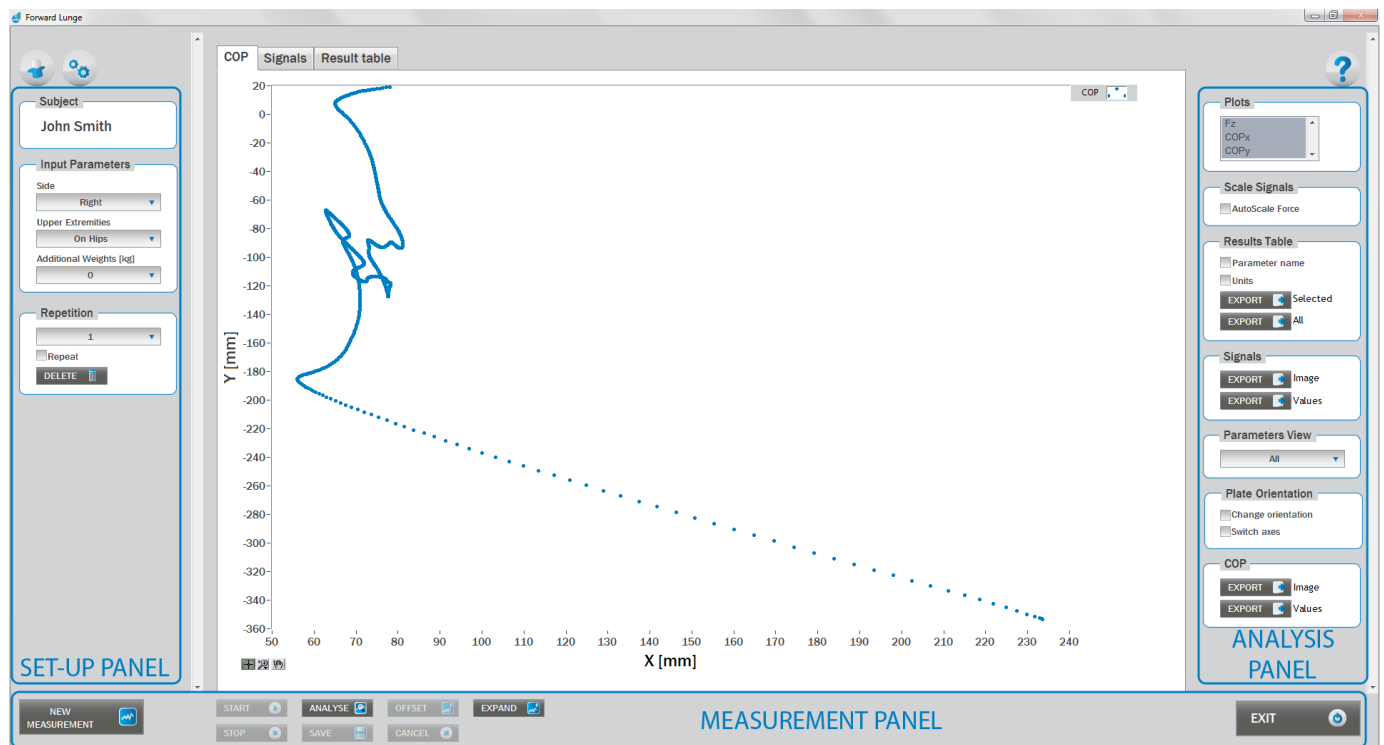
SET-UP PANEL:

SUBJECT

Name
The selected subject.

INPUT PARAMETERS

See Selecting Input Parameters section for details.

REPETITION

Repetition
Number of repetitions for the selected Input parameters.

Repeat
If checked, the selected repetition is replaced when the new measurement is performed.

Delete
Delete the selected repetition.

ANALYSIS PANEL:

PLOTS

Plots
The list of all channels. The selected channels are shown on the graph.

SCALE

AutoScale Force
If checked, the vertical scale of the graph is adapted to the maximum and minimum value of all force signals.

RESULTS TABLE

In the Result Table panel, result parameters from Result table tab can be exported into clipboard, CSV or TXT format. Format of the file can be set in settings window under export section. For details about setting the parameters refer to Settings Section.

Parameter Name
Parameter name will be included.

Units
Units of the parameters will be included.

Export Selected
By clicking on Export Selected button only the parameters that are selected in the table will be included.

Export All
By clicking on Export All button all parameters from the table will be included.

