Supplementary Materials

Acceleroetrometry-based digital gait characteristics for classification of Parkinson’s disease: what counts?

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S1: Motivation to Use the PLS-DA

Typically, to achieve data reduction, principal component analysis (PCA) is performed prior to classification [1]. However, while PCA only takes into account independent variables and generates new components containing high variance without losing information, its major drawback is the potential loss of important information about how independent variables (e.g. gait characteristics) are related to the dependent variables (e.g. groups being classified) [2]. Other techniques like Partial least square discriminant analysis (PLS-DA) can help to tackle this downside as it can deal with situations in which we have a higher number of multi-collinear independent variables compared to the number of subjects in the study and their relation with dependent variables (e.g. groups to classify (PD vs. CL)) [3].

Method (PLS-DA) Detail

PLS-DA is used for the data reduction and to classify the subjects with Parkinson’s disease from controls based on the latent variables (capturing high variance) used as training data in discriminant analysis for classification. This method can provide the contribution of the independent variables (gait characteristics) in the classification modeling based on the variable importance in the projection (VIP) [4], which is calculated with the following equation 1.

$$
VIP_j = \sqrt{p \sum_{k=1}^{N} \left[ SS_k \left( \frac{w_{kj}}{||w_k||^2} \right) \right]} 
$$

(1)

$p$ is a total number of gait characteristics in the model. $N$ is the number of latent variables in the PLS-DA model. $SS_k$ is the sum of variance of the latent variable. $w_{kj}$ quantify the contribution of gait characteristics $j$ according to the $k$th latent variable. $w_k$ is the contribution of the $k$th latent variable. If the VIP is above 1 then the particular gait characteristic is highly influential in the model and higher VIP value indicates the higher contribution of the gait characteristic.

The model quality is based on the standard goodness of fit indices such as Q2, R2X and R2Y (Figure S1). Number of components (latent variables) in the PLS-DA are based on these indices. Q2 explains the predictive capability of the model, and with its value the suitable number of components in the PLS-DA can be identified. If the value of Q2 is higher than 0 then model prediction capability is better, if its value is below 0 then model performance will be poor. Therefore, based on its value we selected the number of components in the PLS-DA. Other indices, such as R2X and R2Y explain the captured variance by independent and dependent variables respectively.
**MODEL QUALITY**

![Graphs showing model quality based on Axivity - Spatial Temporal, Axivity - Signal Characteristics, Axivity - Spatial Temporal and signal characteristics, Axivity - ST + Demographics, Axivity - SC + Demographics, and overall dataset (ST + SC + Dem).]

Fig. S1. PLS-DA models quality based on the number of components

| Domain            | Variable                              | Comp 1 | Comp 2 | Comp 3 | Comp 4 | Comp 5 | Average |
|-------------------|---------------------------------------|--------|--------|--------|--------|--------|---------|
| Spatial Temporal  | Step Velocity                         | 1.840  | 1.398  | 1.217  | 1.096  | 1.071  | 1.325   |
|                   | Step Length                            | 1.705  | 1.313  | 1.119  | 1.188  | 1.175  | 1.300   |
|                   | Step Length Coefficient of Variation (CV) | 1.556  | 1.183  | 1.113  | 1.073  | 1.231  | 1.231   |
|                   | Swing Time Variability                 | 1.463  | 1.118  | 1.232  | 1.171  | 1.126  | 1.222   |
|                   | Cadence                               | 1.010  | 1.120  | 1.144  | 1.437  | 1.360  | 1.214   |
|                   | Step Velocity (CV)                     | 1.499  | 1.141  | 1.136  | 1.066  | 1.020  | 1.172   |
|                   | Step Time Variability                  | 1.362  | 1.085  | 1.156  | 1.042  | 1.071  | 1.143   |
|                   | Swing Time (CV)                        | 1.312  | 1.004  | 1.144  | 1.137  | 1.101  | 1.139   |
|                   | Stride Time Variability                | 1.372  | 1.068  | 1.106  | 0.996  | 1.043  | 1.117   |
|                   | Stride Time (CV)                       | 1.324  | 1.029  | 1.089  | 1.014  | 1.060  | 1.103   |
|                   | Step Length Variability                | 1.382  | 1.051  | 0.965  | 0.966  | 1.119  | 1.097   |
|                   | Step Time (CV)                         | 1.248  | 1.003  | 1.110  | 1.028  | 1.059  | 1.09    |
|                   | Stance Time Variability                | 1.056  | 0.818  | 1.231  | 1.164  | 1.135  | 1.081   |
|                   | Stance Time (CV)                       | 0.937  | 0.724  | 1.189  | 1.153  | 1.128  | 1.026   |
|                   | Stride Time                            | 1.093  | 0.831  | 0.774  | 1.130  | 1.091  | 0.984   |
|                   | Swing Time                             | 1.267  | 0.963  | 0.866  | 0.933  | 0.883  | 0.982   |
| Signals power spectral density | 1.089 | 0.828 | 0.772 | 1.131 | 1.091 | 0.982 |
|------------------------------|-------|-------|-------|-------|-------|-------|
| Step Time                    | 0.728 | 0.571 | 1.160 | 1.054 | 1.002 | 0.903 |
| Swing Time Asymmetry         | 0.852 | 0.668 | 0.667 | 1.185 | 1.129 | 0.900 |
| Stance Time                  | 0.973 | 0.742 | 0.827 | 0.751 | 1.029 | 0.864 |
| Step Length Asymmetry        | 0.948 | 0.786 | 0.869 | 0.786 | 0.771 | 0.832 |
| Step Time Asymmetry          | 0.908 | 0.690 | 0.761 | 0.901 | 0.857 | 0.823 |
| Step Velocity Variability    | 0.574 | 0.487 | 1.091 | 0.993 | 0.939 | 0.817 |
| Stance Time Asymmetry        | 0.451 | 0.347 | 0.713 | 1.130 | 1.069 | 0.742 |
| Stride Time Asymmetry        | 0.331 | 0.252 | 0.593 | 0.547 | 0.537 | 0.452 |

Power spectral density (PSD) Amplitude (ML)

| Harmonic Ratio (AP)          | 1.337 | 1.181 | 1.619 | 1.553 | 1.479 | 1.561 |
|------------------------------|-------|-------|-------|-------|-------|-------|
| Slope of dominant peak of PSD (ML) | 1.712 | 1.607 | 1.370 | 1.286 | 1.426 | 1.480 |
| Index of Harmonicity (ML)    | 1.243 | 1.673 | 1.470 | 1.460 | 1.393 | 1.448 |
| Normalized amplitude of dominant peak of PSD (ML) | 1.666 | 1.418 | 1.342 | 1.270 | 1.201 | 1.379 |
| Range of dominant peak of PSD (AP) | 1.150 | 1.608 | 1.411 | 1.372 | 1.334 | 1.375 |
| PSD Normalized Range (AP)    | 1.808 | 1.374 | 1.317 | 1.186 | 1.133 | 1.364 |
| PSD Amplitude (R)            | 1.486 | 1.405 | 1.300 | 1.190 | 1.190 | 1.314 |
| Slope of dominant peak of PSD (R) | 1.469 | 1.376 | 1.296 | 1.184 | 1.181 | 1.301 |
| PSD Normalized Slope (ML)    | 1.065 | 1.475 | 1.279 | 1.296 | 1.263 | 1.276 |
| Harmonic Ratio (V)           | 1.596 | 1.405 | 1.211 | 1.091 | 1.033 | 1.267 |
| Harmonic Ratio (ML)          | 1.394 | 1.388 | 1.191 | 1.104 | 1.127 | 1.241 |
| PSD Amplitude (V)            | 1.251 | 1.181 | 1.114 | 1.145 | 1.142 | 1.167 |
| Range of dominant peak of PSD (ML) | 1.435 | 1.098 | 1.194 | 1.080 | 1.021 | 1.166 |
| PSD Normalized Range (ML)    | 1.435 | 1.098 | 1.194 | 1.080 | 1.021 | 1.166 |
| Slope of dominant peak of PSD (V) | 1.236 | 1.152 | 1.110 | 1.139 | 1.133 | 1.154 |

