## Topic: Influence of gait assessment length on disease classification and hospital outcome measures

Human gait alters with age and disease stages [1, 2]. Objective monitoring of these changes is possible using wearable sensors, for example integrated into smart shoes. This enables binary classification of patients suffering from neurodegenerative diseases such as Parkinson's Disease and control subjects as well as multiclass classification of disease severity [3, 4, 5].

Previously, sensor based gait analysis has been technically validated in various studies, but only recently Kroneberg et al. [6] investigated how many strides of a subject have to be collected to correctly measure a subjects gait variability. Therefore, they made use of pearson's correlation coefficient $r$ between shorter and longer gait sequences. Using this measure, they find a minimum number of strides necessary to correctly reflect gait variability. To do so, a threshold of $r = 0.8$ was used, what is commonly referred to as *high* or *strong* correlation [7, 8].

Although it was found that approximately 20 strides sufficiently represent gait variability, it is noteworthy that the recorded gait parameters might be used as input for classifiers as described above. It remains unknown to what extent $r \neq 1$ in the first stage impacts this clinical application. Therefore, the goal of this work is to investigate to what extent a reduced number of recorded strides influences the discriminative power of gait parameters in terms of disease classification. Furthermore a second data set of geriatric patients will be used to assess the effect of the recorded number of strides on effect sizes betweeen pre- and post-hospital-stay assessment. To evaluate the influence of longer or shorter gait assessments on disease classification and outcome measures, the following steps have to be conducted:

- Literature research on Parkinson's Disease classification using gait parameters
- Implementation & evaluation of at least two classifiers on available data
- Performance analysis for varying number of used strides (varying thersholds for $r$)

The thesis must contain a detailed description of all developed and used algorithms as well as a profound result evaluation and discussion. The implemented code has to be documented and provided. An extended research on literature, existing patents and related work in the corresponding areas has to be performed. No prior knowledge in the medical domain is necessary.

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# References

[1] Virmani, T. et al.:*Objective measures of gait and balance in healthy non-falling adults as a function of age.*. Gait & Posture, vol. 65, pp. 100–105, 2018.
[2] Schlachetzik, J. C. M. et al.: *Wearable sensors objectively measure gait parameters in Parkinson's disease*. PLOS ONE, 12 (10), pp. 1–18, 2017.
[3] Klucken, J. et al.: *Unbiased and Mobile Gait Analysis Detects Motor Impairment in Parkinson's Disease*. PLOS ONE, 8 (2).
[4] Baby, M. S. et al.: *Parkinsons disease classification using wavelet transform based feature extraction of gait data*. 2017 International Conference on Circuit, Power and Computing Technologies (ICCPCT), Kollam, 2017.
[5] El Maachi, I. et al.: *Deep 1D-Convnet for accurate Parkinson disease detection and severity prediction from gait*. Expert Systems with Applications, vol. 143, 2020.

[6] Kroneberg, D. et al.: *Less is more – estimation of the number of strides required to assess gait variability in spatially confined settings.* Frontiers in Aging Neuroscience, vol. 10, p. 435, 2019.
[7] Oleske, D. M. et al.: *Epidemiology and the Delivery of Health Care Services: Methods and Applications.* Springer, 2009.
[8] Mukaka, M. M. et al.:*Statistics Corner: A guide to appropriate use of Correlation coefficient in medical research.* Malawi Medical Journal, 24 (3), pp. 69–71, 2012.