SIGNALS

In the Signals panel, image or values (row data) of acquired signal can be exported. Image and values can be exported with different parameters, which can be set in Settings window under export section. For details about setting the parameters refer to Settings Section.

Export Image
Export the image of signals (as visible on the graph on the Signals tab)into the clipboard. Image can be paste in any image editor.

Export Values

Export values (raw data) of signals (as visible on the graph on the Signals tab) into CSV or TXT format. Format of the file can be set in settings window under export section. For details about setting the parameters refer to Settings Section.

PARAMETERS VIEW

In the Parameters View panel, calculated parameters which are displayed in the result table can be set. By default, all and basic view are available. Basic view contains preset parameters and cannot be changed. Custom view can be defined, by clicking »Manage...« button.

To create a new view click on add button and enter the name of the view. Parameters included in the view are selected by checking the checkboxes next to them. To confirm the changes click save.

COP

In the COP panel, image or values (row data) of acquired signal can be exported. Image and values can be exported with different parameters, which can be set in Settings window under export section. For details about setting the parameters refer to Settings Section.

Export Image

Export the image of signals (as visible on the graph on the Signals tab)into the clipboard. Image can be paste in any image editor.

Export Values

Export values (raw data) of signals (as visible on the graph on the Signals tab) into CSV or TXT format. Format of the file can be set in settings window under export section. For details about setting the parameters refer to Settings Section.

PLATE ORIENTATION

Change orientation
Plate orientation is changed for 180°.

Switch axes
Switches the X and Y axes without moving the force platform.

MEASUREMENT PANEL

New Measurement
Starts with a new measurement.

Start
Starts the measurement.

Stop
Stops the measurement.

Save
Saves the measurement.

Cancel
Cancel the last measurement.

Offset
Makes zero offset. Note that the force platform must be unloaded during the process.

Analyse
Performs the analysis.

Collapse
Collapses the graph and the side panels are shown.

Expand
Expands the graph and the side panels are hidden.

Exit
Closes the measurement module.

SELECTING INPUT PARAMETERS:

Before the measurement can start, the user has to choose some input parameters with which the measured motor task is specifically defined. These parameters are important for further analysis, comparisons and reporting. The task`s characteristics are defined by the following parameters:

SIDE:

Left leg
The subject performs a step/lunge on a plate with his/her left leg.

Right leg
The subject performs a step/lunge on a plate with his/her right leg.

UPPER EXTREMITIES:

On Hips
The subject places his/her hands on his/her hips.

Free
Subjects are free to use their arms as they want. Specifically useful when observing how subjects differ in using arms as a biomechanical advantage.


On Barbell
The subject places his/her hands on a barbell which is placed on shoulders behind the neck.

Other user defined
In case of any other position of the upper extremities, the user can select this option and can define another function/placement of the upper extremities (see Settings Section for details). After doing

so, the newly defined input parameter will from then on appear as an optional choice under the Upper extremities in the Forward Lunge measurement module.
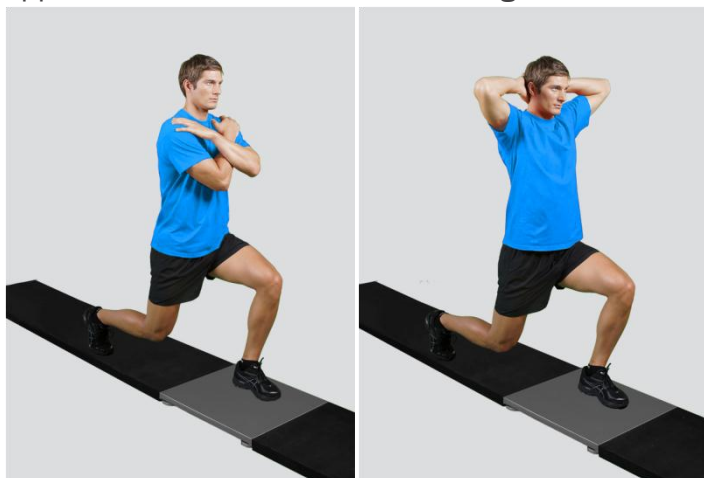
ADDITIONAL WEIGHTS:

0/5/10/15/20/25/30/35/40/45/50/55/60/65/70/75/80/85/90/95/100 kg

Other user defined

In case of different amount of additional weights, the user can select this option and can define other values (see Settings Section for details). After doing so, the newly defined input parameter will from then on appear as an optional choice under the Additional Weights in the Forward Lunge measurement module.