Normalized amplitude of dominant peak of PSD (R)

| Harmonic Ratio (V)           | 1.260 | 1.111 | 1.172 | 1.087 | 1.078 | 1.142 |
| PSD Mean Power (V)           | 0.889 | 1.204 | 1.271 | 1.151 | 1.176 | 1.138 |
| PSD Integrated Power (V)     | 0.889 | 1.204 | 1.271 | 1.151 | 1.176 | 1.138 |
| Range of dominant peak of PSD (R) | 1.262 | 1.089 | 1.134 | 1.121 | 1.061 | 1.133 |
| PSD Normalized Range (R)     | 1.262 | 1.089 | 1.134 | 1.121 | 1.061 | 1.133 |
| PSD Normalized Slope (R)     | 1.229 | 1.073 | 1.168 | 1.082 | 1.069 | 1.124 |
| Index of Harmonicity (AP)    | 1.083 | 0.913 | 1.112 | 1.241 | 1.195 | 1.109 |
| Index of Harmonicity (R)     | 1.360 | 1.104 | 1.097 | 0.990 | 0.937 | 1.098 |
| Range of dominant peak of PSD (V) | 1.161 | 1.042 | 1.089 | 1.113 | 1.071 | 1.095 |
| PSD Normalized Range (V)     | 1.161 | 1.042 | 1.089 | 1.113 | 1.071 | 1.095 |
| Harmonic Ratio (R)           | 1.312 | 1.078 | 1.014 | 0.897 | 0.968 | 1.072 |
| Normalized amplitude of dominant peak of PSD (V) | 1.026 | 0.894 | 1.013 | 1.070 | 1.064 | 1.013 |
| PSD Normalized Slope (V)     | 1.000 | 0.860 | 1.015 | 1.065 | 1.056 | 0.999 |
| PSD Mean Power (R)           | 0.714 | 1.101 | 1.077 | 1.020 | 1.096 | 0.983 |
| PSD Integrated Power (R)     | 0.714 | 1.101 | 1.077 | 1.020 | 1.096 | 0.983 |
| Dominant Frequency (V)       | 0.321 | 0.598 | 1.169 | 1.064 | 1.024 | 0.835 |
| Index of Harmonicity (V) | 0.877 | 0.676 | 0.834 | 0.801 | 0.758 | 0.789 |
|------------------------|-------|-------|-------|-------|-------|-------|
| PSD Mean Power (ML)    | 0.555 | 0.651 | 0.748 | 0.755 | 1.065 | 0.755 |
| PSD Integrated Power (ML) | 0.555 | 0.651 | 0.748 | 0.755 | 1.065 | 0.755 |
| Width of dominant peak of PSD (V) | 0.073 | 0.441 | 1.021 | 0.970 | 1.095 | 0.720 |
| PSD Normalized Width (V) | 0.073 | 0.441 | 1.021 | 0.970 | 1.095 | 0.720 |
| PSD Amplitude (AP)     | 0.460 | 0.558 | 0.824 | 0.847 | 0.860 | 0.710 |
| Slope of dominant peak of PSD (AP) | 0.432 | 0.558 | 0.829 | 0.842 | 0.861 | 0.704 |
| PSD Normalized amplitude (AP) | 0.380 | 0.493 | 0.859 | 0.806 | 0.853 | 0.678 |
| PSD Normalized Slope (AP) | 0.352 | 0.494 | 0.857 | 0.799 | 0.851 | 0.670 |
| PSD Median Power (ML)  | 0.01  | 0.235 | 0.518 | 1.312 | 1.246 | 0.664 |
| PSD Median Power (AP)  | 0.087 | 0.427 | 0.649 | 1.080 | 1.024 | 0.653 |
| Width of dominant peak of PSD (R) | 0.148 | 0.437 | 0.816 | 0.790 | 0.98  | 0.634 |
| PSD Normalized Width (R) | 0.148 | 0.437 | 0.816 | 0.790 | 0.98  | 0.634 |
| Width of dominant peak of PSD ML | 0.154 | 0.299 | 0.733 | 0.996 | 0.976 | 0.632 |
| PSD Normalized Width (ML) | 0.154 | 0.299 | 0.733 | 0.996 | 0.976 | 0.632 |
| PSD Median Power (R)   | 0.120 | 0.370 | 0.682 | 0.965 | 0.928 | 0.613 |
| PSD Median Power (AP)  | 0.087 | 0.427 | 0.649 | 1.080 | 1.024 | 0.653 |
| Width of dominant peak of PSD (AP) | 0.559 | 0.582 | 0.538 | 0.632 | 0.674 | 0.597 |
| PSD Normalized Width (AP) | 0.559 | 0.582 | 0.538 | 0.632 | 0.674 | 0.597 |
| PSD Mean Power (AP)    | 0.463 | 0.352 | 0.428 | 0.843 | 0.862 | 0.590 |
| PSD Integrated Power (AP) | 0.463 | 0.352 | 0.428 | 0.843 | 0.862 | 0.590 |
| PSD Median Power (V)   | 0.124 | 0.493 | 0.719 | 0.777 | 0.737 | 0.570 |
| Dominant Frequency (ML) | 0.364 | 0.471 | 0.401 | 0.389 | 0.763 | 0.477 |
| Dominant Frequency (R) | 0.017 | 0.103 | 0.688 | 0.707 | 0.675 | 0.438 |
| Dominant Frequency (AP) | 0.239 | 0.377 | 0.386 | 0.372 | 0.36  | 0.347 |

