Procedures for measurement of feet pressure during gait

# Indications

No motions other than walking are allowed (E.g.: standing, jumping, etc). Only pass through the mat.

# Procedure for sampling the data and generating the output for the demo

1. Run the Python program pressure\_analysis.py
2. Open Walkway program

A screenshot of a computer

Description automatically generated with medium confidence

1. Start New examination 新規検査

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1. Register examination information: ID: ‘\_nnn’, time: ‘5s’, start mode: auto. Additionally, check the connection with the 4 mats. Click OK.

A screenshot of a computer

Description automatically generated

1. Wait for the subject to pass through the sensor (take less than 4s) Don’t press anything.
2. After 5s the program will load the sample data and show a confirmation screen.

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1. Verify left and right feet are labeled correctly across the pressure progress, by pressing 電子スケール→再生, and following the time cursor.

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Description automatically generated

1. In case they are not labeled correctly perform a re-detection from the button 再認識

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1. In case they are correctly identified, press 解析へ (don’t check any additional boxes)

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Description automatically generated

1. Go to the Menu ツール, then to データ出力 and select 解析データ（１トライアル）, copy the name of the file, and save the CSV file. The file with name of format YYYYMMDDHHMMSSID\_1ANA.csv will contain the essential data to conduct the analysis.

A screen shot of a graph

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1. Insert the name of the file into the Python program and wait for the analysis output
2. The output should show the foot that supports the user’s weights for more time and the side the user tends to go.

# Analysis Program

## Software capabilities

The program has useful visual output, like the double screen 距離時間, where the pressure progress can be seen by clicking 電子スケール and clicking the time bar.

A screenshot of a computer

Description automatically generated with medium confidence

Additionally, an Excel file of the program analysis can be exported by clicking エクセルレポート. However, the radial graph has relative values whose standard values to which are compared are not comprehended.

Finally, CSV files containing different sampled data can be exported.

計測データ

Using the complement program PREDAS, it could be understood that the value of each cell is the pressure in a sensing unit, in kgf/cm^2

A screenshot of a computer

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Description automatically generated with medium confidence

COPデータ

解析データ(トライアル)

解析データ

## Preliminary experiments

Our aim is to generate analysis output in the fastest and most automatic way possible, but the programs (WalkWay and PREDAS) relied greatly on outputting Excel or pdf files for the interpretation of a person. So we had to mainly focus on the CSV files since programs can read its data at any time. On one hand, we had the output raw data in 計測データ which consisted of the pressure values per sensor unit in the mat sensor across the trial duration.

We can obtain:

* The total and unitary pressure in the mat per instant of time

We cannot obtain:

* The foot label of each unitary pressure
* The interval of time of each footstep and its side

On the other hand from the 解析データ file, we can obtain the instant of times that describe each moment of a step.

We can obtain:

* The time duration of each footstep
* The categorization of each footstep as left or right
* The position of the COP per footstep

We cannot obtain:

* The pressure information across time

Since the second type of file gives more information than the raw pressure data, we decide to use only the second one.

However, to derive conclusions about the pressures from the time information, we decided to analyze the relationship between the time intervals and the pressure evolution per step.

The program PREDAS has the functionality to separate the footstep of a gait sample and give detailed information about the pressures per foot and across time. We must focus on general information to derive conclusions for each footstep and not time-specific information. Therefore, we observed the duration of each footstep and the average pressure during that interval and calculate the accumulated pressure. For one experiment we saw that while the longer the step, the smaller the integral of pressures. We run multiple experiments to validate if the pattern is correct.

Spending more time on one foot means that the person can maintain their balance better on such foot.

From another perspective, if we see the graph of the pressure evolution per step, the accumulated (integral of) pressure across the time of step increases while the step is shorter, meaning that the motion adds impulse from that foot to return to the other foot faster, hinting about the weakness of maintaining balance in that foot.

## Program logic