

Master track Medical Sensing and Simulation

Quantifying postural instability in Parkinson's Disease using the sway of the Centre of Mass

Group 1; Dorien van Blooij, Alette Koopman, Mathilde Hermans, Sytse de Jong

Background: Parkinson's Disease (PD) is often accompanied with postural instability. In clinical practice, postural instability is mostly assessed using subjective methods. This study aims to discover the ability to objectively quantify balance disorders using the sway of the Centre of Mass (COM) measured using inertial measurements units (IMU).

Method: IMU is used to measure the sway of the COM in one PD subject and two healthy subjects during quiet stance, with or without eyes opened, and during initiation (I) and termination (T) of a single step. Mean deviation and mean velocity of COM are analysed.

Results: For all subjects, small sway of the COM is seen. The deviation and velocity of the COM in the I-phase is significantly higher than in T- and hold (H) phase. The deviation in the I-phase is increased when the non-dominant is moved first. During stance, no difference was found between opening or closing of eyes. Significant difference between the PD and healthy subjects was noticed in stance with eyes opened and in the mutual difference in mean velocity between the H- and T-phase.

Conclusions: Several parameters, acquired in the COM sway test, are able to assess postural instability. To strengthen the validity and reliability of this conclusion, the test should be performed on more patients and additional research to influencing factors should be performed. Besides, costs and measurement time of this method should be decreased to make it more susceptible for routine use in clinical practice.

The practicability of speech analysis in PD patients

Group 2: Jurgen Oude Booijink BSc, Bart Hoeben BSc, Feiko Tiessens BSc and Robin Wesselink BSc

Abstract:

In 70% to 90% of patients suffering from Parkinson's disease (PD), some impairment of the vocal capabilities is present. It is one of the first symptoms that can present itself in PD. Dysphonia, dysarthria, reduced loudness and vocal tremor are examples of ways the voice of the patient can change. This study aims to design and test the practicality of a method which quantifies these impairments. From recorded data of a PD patients voice and the voices of presumably healthy volunteers, the rate of speech, variations in rate of speech, the pauses between speech, the frequency(band) of speech and the volume and variation in articulation were analysed. Results imply that volume, rate of speech, variations in rate of speech, pauses in speech and the frequency(band) can be analysed without any problems. Results of variation in articulation are still very doubtful. Further it is shown that the method is feasible, non-invasive, relatively cheap and time-efficient. Therefore it has the potential to be used in a clinical or domestic setting, after it has been validated and standardized.

Parkinson's disease: towards a method providing insight in the progression and the effectiveness of treatment

Group 3 Frank Bennis, BSc, Timon Fabius, BSc, Ben Hermans, BSc, Frank van Rosmalen, BSc

Abstract

During Parkinson's disease (PD), the arm swing of the patient is one of the aspects that is affected first, resulting in asymmetry in arm swing between the affected and healthy side. In this study, a method to quantify the decrease in arm swing over time is presented as a possible substitute for the MDS-UPDRS to assess the progression of PD or effectiveness of treatment. From 3 healthy subjects and 1 PD patient, the flexion angles of both the shoulders and elbows were obtained using the Xsens MVN Biomech inertial motion capture full body suit. The data was used to calculate the ratio and correlation between left and right, representing asymmetry. One healthy subject showed no indication for asymmetry in all parameters. Another healthy subject showed an indication for asymmetry in both the shoulder and elbow ratio but not in the correlations. A third healthy subject showed an indication for asymmetry in all parameters. The PD patient showed an indication for asymmetry in the elbow ratio only. This ratio showed a higher amplitude for the right side, which was the affected side. It was unexpected that the PD patients affected side would have a larger amplitude than the other side. Also it was unexpected that a healthy subject would have a high indication for asymmetry. Therefore, further research is needed to investigate the quality and usefulness of this analysis method.

Keywords

Parkinson's Disease, Arm swing, Xsens, Quantification

Just a Moment: Analysing Ankle Torque in Patients with Parkinson's Disease

Group 4; Carmen van de Hoven, Gersom Post Hospers, Eline Vinke

Abstract

Parkinson's Disease is a progressive neurodegenerative movement disorder, which in advanced stages affects the normal lives of patients with symptoms such as motor disability, tremors, dyskinesia, rigidity and postural instability. The most commonly used rating scale for ranging the severity of Parkinson's Disease is the Unified Parkinson's Disease Rating Scale (UPDRS). The problem of this rating scale is that it relies on a human observer for the severity assessments. This judgement can be subjective and inadequate for tracking the progression of mild symptoms. In order to gain a more objective insight on the effects of Parkinson's Disease and to further investigate the disease, the response of the ankle torque on translation surface perturbations with different amplitudes and directions is analysed using a force plate, VICON and MATLAB. The ankle torque of the subject with Parkinson's Disease is compared to that of a healthy subject, providing a reproducible result which could be used for objectively grading the severeness of postural instability in patients with Parkinson's Disease, when applied in a larger study.

Qualitative assessment of gait in Parkinson's patients

Group 5; Tessa Kappers BSc, Petra Porte BSc, Joyce van Sluis BSc

Abstract

In Parkinson's patients there is a visible change in gait, these changes will be more visible when the condition progresses. Changes are a decrease in stride length, step height, off-on ratio and an increase in step width. The difference in gait between healthy subjects and a Parkinson's patient is analyzed in a movement laboratory by using a treadmill and a Vicon camera system. Special markers are stuck on several parts of the subjects to analyze the movements in the right way. Measurements are performed on a treadmill, whereby the first measurement is at a comfortable speed and the second measurement is at a speed one km/hour higher than comfortable speed. The measurements show a higher step width and step height and a lower off-on ratio in the Parkinson's patient, the step length is the same. An increase in speed of the treadmill causes a same amount of increase within healthy subjects and the Parkinson's patient, except for the off-on ratio. The off-on ratio increases less strongly than in the healthy subjects. From these results it can be seen that there are differences between healthy subjects and Parkinson's patients. Some of the outcomes are as expected; others might be influenced by the medication of the patient or another preferred gait. This method might be a good way of qualitatively testing for Parkinson's disease, but further research is necessary for optimizing this test method.

What is the influence of balance perturbations and multitasking on the Center of Mass and the left-right contribution in patients with Parkinson's Disease

Group 7; Xenia Hoppenbrouwer, Jeffrey Benistant, Joannet Onvlee, Marly van Assen

Abstract

The diagnosis of the different symptoms of Parkinson's Disease is subjective and there is a need for objective testing methods, allowing the classification of the symptoms to be more accurate and more consistent. One of the most common disabling motoric symptom of Parkinson's Disease is Postural Instability. Postural Instability in late Parkinson's Disease is caused by L-DOPA induced dyskinesia. To examine the balance control of patients with Parkinson's Disease, the Centre of Mass is examined and combined with information over left-right contribution. In addition another problem presenting in patients with Parkinson's Disease is the difficulty with multitasking. This study compares data from one patient with Parkinson's Disease with two healthy subjects. From the position of reflective markers, the Centre of Mass can be calculated and can be used to plot the deviation during the trials. Secondly the left-right contribution was determined in order to see which leg compensates the perturbations the most. The results show that patients with Parkinson's Disease deviate in the anterior-posterior plane as well as in the medial-lateral plane when they have to perform a multitask during the perturbations. The healthy subjects deviate in the anterior-posterior plane and only minimal in the medial-lateral plane.