| Root mean square (RMS) of Straight Walk (ML) | 2.115 | 1.663 | 1.642 | 1.500 | 1.431 | 1.670 |
| RMS Stride (ML) | 2.078 | 1.632 | 1.63  | 1.489 | 1.420 | 1.650 |
| RMS Step (ML) | 2.076 | 1.619 | 1.598 | 1.451 | 1.385 | 1.626 |
| RMS Stride (R) | 2.092 | 1.592 | 1.389 | 1.251 | 1.186 | 1.502 |
| RMS of Straight Walk (AP) | 2.044 | 1.559 | 1.345 | 1.241 | 1.216 | 1.481 |
| RMS Straight Walk (R) | 2.053 | 1.567 | 1.35  | 1.219 | 1.162 | 1.470 |
| RMS Stride (AP) | 2.021 | 1.540 | 1.337 | 1.225 | 1.216 | 1.468 |
| RMS Step (R) | 2.032 | 1.551 | 1.359 | 1.224 | 1.159 | 1.465 |
| Signal Magnitude |
| RMS Step (AP) | 1.877 | 1.427 | 1.237 | 1.137 | 1.139 | 1.363 |
| RMS Stride (V) | 1.669 | 1.331 | 1.132 | 1.039 | 1.053 | 1.245 |
| RMS Straight Walk (V) | 1.585 | 1.302 | 1.113 | 1.009 | 1.057 | 1.214 |
| RMS Step (V) | 1.589 | 1.293 | 1.100 | 1.009 | 1.022 | 1.202 |
| RMS Ratio Step (ML) | 0.659 | 0.758 | 0.947 | 1.092 | 1.035 | 0.898 |
| RMS Ratio Straight Walk (V) | 0.205 | 0.716 | 0.843 | 1.130 | 1.297 | 0.838 |
| RMS Ratio Step (V) | 0.417 | 0.701 | 0.742 | 1.098 | 1.197 | 0.831 |
| RMS Ratio Straight Walk (ML) | 0.323 | 0.650 | 0.983 | 1.108 | 1.068 | 0.826 |
| RMS Ratio Stride (ML) | 0.331 | 0.582 | 0.873 | 1.105 | 1.050 | 0.788 |
| Signal Complexity | RMS Ratio Stride (V) | 0.177 | 0.634 | 0.719 | 1.129 | 1.246 | 0.781 |
| | RMS Ratio Step (AP) | 0.379 | 0.293 | 0.340 | 0.535 | 0.917 | 0.493 |
| | RMS Ratio Stride (AP) | 0.275 | 0.318 | 0.302 | 0.487 | 1.011 | 0.478 |
| | RMS Ratio Straight Walk (AP) | 0.182 | 0.360 | 0.313 | 0.470 | 1.027 | 0.471 |
| | Step Regularity (ML) | 1.722 | 1.747 | 1.487 | 1.376 | 1.314 | 1.529 |
| | Stride Harmonic Ratio (ML) | 1.678 | 1.652 | 1.411 | 1.321 | 1.269 | 1.466 |
| | Stride Harmonic Ratio (AP) | 1.671 | 1.381 | 1.174 | 1.112 | 1.078 | 1.283 |
| | Stride Regularity (ML) | 1.504 | 1.163 | 1.137 | 1.100 | 1.049 | 1.190 |
| | Step Regularity (V) | 0.969 | 0.760 | 1.295 | 1.176 | 1.158 | 1.072 |
| | Stride Harmonic Ratio (V) | 1.240 | 1.014 | 0.996 | 0.897 | 0.903 | 1.010 |
| | Stride Regularity (V) | 0.858 | 0.663 | 1.244 | 1.149 | 1.094 | 1.002 |
| | Symmetry Autocorrelation Difference (ML) | 0.458 | 1.144 | 1.112 | 1.041 | 1.036 | 0.958 |
| | Symmetry Autocorrelation Difference (AP) | 0.946 | 0.719 | 1.105 | 1.019 | 0.979 | 0.954 |
| | Step Regularity (AP) | 0.800 | 0.638 | 1.138 | 1.038 | 1.009 | 0.925 |
| | Step Regularity (R) | 1.072 | 0.814 | 0.843 | 0.904 | 0.870 | 0.901 |
| | Stride Regularity (R) | 0.986 | 0.789 | 0.799 | 0.772 | 0.731 | 0.815 |
| | Symmetry Autocorrelation Ratio (ML) | 0.141 | 0.898 | 1.068 | 0.974 | 0.946 | 0.805 |
| | Gait Symmetry Index | 0.266 | 0.293 | 1.054 | 1.017 | 0.964 | 0.719 |
| | Symmetry Autocorrelation Difference (V) | 0.789 | 0.600 | 0.668 | 0.652 | 0.631 | 0.668 |
| | Symmetry Autocorrelation Difference (AP) | 0.299 | 0.393 | 0.774 | 0.717 | 0.739 | 0.584 |
| | Symmetry Autocorrelation Ratio (V) | 0.542 | 0.444 | 0.657 | 0.596 | 0.673 | 0.583 |
| | Symmetry Autocorrelation Ratio (AP) | 0.361 | 0.359 | 0.704 | 0.635 | 0.620 | 0.536 |
| | Symmetry Autocorrelation Difference (R) | 0.407 | 0.318 | 0.422 | 0.543 | 0.546 | 0.447 |
| | Symmetry Autocorrelation Ratio (R) | 0.435 | 0.384 | 0.386 | 0.480 | 0.475 | 0.432 |
| Signal Complexity | Jerk RMS of Straight walk (AP) | 1.353 | 1.213 | 1.051 | 1.083 | 1.024 | 1.145 |
| | Jerk RMS of Straight walk (R) | 1.012 | 1.336 | 1.144 | 1.052 | 0.997 | 1.108 |
| | Jerk RMS of Straight walk (ML) | 1.137 | 1.114 | 1.002 | 0.924 | 0.881 | 1.011 |
| | Jerk RMS of Straight walk (V) | 1.021 | 1.318 | 1.128 | 1.016 | 0.967 | 1.090 |
| | Jerk RMS of Stride (AP) | 1.360 | 1.204 | 1.053 | 1.080 | 1.022 | 1.144 |
| | Jerk RMS of Stride (R) | 1.053 | 1.308 | 1.128 | 1.035 | 0.983 | 1.102 |
| | Jerk RMS of Stride (ML) | 1.134 | 1.096 | 0.999 | 0.925 | 0.881 | 1.007 |
| | Jerk RMS of Stride (V) | 1.042 | 1.302 | 1.120 | 1.008 | 0.958 | 1.086 |
| | Jerk RMS of Step (AP) | 1.355 | 1.228 | 1.058 | 1.090 | 1.030 | 1.152 |
| | Jerk RMS of Step (R) | 1.021 | 1.346 | 1.148 | 1.066 | 1.009 | 1.118 |
| | Jerk RMS of Step (ML) | 1.132 | 1.107 | 0.999 | 0.918 | 0.871 | 1.005 |
| | Jerk RMS of Step (V) | 0.994 | 1.337 | 1.140 | 1.027 | 0.981 | 1.096 |
| | Jerk Mean Ratio of Straight Walk (AP) | 0.783 | 0.844 | 0.827 | 0.857 | 0.916 | 0.846 |
| | Jerk Mean Ratio of Straight Walk (ML) | 0.636 | 0.832 | 0.816 | 0.762 | 0.724 | 0.754 |
| | Jerk Mean Ratio of Straight Walk (V) | 0.716 | 0.702 | 0.608 | 0.550 | 0.556 | 0.626 |
| | Jerk Mean Ratio of Stride (AP) | 0.341 | 0.373 | 0.463 | 0.528 | 0.512 | 0.443 |
| Metric                                      | AP Mean | ML Mean | V Mean |
|---------------------------------------------|---------|---------|--------|
| Jerk Mean Ratio of Stride (ML)              | 0.018   | 0.152   | 0.448  |
| Jerk Mean Ratio of Stride (V)               | 0.260   | 0.222   | 0.204  |
| Jerk Mean Ratio of Step (AP)                | 0.441   | 0.376   | 0.378  |
| Jerk Mean Ratio of Step (ML)                | 0.370   | 0.285   | 0.355  |
| Jerk Mean Ratio of Step (V)                 | 0.410   | 0.363   | 0.606  |
| Jerk Mean Log Ratio of Straight Walk (AP)   | 0.114   | 0.973   | 0.934  |
| Jerk Mean Log Ratio of Straight Walk (ML)   | 0.183   | 0.569   | 0.568  |
| Jerk Mean Log Ratio of Step (AP)            | 0.569   | 0.523   | 0.495  |
| Jerk Mean Log Ratio of Step (ML)            | 0.569   | 0.523   | 0.495  |
| Jerk Max of Straight Walk (AP)              | 0.832   | 0.829   | 0.791  |
| Jerk Max of Straight Walk (R)               | 0.483   | 1.152   | 1.041  |
| Jerk Max of Straight Walk (ML)              | 0.672   | 0.879   | 0.834  |
| Jerk Max of Straight Walk (V)               | 0.778   | 1.091   | 1.102  |
| Jerk Max of Stride (AP)                     | 0.989   | 0.860   | 0.815  |
| Jerk Max of Stride (R)                      | 0.585   | 1.031   | 1.031  |
| Jerk Max of Stride (ML)                     | 0.789   | 0.888   | 0.912  |
| Jerk Max of Stride (V)                      | 0.841   | 1.096   | 1.045  |
| Jerk Min of Straight Walk (AP)              | 0.546   | 1.052   | 1.081  |
| Jerk Min of Straight Walk (R)               | 0.615   | 1.104   | 0.993  |
| Jerk Min of Straight Walk (ML)              | 0.516   | 0.921   | 0.919  |
| Jerk Min of Straight Walk (V)               | 0.572   | 1.063   | 0.996  |
| Jerk Min of Stride (AP)                     | 0.698   | 1.072   | 1.130  |
| Jerk Min of Stride (R)                      | 0.635   | 1.119   | 1.006  |
| Jerk Min of Stride (ML)                     | 0.740   | 0.873   | 0.895  |
| Jerk Min of Stride (V)                      | 0.656   | 1.047   | 0.997  |
| Jerk Min of Step (AP)                       | 0.836   | 1.097   | 1.151  |
| Jerk Min of Step (R)                        | 0.558   | 1.101   | 1.047  |
| Jerk Min of Step (ML)                       | 0.825   | 0.970   | 0.830  |
| Jerk Min of Step (V)                        | 0.694   | 1.058   | 1.102  |
| Jerk Range of Straight Walk (AP)            | 0.721   | 1.091   | 1.032  |
| Jerk Range of Straight Walk (R)             | 0.560   | 1.051   | 1.046  |
| Jerk Range of Straight Walk (ML)            | 0.609   | 0.912   | 0.870  |
| Jerk Range of Straight Walk (V)             | 0.705   | 1.114   | 1.103  |
## Supplementary Materials