MEASUREMENT:

After selecting input parameters, the subject steps in front of the plate and goes in a required position. When the subject acquires the required position and is ready to start the movement, click Start. At that time, the subject is free to start the lunge and the software will automatically recognize the beginning and the end of the lunge. For details about this automatic acquisition please see Settings Section.

If you want to start a new measurement, click the New Measurement button and repeat the procedure. Before doing so, you can change the Input Parameters; if not, the Input Parameters of the previous measurements will be used. If you want to repeat a certain measurement, click on the drop down menu, select the repetition you want to replace and check the box Repeat. Then click Start and a pop-up window will ask you if you really want to repeat the measurement. Click OK if you want to repeat.

ANALYSIS:

Analysis enables you to check the raw signal of the ground reaction force (GRF) and the calculated parameters. Under the Signal tab you can see the signal and markers which are placed automatically. You can move all markers if they were placed incorrectly. Under the Results Table tab you can see all the calculated parameters numerically, while the visualization of the results comparisons can be done under the Results Graphs tab. These two tabs enable you to make quick comparisons of the values of the parameters among different repetitions and/or among different

sub-versions of the test. If you want to confirm the measurement, click Save. If you would like to export the calculated parameters use Export function in Result Table panel.

All the parameters calculated for analysis are commonly used in biomechanics, kinesiology and rehabilitation[1-4]. Parameters are calculated from the ground reaction force. For more information regarding the parameters click on the references below.

For some modules additional analysis routines are available as a separate product. See section About the Product for more information.
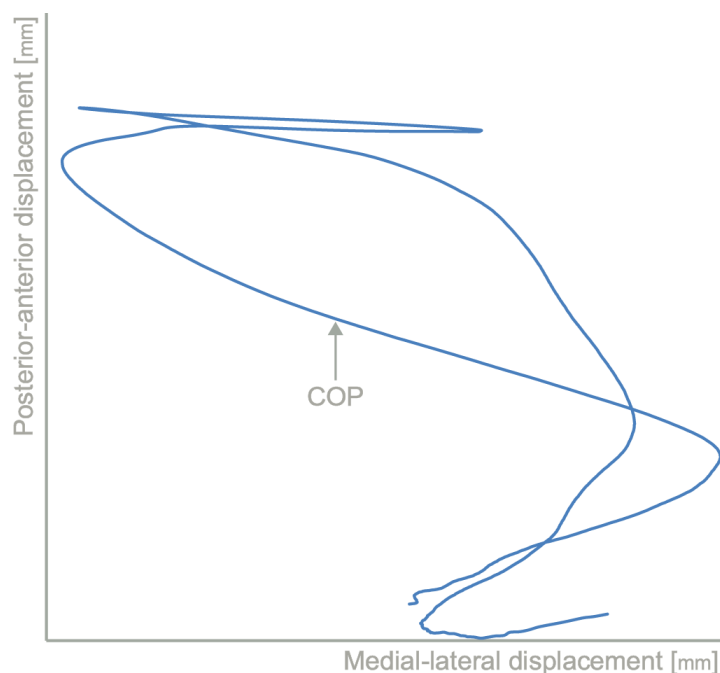
CALCULATED PARAMETERS:

PARAMETERS

Relative impact F [%BW]
Maximum vertical force exerted by the lunge/step leg onto the surface during the landing, expressed as percentage of body weight.

Contact T [s]
Duration in seconds of surface contact with the lunging leg in the forward direction.

Total FI [%BWs]
Measure of the total work performed by the lunging leg during the landing and thrust phases of the movement. Force impulse is expressed as a percentage of body weight (force) multiplied by the time the force is exerted in seconds.

REFERENCES:

1. Escamilla, R.F. et al. Cruciate ligament forces between short-step and long-step forward lunge. Medicine & Science in Sports & Exercise 42, 1932-1942 (2010).

2.   Mattacola, C.G., Jacobs, C.A., Rund, M.A. & Johnson, D.L. Functional assessment using the step-up-and-over test and forward lunge following ACL reconstruction. Orthopedics 27, 602-608 (2004).

3.   Yiou, E. & Do, M.C. In a complex sequential movement, what component of the motor program is improved with intensive practice, sequence timing or ensemble motor learning? Exp Brain Res 137, 197-204 (2001).

4.   Escamilla, R.F. et al. Patellofemoral joint force and stress between a short- and long-step forward lunge. J Orthop Sports Phys Ther 38, 681-690 (2008).