TU Informatics

BrainGait: Gait Event Detection and Visualization for Robotic Rehabilitation

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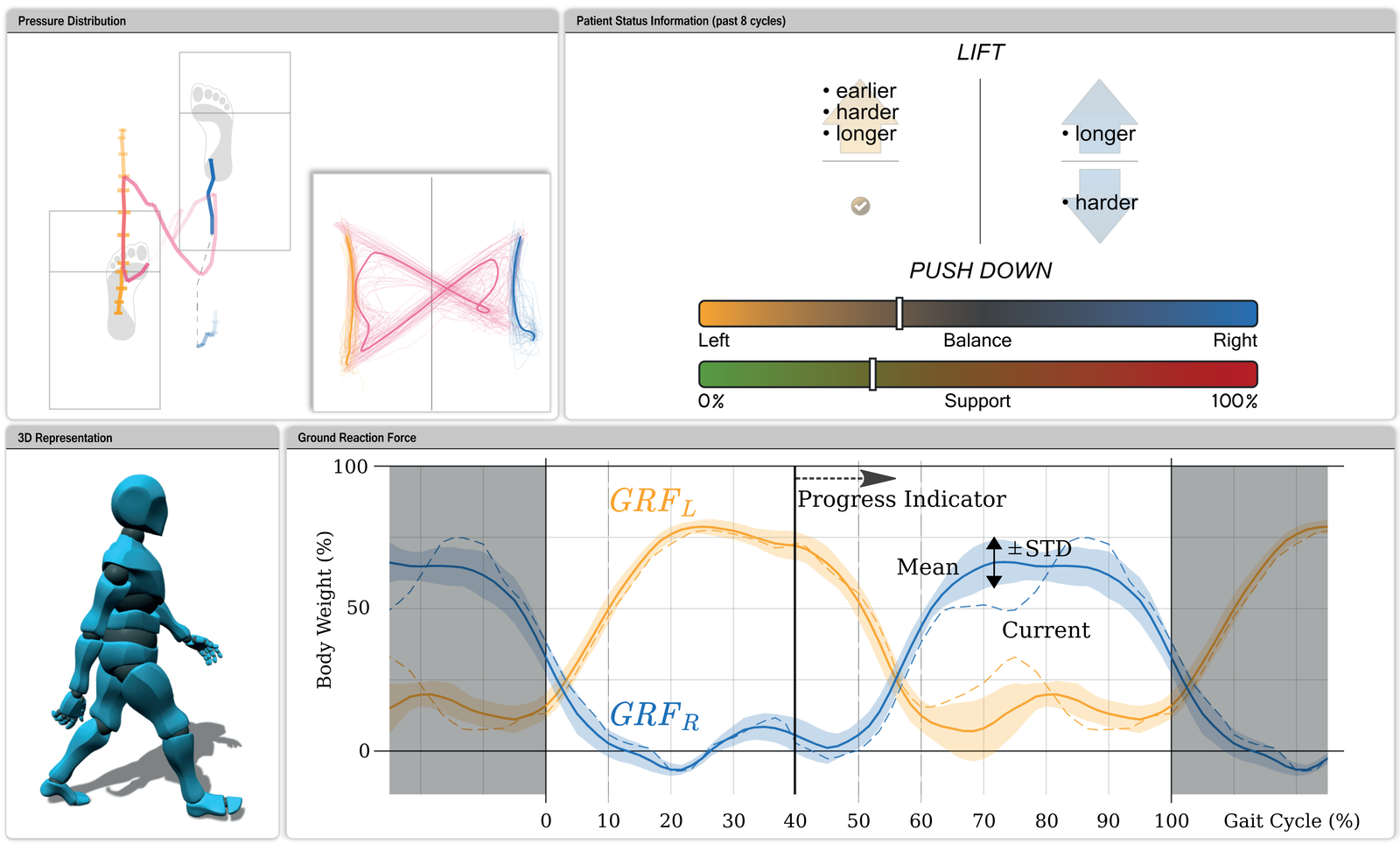
Introduction

Gait rehabilitation is used to regain some or all motor functions, especially after a stroke.
Robot-assisted gait training is of increasing interest in rehabilitation facilities and scientific research.
With the advent of robotic recovery comes the need to objectively measure the patient's performance.

Physiotherapists need feedback about the patient's activity during training in a compact form, while physicians rely on statistical measures to evaluate the patient's progress throughout the therapy.

We measure activity on a novel robotic gait rehabilitation device, named ***PerPedes***, using pressure plates.
With our newly developed algorithm, statistical data is extracted and visualizations are created.

Visualization



The user interface during the rehabilitation training (pictured above) uses a consistent color-coding scheme to highlight data for the left (orange) and the right side (blue), respectively.

The emphasis is on providing visualizations with a minimal number of textual instructions. This allows the physiotherapist to focus on the patient, while auxiliary information is provided by our system in an easy to grasp fashion.

We are providing visualizations from the biomechanics literature and augment them in the context of the PerPedes system in order to answer ***»How does the patient perform?«***

Furthermore, using performance measures extracted during the training process, instructions are generated to answer the question of ***»How could the patient improve?«***

Performance Measures

Description	Unit	Value	STD
Gait Cycle Count	#	48	
Body Weight	[kg]	84	
Body Weight Support	[%]	33.2	± 3.5
Step Length (L)	[mm]	466	± 118
Step Length (R)	[mm]	518	± 69
Symmetry Index - Step Length	[%]	14.0	
Stride Length	[mm]	983	± 165
Swing Time (L)	[s]	0.9	± 0.1
Swing Time (R)	[s]	1.1	± 0.2
Symmetry Index - Swing Time	[%]	12.1	
Force Difference - Swing	[%]	-10.6	± 7.4
Stance Time (L)	[s]	2.0	± 0.1
Stance Time (R)	[s]	1.9	± 0.2
Symmetry Index - Stance Time	[%]	-7.7	
Force Difference - Stance	[%]	-11.9	± 8.0
Variability - Anterior/Posterior	[mm]	17.8	
Variability - Lateral	[mm]	8.0	
Timing - Toe Off (L)	[% GC]	1.3	± 3.2
Timing - Toe Off (R)	[% GC]	-0.3	± 6.2
Timing - Heel Strike (L)	[% GC]	-6.0	± 4.9
Timing - Heel Strike (R)	[% GC]	-3.1	± 3.6
Force in Swing Phase (L)	[%]	14.5	± 4.7
Force in Swing Phase (R)	[%]	7.3	± 4.0
Asymmetry	[%]	20.7	± 12.3

Results

Our algorithm is the basis for extracting performance measures during training. We show that algorithms from the standard literature will likely fail to correctly measure the patient's activity within the PerPedes system.

The collected measures can be used to objectively describe the patient's activity and document the therapy's progress. The visualizations provide prompt feedback for the therapist during the rehabilitation training. They highlight:

- Gait symmetry
- Timing
- Distribution of pressure

Furthermore, the visual instructions generated by our system can be used to improve gait.
Our algorithm might be applicable in the analysis of certain motor impairments even outside the PerPedes ecosystem.

https://rebrand.ly/BrainGait

FFG Promoting Innovation.
VISUAPPS the visual application company

*This work was developed for the company **VISUAPPS** within the FFG project **BrainGait***