### Table S2.

**Difference between people with PD and CL based on the independent samples t-test**

| Domain                              | Variable                              | CL (n=61) Mean ± SD | PD (n=81) Mean ± SD | Normality test - Mann Whitney | Non-Parametric t-test | Parametric t-test |
|-------------------------------------|---------------------------------------|---------------------|---------------------|-------------------------------|----------------------|-------------------|
### Supplementary Materials

| Parameter                                      | Value               |
|-----------------------------------------------|---------------------|
| Step Length                                   | 0.708 ± 0.077       |
| Step Velocity                                 | 1.324 ± 0.164       |
| Step Time                                     | 0.539 ± 0.045       |
| Stride Time                                   | 1.078 ± 0.090       |
| Swing Time                                    | 0.384 ± 0.041       |
| Cadence                                       | 67.161 ± 7.902      |
| Step Length Variability                       | 0.044 ± 0.017       |
| Step Velocity Variability                     | 0.097 ± 0.046       |
| Step Time Variability                         | 0.024 ± 0.015       |
| Stride Time Variability                       | 0.019 ± 0.007       |
| Swing Time Variability                        | 0.022 ± 0.016       |
| Stance Time Variability                       | 0.026 ± 0.015       |
| Step Length Asymmetry                         | 0.041 ± 0.019       |
| Step Velocity Asymmetry                       | 0.099 ± 0.062       |
| Step Time Asymmetry                           | 0.024 ± 0.015       |
| Stride Time Asymmetry                         | 0.015 ± 0.008       |
| Swing Time Asymmetry                          | 0.029 ± 0.028       |
| Stance Time Asymmetry                         | 0.029 ± 0.026       |
| Step Length Coefficient of variation (CV)     | 0.065 ± 0.032       |
| Step Velocity (CV)                            | 0.076 ± 0.040       |
| Step Time (CV)                                | 0.045 ± 0.029       |
| Stride Time (CV)                              | 0.018 ± 0.007       |
| Swing Time (CV)                               | 0.057 ± 0.041       |
| Stance Time (CV)                              | 0.037 ± 0.025       |
| Dominant Frequency (AP)                       | 1.879 ± 0.385       |
| Dominant Frequency (R)                        | 1.886 ± 0.171       |
| Dominant Frequency (ML)                       | 4.269 ± 1.724       |
| Dominant Frequency (V)                        | 1.986 ± 0.575       |
| Normalized Amplitude of dominant peak of PSD (AP) | 0.035 ± 0.007     |
| Normalized Amplitude of dominant peak of PSD (R) | 0.044 ± 0.007     |
| Normalized Amplitude of dominant peak of PSD (ML) | 0.020 ± 0.008    |
| Normalized Amplitude of dominant peak of PSD (V) | 0.041 ± 0.009     |
| Width of dominant peak of PSD (AP)            | 0.481 ± 0.005       |
| Width of dominant peak of PSD (R)             | 0.482 ± 0.005       |
| Width of dominant peak of PSD (ML)            | 0.510 ± 0.038       |
| Width of dominant peak of PSD (V)             | 0.483 ± 0.005       |
| Slope of dominant peak of PSD (AP)            | 0.073 ± 0.015       |
| Slope of dominant peak of PSD (R)             | 0.092 ± 0.015       |
| Slope of dominant peak of PSD (ML)            | 0.041 ± 0.017       |
| Slope of dominant peak of PSD (V)             | 0.085 ± 0.019       |
| Parameter                                           | AP             | R              | ML             | V              |
|-----------------------------------------------------|-----------------|-----------------|-----------------|-----------------|
| Range of dominant peak of PSD (AP)                  | 0.918 ± 0.223   | 0.780 ± 0.204   | 0.004           | 0.001           |
| Range of dominant peak of PSD (R)                   | 1.263 ± 0.348   | 1.120 ± 0.306   | < 0.001         | 0.015           |
| Range of dominant peak of PSD (ML)                  | 0.991 ± 0.303   | 0.843 ± 0.264   | < 0.001         | 0.005           |
| Range of dominant peak of PSD (V)                   | 1.191 ± 0.328   | 1.065 ± 0.296   | < 0.001         | 0.030           |
| PSD Amplitude (AP)                                  | 1.068 ± 0.215   | 1.102 ± 0.221   | 0.318           | 0.313           |
| PSD Amplitude (R)                                   | 1.394 ± 0.226   | 1.255 ± 0.289   | 0.011           | 0.004           |
| PSD Amplitude (ML)                                  | 0.608 ± 0.231   | 0.515 ± 0.170   | < 0.001         | 0.016           |
| PSD Amplitude (V)                                   | 1.281 ± 0.278   | 1.156 ± 0.292   | 0.078           | 0.010           |
| PSD Mean Power (AP)                                 | 0.020 ± 0.001   | 0.021 ± 0.001   | 0.001           | 0.534           |
| PSD Mean Power (R)                                  | 0.021 ± 0.001   | 0.021 ± 0.001   | 0.005           | 0.094           |
| PSD Mean Power (ML)                                 | 0.020 ± 0.001   | 0.020 ± 0.002   | 0.013           | 0.213           |
| PSD Mean Power (V)                                  | 0.021 ± 0.001   | 0.021 ± 0.001   | 0.006           | 0.045           |
| PSD Median Power (AP)                               | 0.001 ± 0.001   | 0.001 ± 0.001   | 0.001           | 0.534           |
| PSD Median Power (R)                                | 0.001 ± 0.001   | 0.001 ± 0.001   | 0.005           | 0.094           |
| PSD Median Power (ML)                               | 0.001 ± 0.001   | 0.001 ± 0.001   | 0.013           | 0.213           |
| PSD Median Power (V)                                | 0.001 ± 0.001   | 0.001 ± 0.001   | 0.006           | 0.045           |
| PSD Normalized Width (AP)                           | 0.481 ± 0.005   | 0.482 ± 0.005   | 0.204           | 0.403           |
| PSD Normalized Width (R)                            | 0.482 ± 0.005   | 0.482 ± 0.010   | < 0.001         | 0.561           |
| PSD Normalized Width (ML)                           | 0.510 ± 0.038   | 0.512 ± 0.05    | < 0.001         | 0.419           |
| PSD Normalized Width (V)                            | 0.483 ± 0.005   | 0.483 ± 0.012   | < 0.001         | 0.662           |
| PSD Normalized Slope (AP)                           | 0.073 ± 0.015   | 0.075 ± 0.015   | 0.264           | 0.360           |
| PSD Normalized Slope (R)                            | 0.092 ± 0.015   | 0.085 ± 0.019   | 0.013           | 0.004           |
| PSD Normalized Slope (ML)                           | 0.041 ± 0.017   | 0.035 ± 0.013   | < 0.001         | 0.021           |
| PSD Normalized Slope (V)                            | 0.085 ± 0.019   | 0.078 ± 0.020   | 0.064           | 0.010           |
| PSD Normalized Range (AP)                           | 0.918 ± 0.223   | 0.780 ± 0.204   | 0.004           | 0.001           |
| PSD Normalized Range (R)                            | 1.263 ± 0.348   | 1.120 ± 0.306   | < 0.001         | 0.015           |
| PSD Normalized Range (ML)                           | 0.991 ± 0.330   | 0.843 ± 0.264   | < 0.001         | 0.005           |
| PSD Normalized Range (V)                            | 1.191 ± 0.328   | 1.065 ± 0.296   | < 0.001         | 0.030           |
| PSD Integrated Power (AP)                           | 30.610 ± 1.321  | 30.906 ± 2.177  | 0.001           | 0.534           |
| PSD Integrated Power (R)                            | 31.438 ± 1.559  | 30.944 ± 2.282  | 0.005           | 0.094           |
| PSD Integrated Power (ML)                           | 30.285 ± 1.767  | 29.851 ± 2.585  | 0.013           | 0.213           |
| PSD Integrated Power (V)                            | 31.458 ± 1.523  | 30.857 ± 2.224  | 0.006           | 0.045           |
| Harmonic Ratio (AP)                                 | 3.502 ± 1.248   | 2.836 ± 0.949   | 0.146           | 0.001           |
| Harmonic Ratio (R)                                  | 3.829 ± 1.173   | 3.287 ± 1.18    | 0.015           | 0.005           |
| Harmonic Ratio (ML)                                 | 2.360 ± 0.862   | 1.994 ± 0.642   | < 0.001         | 0.006           |
| Harmonic Ratio (V)                                  | 3.760 ± 1.214   | 3.110 ± 1.091   | 0.017           | 0.001           |
| Index of Harmonicity (AP)                           | 0.630 ± 0.143   | 0.683 ± 0.136   | < 0.001         | 0.010           |
| Index of Harmonicity (R)                            | 0.747 ± 0.103   | 0.678 ± 0.171   | < 0.001         | 0.011           |
| Index of Harmonicity (ML)                           | 0.136 ± 0.166   | 0.243 ± 0.189   | < 0.001         | < 0.001         |
| Index of Harmonicity (V)                            | 0.719 ± 0.143   | 0.670 ± 0.177   | < 0.001         | 0.061           |

Root Mean Square (RMS) of Straight Walk (AP) 0.163 ± 0.035 0.136 ± 0.036 0.003 < 0.001 < 0.001
| Signal Magnitude | RMS Straight Walk (R) | 0.325 ± 0.067 | 0.271 ± 0.076 | 0.001 | < 0.001 | < 0.001 |
|------------------|----------------------|----------------|----------------|-------|---------|---------|
|                  | RMS Straight Walk (ML)| 0.154 ± 0.049 | 0.123 ± 0.032 | < 0.001 | < 0.001 | < 0.001 |
|                  | RMS Straight Walk (V) | 0.231 ± 0.052 | 0.197 ± 0.068 | < 0.001 | < 0.001 | 0.001  |
|                  | RMS Stride (AP)      | 0.159 ± 0.035 | 0.133 ± 0.035 | 0.001 | < 0.001 | 0.001  |
|                  | RMS Stride (R)       | 0.302 ± 0.067 | 0.265 ± 0.075 | 0.001 | < 0.001 | < 0.001 |
|                  | RMS Stride (ML)      | 0.151 ± 0.050 | 0.119 ± 0.032 | < 0.001 | 0.001 | < 0.001 |
|                  | RMS Stride (V)       | 0.228 ± 0.052 | 0.193 ± 0.066 | < 0.001 | < 0.001 | < 0.001 |
|                  | RMS Step (AP)        | 0.143 ± 0.033 | 0.120 ± 0.033 | 0.001 | < 0.001 | < 0.001 |
|                  | RMS Step (R)         | 0.293 ± 0.063 | 0.243 ± 0.070 | 0.001 | < 0.001 | < 0.001 |
|                  | RMS Step (ML)        | 0.142 ± 0.049 | 0.111 ± 0.033 | < 0.001 | 0.001 | < 0.001 |
|                  | RMS Step (V)         | 0.206 ± 0.046 | 0.175 ± 0.060 | < 0.001 | < 0.001 | 0.001  |
|                  | RMS Ratio Straight Walk (AP) | 0.504 ± 0.062 | 0.509 ± 0.070 | 0.595 | 0.319 | 0.713  |
|                  | RMS Ratio Straight Walk (ML) | 0.469 ± 0.088 | 0.460 ± 0.072 | 0.150 | 0.689 | 0.515  |
|                  | RMS Ratio Straight Walk (V) | 0.712 ± 0.076 | 0.717 ± 0.067 | 0.070 | 0.970 | 0.680  |
|                  | RMS Ratio Stride (AP) | 0.501 ± 0.063 | 0.507 ± 0.069 | 0.514 | 0.234 | 0.580  |
|                  | RMS Ratio Stride (ML) | 0.466 ± 0.092 | 0.457 ± 0.072 | 0.309 | 0.764 | 0.505  |
|                  | RMS Ratio Stride (V) | 0.714 ± 0.079 | 0.718 ± 0.067 | 0.062 | 0.866 | 0.721  |
|                  | RMS Ratio Step (AP)  | 0.493 ± 0.068 | 0.502 ± 0.071 | 0.520 | 0.319 | 0.444  |
|                  | RMS Ratio Step (ML)  | 0.479 ± 0.094 | 0.460 ± 0.074 | 0.571 | 0.317 | 0.183  |
|                  | RMS Ratio Step (V)   | 0.701 ± 0.078 | 0.711 ± 0.067 | 0.158 | 0.604 | 0.401  |
|                  | Step Regularity (AP) | 0.761 ± 0.191 | 0.712 ± 0.169 | < 0.001 | 0.001 | 0.105  |
|                  | Step Regularity (R)  | 0.595 ± 0.145 | 0.541 ± 0.148 | < 0.001 | 0.012 | 0.029  |
|                  | Step Regularity (ML) | 0.541 ± 0.144 | 0.456 ± 0.135 | 0.087 | 0.001 | 0.001  |
|                  | Step Regularity (V)  | 0.796 ± 0.143 | 0.741 ± 0.177 | < 0.001 | 0.004 | 0.049  |
|                  | Stride Regularity (AP)| 0.835 ± 0.077 | 0.804 ± 0.105 | < 0.001 | 0.049 | 0.055  |
|                  | Stride Regularity (R) | 0.688 ± 0.100 | 0.652 ± 0.110 | 0.001 | 0.032 | 0.045  |
|                  | Stride Regularity (ML)| 0.688 ± 0.121 | 0.616 ± 0.145 | 0.001 | 0.005 | 0.002  |
|                  | Stride Regularity (V) | 0.847 ± 0.115 | 0.813 ± 0.117 | < 0.001 | 0.011 | 0.082  |
|                  | Symmetry Autocorrelation Ratio (AP) | 0.013 ± 0.029 | 0.016 ± 0.024 | < 0.001 | 0.043 | 0.466  |
|                  | Symmetry Autocorrelation Ratio (R) | 0.016 ± 0.022 | 0.019 ± 0.023 | < 0.001 | 0.139 | 0.380  |
|                  | Symmetry Autocorrelation Ratio (ML) | 0.174 ± 0.215 | 0.189 ± 0.382 | < 0.001 | 0.247 | 0.777  |
|                  | Symmetry Autocorrelation Ratio (V) | 0.009 ± 0.011 | 0.012 ± 0.023 | < 0.001 | 0.876 | 0.274  |
|                  | Symmetry Autocorrelation Difference (AP) | 0.099 ± 0.157 | 0.114 ± 0.132 | < 0.001 | 0.036 | 0.547  |
|                  | Symmetry Autocorrelation Difference (R) | 0.121 ± 0.110 | 0.137 ± 0.110 | < 0.001 | 0.149 | 0.411  |
|                  | Symmetry Autocorrelation Difference (ML) | 0.171 ± 0.105 | 0.189 ± 0.122 | < 0.001 | 0.484 | 0.355  |
|                  | Symmetry Autocorrelation Difference (V) | 0.067 ± 0.058 | 0.095 ± 0.126 | < 0.001 | 0.235 | 0.110  |
|                  | Gait Symmetry Index   | 0.644 ± 0.083 | 0.637 ± 0.077 | < 0.001 | 0.162 | 0.592  |
|                  | Stride Harmonic Ratio (AP) | 2.332 ± 0.552 | 2.049 ± 0.406 | 0.529 | 0.001 | 0.001  |
|                  | Stride Harmonic Ratio (ML) | 1.843 ± 0.510 | 1.584 ± 0.365 | 0.005 | 0.001 | 0.001  |
|                  | Stride Harmonic Ratio (V) | 2.280 ± 0.478 | 2.088 ± 0.416 | 0.107 | 0.003 | 0.011  |
|                  | Jerk RMS of Straight walk (AP) | 5.638 ± 1.900 | 4.802 ± 1.642 | < 0.001 | 0.008 | 0.006  |
### Jerk RMS of Straight Walk

| Signal Complexity | AP     | R       | ML     | V       | P       |
|-------------------|--------|---------|--------|---------|---------|
|                   | 7.086 ± 2.622 | 6.198 ± 2.451 | < 0.001 | 0.041  | 0.040 |
|                   | 6.354 ± 2.444 | 5.500 ± 1.907 | < 0.001 | 0.025  | 0.021 |
|                   | 7.615 ± 2.696 | 6.659 ± 2.690 | < 0.001 | 0.016  | 0.038 |
|                   | 5.656 ± 1.911 | 4.808 ± 1.658 | < 0.001 | 0.007  | 0.005 |
|                   | 7.098 ± 2.613 | 6.178 ± 2.432 | < 0.001 | 0.041  | 0.040 |
|                   | 6.341 ± 2.471 | 5.487 ± 1.896 | < 0.001 | 0.030  | 0.021 |
|                   | 7.638 ± 2.731 | 6.660 ± 2.678 | < 0.001 | 0.014  | 0.034 |
|                   | 5.571 ± 1.856 | 4.752 ± 1.610 | < 0.001 | 0.041  | 0.041 |
|                   | 6.942 ± 2.486 | 6.095 ± 2.308 | < 0.001 | 0.321  | 0.234 |
|                   | 6.228 ± 2.42  | 5.391 ± 1.865 | < 0.001 | 0.133  | 0.083 |
|                   | 7.510 ± 2.657 | 6.596 ± 2.643 | < 0.001 | 0.194  | 0.155 |
|                   | -0.895 ± 4.075 | 0.215 ± 4.124 | < 0.001 | 0.012  | 0.113 |
|                   | -0.287 ± 4.151 | 0.476 ± 2.885 | < 0.001 | 0.207  | 0.199 |
|                   | -0.421 ± 5.235 | 0.584 ± 2.912 | < 0.001 | 0.396  | 0.148 |
|                   | 0.361 ± 4.626 | 1.477 ± 11.974 | < 0.001 | 0.951  | 0.491 |
|                   | -0.507 ± 3.311 | -0.532 ± 4.589 | < 0.001 | 0.550  | 0.971 |
|                   | 1.265 ± 5.900 | 2.498 ± 17.561 | < 0.001 | 0.561  | 0.600 |
|                   | 0.442 ± 5.292 | -2.729± 27.314 | < 0.001 | 0.846  | 0.373 |
|                   | -2.303 ± 26.784 | -20.711± 190.467 | < 0.001 | 0.531  | 0.455 |
|                   | -0.702 ± 9.174 | -7.326 ± 61.82 | < 0.001 | 0.443  | 0.408 |
|                   | -1.305 ± 0.959 | -1.344 ± 1.026 | 0.562  | 0.961  | 0.818 |
|                   | -0.83 ± 1.021  | -0.759 ± 1.212 | 0.402  | 0.872  | 0.712 |
|                   | 1073.052 ± 8391.063 | -1.344 ± 1.015 | < 0.001 | 0.869  | 0.251 |
|                   | 1073.497 ± 8391.007 | -0.785 ± 1.208 | < 0.001 | 0.977  | 0.251 |
|                   | 1073.065 ± 8391.063 | -1.367 ± 0.997 | < 0.001 | 0.683  | 0.251 |
|                   | 1073.488 ± 8391.008 | -0.841 ± 1.205 | < 0.001 | 0.817  | 0.251 |
|                   | 18.144 ± 7.931 | 16.159 ± 6.020 | < 0.001 | 0.209  | 0.092 |
|                   | 27.934 ± 12.564 | 25.984± 11.126 | < 0.001 | 0.426  | 0.330 |
|                   | 23.190 ± 9.934 | 21.202 ± 7.419 | < 0.001 | 0.347  | 0.174 |
|                   | 29.193 ± 12.821 | 26.007± 11.094 | < 0.001 | 0.178  | 0.116 |
|                   | 15.111 ± 6.843 | 13.057 ± 5.251 | < 0.001 | 0.074  | 0.045 |
|                   | 23.495 ± 10.674 | 21.456 ± 9.727 | < 0.001 | 0.252  | 0.238 |
|                   | 19.227 ± 8.738 | 17.197 ± 6.325 | < 0.001 | 0.223  | 0.110 |
|                   | 24.484 ± 11.627 | 21.449 ± 9.446 | < 0.001 | 0.135  | 0.088 |
|                   | 12.622 ± 5.227 | 10.849 ± 4.157 | < 0.001 | 0.044  | 0.026 |
|                   | 20.046 ± 9.319 | 18.283 ± 7.951 | < 0.001 | 0.315  | 0.227 |
|                   | 16.295 ± 7.623 | 14.373 ± 5.302 | < 0.001 | 0.141  | 0.079 |
|                   | 20.481 ± 9.318 | 18.457 ± 8.286 | < 0.001 | 0.199  | 0.174 |
| Parameter                                      | Mean ± Standard Deviation | t-Value | p-Value | Effect Size | Cohen’s d |
|------------------------------------------------|---------------------------|---------|---------|-------------|-----------|
| Jerk Min of Straight Walk (AP)                | -23.532 ± 9.171           |         |         |             |           |
| Jerk Min of Straight Walk (R)                 | -27.921 ± 11.039          |         |         |             |           |
| Jerk Min of Straight Walk (ML)                | -23.272 ± 11.62           |         |         |             |           |
| Jerk Min of Straight Walk (V)                 | -27.322 ± 11.62           |         |         |             |           |
| Jerk Min of Stride (AP)                       | -20.382 ± 8.191           |         |         |             |           |
| Jerk Min of Stride (R)                        | -23.145 ± 9.566           |         |         |             |           |
| Jerk Min of Stride (ML)                       | -19.309 ± 8.436           |         |         |             |           |
| Jerk Min of Stride (V)                        | -23.15 ± 10.192           |         |         |             |           |
| Jerk Min of Step (AP)                         | -17.956 ± 7.244           |         |         |             |           |
| Jerk Min of Step (R)                          | -19.273 ± 7.817           |         |         |             |           |
| Jerk Min of Step (ML)                         | -16.095 ± 7.041           |         |         |             |           |
| Jerk Min of Step (V)                          | -19.874 ± 8.604           |         |         |             |           |
| Jerk Range of Straight Walk (AP)              | 41.676 ± 15.642           |         |         |             |           |
| Jerk Range of Straight Walk (R)               | 55.855 ± 23.125           |         |         |             |           |
| Jerk Range of Straight Walk (ML)              | 46.460 ± 18.960           |         |         |             |           |
| Jerk Range of Straight Walk (V)               | 56.515 ± 23.868           |         |         |             |           |
| Jerk Range of Stride (AP)                     | 35.493 ± 13.622           |         |         |             |           |
| Jerk Range of Stride (R)                      | 46.64 ± 19.846            |         |         |             |           |
| Jerk Range of Stride (ML)                     | 38.536 ± 16.848           |         |         |             |           |
| Jerk Range of Stride (V)                      | 47.634 ± 21.333           |         |         |             |           |
| Jerk Range of Step (AP)                       | -30.578 ± 11.385          |         |         |             |           |
| Jerk Range of Step (R)                        | 39.318 ± 16.896           |         |         |             |           |
| Jerk Range of Step (ML)                       | 32.389 ± 14.503           |         |         |             |           |
| Jerk Range of Step (V)                        | 40.355 ± 17.546           |         |         |             |           |
| Lyapunov RC (AP)                              | 1150.261 ± 8385.92        |         |         |             |           |
| Lyapunov RC (R)                               | 0.619 ± 0.138             |         |         |             |           |
| Lyapunov RC (ML)                              | 0.574 ± 0.117             |         |         |             |           |
| Lyapunov RC (V)                               | 0.608 ± 0.142             |         |         |             |           |
| Lyapunov W (AP)                               | 1.284 ± 0.265             |         |         |             |           |
| Lyapunov W (R)                                | 1.083 ± 0.312             |         |         |             |           |
| Lyapunov W (ML)                               | 1.806 ± 0.473             |         |         |             |           |
| Lyapunov W (V)                                | 1.151 ± 0.377             |         |         |             |           |
| Full Orbit Eccentricity                       | 0.991 ± 0.006             |         |         |             |           |
| Relative Orbit Inclination                    | 6.315 ± 3.436             |         |         |             |           |
| Full Orbit Area                               | 0.138 ± 0.105             |         |         |             |           |
| Full Orbit Minor axis SD                      | 0.023 ± 0.016             |         |         |             |           |
| Full Orbit Major axis SD                      | 0.089 ± 0.123             |         |         |             |           |
| Short Half Orbit Eccentricity Asymmetry       | 0.015 ± 0.018             |         |         |             |           |
### Supplementary Materials

#### Table S3.
**Definitions of the gait characteristics used in the study**

| Domain          | Feature          | Definition                       |
|-----------------|------------------|----------------------------------|
| Spatial-temporal[5] | Step Length      | Distance between two heel strikes |
|                 | Step Velocity    | Step length/step time            |

#### Data Table

|                                | Value 1        | Value 2        | p-value | Std. Error | Std. Error |
|--------------------------------|----------------|----------------|---------|------------|------------|
| Short Half Orbit Segment angle | 4.942 ± 2.713  | 5.985 ± 3.99   | < 0.001 | 0.025      | 0.006      |
| Short Half Orbit Area Asymmetry| 25.906 ± 136.824 | 47.472 ± 248.117 | < 0.001 | 0.209      | 0.541      |
| Long Half Orbit Eccentricity Asymmetry | 0.016 ± 0.016 | 0.023 ± 0.021 | < 0.001 | 0.024 | 0.038 |
| Long Half Orbit Segment Angle  | 4.942 ± 2.713  | 5.985 ± 3.99   | < 0.001 | 0.106      | 0.081      |
| Long Half Orbit Area Asymmetry | 160.622 ± 877.581 | 16.141 ± 30.027 | < 0.001 | 0.323 | 0.141 |
| Intra-Step Correlation         | 0.968 ± 0.022  | 0.934 ± 0.084  | < 0.001 | < 0.001 | 0.003      |
### Step & Stride Time
- Time between two heel strikes & two consecutive heel strikes of same foot

### Swing Time
- Time between toe-off to heel strike

### Stance Time
- Time between heel strike to toe-off

### Cadence
- Number of steps per minute

### Variability (SD & CV)
- Standard deviation (SD) and coefficient of variation (CV:SD/mean) of the extracted mean spatial-temporal gait characteristics

### Asymmetry
- Difference between the left and right feet of the extracted mean spatial-temporal gait characteristics

### Dominant Frequency
- The inverse of the period at which the maximum spectral response is observed. [6, 7]

### Normalized Amplitude of dominant peak of Power Spectral Density (PSD) in the three axes (V, AP, ML, & R)
- Estimated from each detrended acceleration signal (VT, ML, AP) as the magnitude of the PSD at the dominant peak, normalized by the total integrated PSD. This feature represents the relative strength of the signal at the most dominant frequency and reflects the periodicity of the signal. Larger values of this feature indicate a greater periodic gait pattern. [6, 7]

### Width of dominant peak of PSD (V, AP, ML, & R)
- Estimated from each detrended acceleration signal (VT, ML, AP) as the width of the dominant peak of the PSD. This feature is a measure of frequency dispersion and is related to the variability of the dominant cycles of the signal (step cycles in VT and AP, stride cycles in ML). Larger values of this feature indicate a less consistent gait pattern. [7]

### Slope of dominant peak of PSD (V, AP, ML, & R)
- Estimated from each detrended acceleration signal (VT, ML, AP) as the slope of the dominant peak of the PSD. [6]

### Range of dominant peak of PSD (V, AP, ML, & R)
- Estimated from each detrended acceleration signal (VT, ML, AP) as the range of the dominant peak of the PSD. [6]

### PSD Mean Power (V, AP, ML, & R)
- Estimated from each detrended acceleration signal (VT, ML & AP) as the mean power of the PSD. [8]

### PSD Median Power (V, AP, ML, & R)
- Estimated from each detrended acceleration signal (VT, ML & AP) as the median power of the PSD. [8]

### PSD Normalized Width (V, AP, ML, & R)
- Estimated from each detrended acceleration signal (VT, ML, AP) as the width of the dominant peak of the PSD, normalized by the total integrated PSD.

### PSD Normalized Slope (V, AP, ML, & R)
- Estimated from each detrended acceleration signal (VT, ML, AP) as the slope of the dominant peak of the PSD, normalized by the total integrated PSD.

### PSD Normalized Range (V, AP, ML, & R)
- Estimated from each detrended acceleration signal (VT, ML, AP) as the range of the dominant peak of the PSD, normalized by the total integrated PSD.

### PSD Integrated Power (V, AP, ML, & R)
- Estimated from each detrended acceleration signal (VT, ML & AP) as the total integration of the PSD. [9]

### Harmonic Ratio Straight walk (V, AP, ML, & R)
- Estimated for each direction as described by Menz et al., 2003 [10, 11]. Harmonic ratios of acceleration signals in VT and AP directions were calculated as the sum of even harmonics divided by the sum of odd harmonics, since these signals have two phases per stride. Harmonic ratios from ML acceleration were calculated as the sum of odd harmonics divided by the sum of even harmonics, since acceleration signals in mediolateral (ML) direction are monophasic per stride. This measurement reflects the rhythmicity of periodic patterns and relates to gait symmetry [12]. Thus, higher values of this feature are related to more rhythmic, paced and symmetric gait patterns [13].

### Harmonic Ratio
- Stride Harmonic Ratio (V, ML, & AP)
- The step-to-step symmetry within a stride from calculating a ratio of the odd and even harmonics of a signal following fast Fourier transformation [10].
Supplementary Materials

| Supplemental Metrics | Description |
|-----------------------|-------------|
| Index of Harmonicity (V, AP, ML, & R) | Estimated for each direction as the PSD of the fundamental frequency (first harmonic) divided by the cumulative sum of the power spectral density of the first six harmonics [13, 14]. This measure, proposed by Lamoth et al., 2002 reflects gait smoothness [13]. Thus, values approaching the maximum value of 1.0 indicate a smoother gait pattern, which may reflect a less vigorous/more cautious movement pattern, whereas smaller values might indicate movements that are more erratic. |
| Root Mean Square (RMS) | Acceleration RMS: The calculation of the Root mean square of the acceleration signal [15]. |
| RMS of Straight Walk (V, AP, ML, & R) | Jerk RMS: The calculation of the root mean square of the first time derivative of the acceleration signal (jerk) [16]. |
| RMS Stride (V, AP, ML, & R) | Jerk ratio: A logarithmic ratio of either the AP or ML acceleration RMS over the V acceleration RMS [16, 17]. |
| RMS Step (V, AP, ML, & R) | |
| RMS Ratio Straight Walk (V, AP, ML) | |
| RMS Ratio Stride (V, AP, & ML) | |
| RMS Ratio Step (V, AP, & ML) | |
| Jerk | |
| RMS of Straight Walk (V, AP, ML, & R) | |
| RMS of Stride (V, AP, ML, & R) | |
| RMS of Step (V, AP, ML, & R) | |
| - Mean Ratio of Straight Walk (V, AP, & ML) | |
| - Mean Ratio of Stride (V, AP, & ML) | |
| - Mean Ratio of Step (V, AP, & ML) | |
| - Mean Log Ratio of Straight Walk (AP, & ML) | |
| - Mean Log Ratio of Stride (AP, & ML) | |
| - Mean Log Ratio of Step (AP, & ML) | |
| - Max of Straight Walk (V, AP, ML, & R) | |
| - Max of Stride (V, AP, ML, & R) | |
| - Max of Step (V, AP, ML, & R) | |
| - Min of Straight Walk (V, AP, ML, & R) | |
| - Min of Stride (V, AP, ML, & R) | |
| - Min of Step (V, AP, ML, & R) | |
| - Range of Straight Walk (V, AP, ML, & R) | |
| - Range of Stride (V, AP, ML, & R) | |
| - Range of Step (V, AP, ML, & R) | |
| Signal Magnitude | |
| Signal Regularity | |
| Step Regularity (V, AP, ML & R) | Estimated as the normalized unbiased auto-covariance for a lag of one step time [17]. This feature thus reflects the similarity between subsequent steps of the acceleration pattern over a step. Values of this feature close to 1.0 (maximum possible value) reflect repeatable patterns between subsequent steps. |
| Stride Regularity (V, AP, ML, & R) | Estimated as the normalized unbiased auto-covariance for a lag of one stride time [17]. This feature thus reflects the similarity between subsequent strides of the acceleration pattern over a stride cycle. |
| Symmetry Autocorrelation Ratio (V, AP, ML, & R) | A ratio between step and stride regularity designed to quantify the level of symmetry between them and indicative of symmetry during a straight walk [17]. |
| Symmetry Autocorrelation Difference (V, AP, ML, & R) | Difference between step and stride regularity designed to quantify the level of symmetry between them and indicative of symmetry during a straight walk [17]. |
| Gait Symmetry Index | Calculated based upon the concept of the summation of the biased autocorrelation from all three components of movement and a subsequent calculation of step and stride timing asymmetry [18]. |
Lyapunov exponent | Estimated as the exponential rate of divergence or convergence after a small disturbance of nearby orbits in state space. Since nearby orbits correspond to nearly identical states, a positive value indicates that systems with initial differences will soon behave quite differently, and stability is low [19]. The Lyapunov exponent was calculated using the Rostein and Wolf method [20] for each detrended acceleration signal (VT, ML & AP). We used an embedding dimension of 5 and a delay of 12 samples [21]. As local dynamic stability estimates based on a 6D and 12D state space correlated highly with those of the employed 9D state space in a previous study [22] (respectively r≥0.94 and r≥0.81), the number of embedding dimensions has been considered to have minor effects [22]. Thus, to reduce computational cost, we explored the use of a 5D state reconstruction (with two less dimensions than used in the reference) [23].

| Phase plots features [24]: |
|---------------------------|
| Features from ellipses fitted to full cycles/orbits of phase plots: |
| Full orbit eccentricity | Average eccentricity of all fully fitted ellipses. |
| Relative orbit inclination | Average angle subtended by alternating fitted ellipses within a bout of gait. |
| Full orbit area | Average area of all fully fitted ellipses (A = π * minor axis * major axis). |
| Full orbit minor axis SD | SD of minor axes lengths of all fully fitted ellipses. Analogous to PCA (Second component). |
| Full orbit major axis SD | SD of major axes lengths of all fully fitted ellipses. Analogous to PCA (First component). |

Signal Complexity

| Features from ellipses fitted to half-cycles/orbits following ellipse segmentation along the minor (short) axis: |
|---------------------------------------------------------------|
| Short half orbit eccentricity asymmetry | Difference in eccentricity of two ellipses fitted to each half-cycle of a full orbit in the phase plot. Averaged over all orbits in bout’s phase plot. |
| Short half orbit segment angle | Difference in inclination of two ellipses fitted to each half-cycle of a full orbit in the phase plot. Averaged over all orbits in bout’s phase plot. |
| Short half orbit area asymmetry | Difference in area of two ellipses fitted to each half-cycle of a full orbit in the phase plot. Averaged over all orbits in bout’s phase plot. |

| Features from ellipses fitted to half-cycles/orbits following ellipse segmentation along the major (long) axis: |
|---------------------------------------------------------------|
| Long half orbit eccentricity asymmetry | Difference in eccentricity of two ellipses fitted to each half-cycle of a full orbit in the phase plot. Averaged over all orbits in bout’s phase plot. |
| Long half orbit segment angle | Difference in inclination of two ellipses fitted to each half-cycle of a full orbit in the phase plot. Averaged over all orbits in bout’s phase plot. |
| Long half orbit area asymmetry | Difference in area of two ellipses fitted to each half-cycle of a full orbit in the phase plot. Averaged over all orbits in bout’s phase plot. |

Intra-step correlation | Average correlation of acceleration signal corresponding to step i with that of step i-1. I.e. a lag-1 autocorrelation where a single lag is one step cycle’s duration.
Fig. S2. Correlation among important characteristics having variable importance score above 1.5
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